Did China Suppress World Inflation?

A thesis submitted to the University of Sussex for the degree of
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by
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Preface and Acknowledgements

This thesis summarises my findings on the competitive price effect of China. The preparation of the thesis certainly require a lot of dedication and has been more difficult than I initially had in mind, however the things I learnt have certainly been fulfilling and rewarding at the same time. Chapter 4 of the thesis is the full version of the work discussed in Pang and Winters (forthcoming). I would like to thank my supervisor, Professor L. Alan Winters for his continual guidance, helpful comments and patience throughout these four years. I would also like to thank my sponsors, the Brunei government for providing the financial support which makes all this possible. I would also like to thank all my friends which have made my stay in the UK an enjoyable one. I would like to thank my family for their encouragement during this journey. A special dedication goes to my wife, Jessica Huang for her support, understanding and patience during my busy days of writing up.

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- **Summary of Thesis**

China is simply bigger and growing faster than any other country. The rapid growth of China during the past few decades has led to suggestions that China is exporting deflation, but many of studies of this idea have found no significant effect of China on trading countries' price levels, mainly due to the small share of China in world GDP. This study will look at China's impact not through trade shares, but by analysing the price effect directly. For actual competition, we use a model loosely related to the Bertrand model to find the Chinese price effect on Mexico's export prices in the US market. China's productivity has increased faster than any other country's and we assume that the increased productivity as the main exogenous driver of China's market expansion in the world market. The Chinese price effect is indeed statistically significant; after experimenting with various robustness tests, our regression results show that a 10% drop in Chinese price will cause Mexico to drop its price by around 4% to 8%. We also found that China can influence Mexico's price even if it has no direct exports to the USA; the mere threat of entry into the market is enough to constrain Mexico's exporters' pricing ambitions. We term this effect potential competition. The Chinese price effect for the set of potential products is present and is positive and statistically significant at around at 0.20 to 0.50. To compare the Chinese price effect in a relatively small market, we repeat the analysis on Singapore. We found that China influences Malaysia's prices in the Singapore market and the results are comparable to those in the USA. One of the necessary conditions for China exporting deflation is its competitive price effect on other manufacturing producers' prices; we tested for this and have found support for this condition.

- **Abbreviations**

	Abbreviations
UN Comtrade	United Nations Commodity Trade Statistics Database
v.i.f.	variance inflation factor
OECD	The Organisation for Economic Co-operation and Development
WITS	The World Integrated Trade Solution
APO	Asian Productivity Organization
BLS	Bureau of Labour Statistics
USDA	The United States Department of Agriculture
IADB	Inter-American Development Bank
TFP	Total Factor Productivity
GSP	Generalized System of Preferences
V.A.T	Value Added Tariffs
f.o.b	valued free on board
c.i.f.	cost including insurance and freight
HS	Harmonised System
RCA	Revealed Comparative Advantage

1. Introduction

China's influence can be felt more strongly than ever in the world today. Because of its increasing amount of interaction and growing role in the international market, there is ongoing interest in what the country has done, is doing and will do. The Chinese success story can be used as a learning curve for many of the newly emerging economies; however, none has quite attained the same success as China over the past few decades. China's growth is unique because of the country's sheer size and the speed of its success. China simply matters and is central; anything that happens there can be felt worldwide, particularly as far as the USA and Europe. There is a saying that 'When America sneezes, the rest of the world gets a cold', and China is beginning to take on this role. In only around three decades, China has managed to transform itself from a closed-door economy to currently the largest exporter of merchandise trade, the second largest economy and one of the largest recipients of Foreign Direct Investment inflows. Its productivity has been growing at a rate unprecedented among any of its rivals over the past few decades. The growth of China is inevitably going to create more opportunities for some economies, but at the same time it poses a threat to others.

The rapid growth of the Chinese economy, and in particular its exports, since 1990 has led to suggestions that China has partially underpinned the late lamented 'great moderation' and, less charitably, that it has exported deflation (Kamin et al., 2004; Feyzioglu and Willard, 2008; Broda and Weinstein, 2010). If these suggestions are true, they arise not from China's direct impact on the price indices of developed countries, because in 1980 Chinese exports accounted for only about 0.1% of OECD countries' absorption and still less than 3% of OECD countries' GDP in 2010.[1] Given the relatively small share of China's exports in the OECD's GDP, we do not expect cheaper Chinese products to have a significant direct impact on overall consumer prices in the OECD region. The Chinese influence has to rely on the competitive pressure that China exerts on other manufacturing producers' prices – its competitive effect. That is, a necessary condition for China to be exporting deflation is that it has an effect on the prices charged by other exporters and producers.

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[1] GDP data were obtained from World Development Indicators Online, UN Comtrade.

This thesis is primarily concerned with cheaper Chinese products and their influence on competitors' pricing in the destination market. Our main approach is to focus on one market, namely the USA, and another middle-income supplier, Mexico. Based on the theory of comparative advantage, Mexico and China should produce fairly similar products for the US market. For consistent and robustness purposes, we will also look at the Chinese price effect in a relatively smaller economy like Singapore and compare results to the USA. We will also identify the different basket of products which China exports to the different countries and investigate whether China prices exports differently between a big and a relatively small market. However, in the USA, tariff preferences were given to Mexico and there was also some form of Non-Tariff Barriers (NTB) imposed on China. We have argued that tariffs played a very insignificant role in the determination of price as there is little variation in tariff schedules, our results will be more robust if we are to look at the Chinese price effect in an even more liberalized economy like Singapore. We can be more confident that the results obtained will be cleaner and more robust in a sense that it has purged the effects of trade barriers influencing price. We postulate that increased Chinese competition is largely in terms of prices, driven by the rapidly increasing productivity and scale in Chinese industry as producers started to catch up technologically with middle-income countries and absorbed large amounts of surplus labour from the hinterland and capital from the rest of the world. In principle, we see this advance in productivity and scale as the main exogenous driver of China's market expansion and use a Bertrand-like model to gauge the Chinese price effect on the country's competitors.

Our main contribution is that the direct price effect of Chinese competition is clearly present and is stronger and better defined than any effect deriving from China's share of the importer's market; it applies to both the US and Singapore markets. The direct price effect of China is statistically significant after being subjected to several robustness tests. Our results suggest that a 10% reduction in China's price will cause a 4% to 8% drop in the price level of its rivals. Our method for measuring the price effect of China directly is an alternative to the share approach, which has generally had little success. This thesis contains seven chapters and the rest of the introduction provides a little more detail for each chapter.

Chapter 2 of this thesis provides some history on China’s institutional and economic reforms since the 1980s, which paved the way for its growth. We offer stylised facts and discuss in greater detail the factors contributing to China’s growth. We reason that the growth in China’s Total Factor Productivity (TFP) is the main contributing factor and driving force for cheaper products. The abundant labour force (as a result of labour migration from rural to urban areas), capital accumulation and FDI inflows are the important factors contributing to increasing scale and productivity. Several studies have shown that China’s productivity growth has been faster than that of any other country (Asian Productivity Organization, 2011; Holz, 2006; Hu and Khan, 1997; Inter-American Development Bank, 2010). In this chapter we highlight some of the important factors behind Chinese growth, in particular its exports, and justify the assertion that China’s emergence has been an unprecedented shock to the global economy. China’s export basket contains different types of products, ranging from hairpins to more sophisticated products like Apple’s iPod. Heterogeneity exists between products and this is usually reflected in the price, so there is a need to examine the data at product-level in order to investigate the Chinese price effect.. By applying product effects, time-invariant unobserved heterogeneity can be controlled for within products.

In Chapter 3, we explain the data sources and selection that we will use for our main regression analysis. Our study is data intensive and will make use of product-level data at the HS6 digit level and changes in unit price as an indicator of price changes. We use data at the Harmonised System 6 digit level (HS6) obtained from the UN Comtrade database,[2] as this is the finest level of disaggregation that is harmonised internationally. For consistency purposes, we use data obtained from the importing country, the USA. In this chapter, we provide some stylised facts about both China and Mexico’s exports to the USA at the product level, and we find that the trade overlap between the two countries increases over time, during which China exports the majority of the product headings into the US market. There have been a few revisions to the HS classification since 1992 (HS92) and thus there might not be an exact match between every product when converted from the later HS systems to the earlier version. It is important that the products are coded correctly during the conversion so as to make sure that we are comparing the same individual products over time. We thus arrive at a set of ‘clean’

[2] The data are obtained from UN Comtrade under the World Integrated Trade Solution System (WITS).

products that are free of classification issues. However, there is also the issue that the most dynamic sectors – that is, machinery and electronics – are the ones that have undergone most of the classification changes and we lose a great deal of information when using only the ‘clean’ sample set. Thus, we propose to use the full sample set and to repeat some of our estimates on a sample of ‘clean’ products.

In Chapter 4, we use a model loosely related to the Bertrand model to find the Chinese price effect on Mexico’s price in the US market. The set of products that are in direct competition is referred to as the ‘common product’, and our sample period is from 1992 to 2008. Our main objective is to find the direction and magnitude of the effects of changes in China’s price on Mexico’s price at the product level, which we term the Chinese price effect. Our main regression uses post-tariff prices, as we find little variation in the tariff data. The unit price is used as the indicator for price. As unit prices are very noisy, we need to remove outliers that might otherwise reflect errors of measurement and create bias and excess noise. The simple regression results show that the Chinese price effect is roughly around 0.5, meaning that when China reduces its price by 10%, Mexico will reduce its price by 5%.

To correct for the endogeneity in our model (causation), we introduce the use of an Instrumental Variable (IV). China is not at the frontier of technological innovation and is playing catch-up to other countries; hence its rate of technological improvement will be much more likely to reflect local factors determining imitation rather than shifts in global technology that it shares with its trading partners. Thus we postulate that China’s increasing competitiveness is an exogenous shock and is quite independent of what Mexico does, therefore the most natural instrument for Chinese export prices would be factors causing output shocks at home; that is, a productivity shock. However, productivity data are not as finely specified as trade data and so we also need to consider a series of instruments based on trade data. The Chinese price effect increases slightly when we use IV regression. A second potential source of endogeneity is China’s share of imports into the USA, which will be affected by the price of Chinese exports relative to other exports, including those from Mexico. A natural instrument for this would be China’s share of other markets. The Chinese price effect varies only slightly even after inclusion of the other controls in our equation. One worry has been whether Chinese and Mexican export prices have common trends caused by a third factor; to allow for this , we do an estimate in first differences with product fixed effects and still find that, while the Chinese price effect is lower at around 0.30, it remains positive and significant. We also conduct other robustness tests and our results show that the Chinese price effect is positive and significant in the range of around 0.30 to 0.70.

In Chapter 5, we believe that China can also influence Mexico's price even if there is no direct competition involved. This chapter considers the potential competition of Chinese products where the threat of Chinese entry is identified by examining China's exports to the rest of the world (ROW). Contestability is a measure of the extent to which a market is open to new entries. In contestable markets, the threat posed by the possibility of new firms entering the market is taken to be a key determinant of the behaviour of existing firms. This means that based on the contestable model, firms behave like perfect competitive markets to prevent rivals from entering the market. The concept of potential competition is commonly studied in the airline market, where low-cost airlines are able to gain a share of trade when the industry becomes more liberalised and competition increases. However, to our knowledge, not a great deal of research has been done on potential competition in the context of international trade. A study closely related to our work was conducted by Schiff and Chang (2003), which examined the impact of market presence and contestability on the price reaction of member and excluded countries when a Regional Trade Agreement (RTA) was formed. However, they used tariff changes as an indicator of price competition, whereas we attempt to identify price changes directly. One of the problems arising when doing this exercise is to find the estimated Chinese prices for the set of products in potential competition, as there is no trade on these products reported by the USA. Thus we need to use China's export prices to Japan, Korea and the ROW to get the predicted Chinese price in the USA. In potential competition, Mexico will be constrained to charge a lower price to keep China out of the market and gain a bigger share itself. We will use the logit model to find the propensity of China to enter the US market, which is independent of Mexican firms' pricing decisions. The Chinese price effect for the set of potential products is relatively smaller than those in actual competition, but is positive and statistically significant at around 0.20-0.50. Our results suggest that the Chinese price effect in the USA is not significantly affected by the probability of China exporting to the US market. This raises the possibility that the methods used to estimate the probability to export are responsible for the results. Another method that we use to measure the effects of potential competition is to examine the price for the period before and after China's first entry, which we define as temporal competition. We find that there is an equal chance that Mexico's firms will either engage in price competition or cooperate after Chinese entry. Unfortunately, we do not find any evidence of a difference in the characteristics of the products between the two groups.

Chapter 6 is a case study that considers the Chinese price effect on Malaysia's prices in the Singapore market. Initially our aim was to find the Chinese price effect in a much smaller economy like Brunei Darussalam, but that did not materialise due to data constraints. Singapore is a relatively smaller market compared to the USA and we might observe a different magnitude of the Chinese price effect in a small economy. Again we choose a developing country like Malaysia, one of the most important trading partners for Singapore. However, China has been gaining share in the Singapore market and we wanted to determine its influence on Malaysia's products at the product level. This exercise was set up using the same methods as in Chapters 4 and 5. We wanted to find the Chinese price effect in a smaller market. We found that Malaysia will reduce its price by around 6% to 7% if the Chinese price falls by 10% for products that are in direct competition.

Chapter 7 outlines the main conclusions. This thesis aims to find the influence of China's exports on other competitors through price competition. We predict that China influences other competitors' prices not only in products that are in direct competition, but also in products that China has the potential to export. Overall our results are positive: we find that China does influence its rivals' price in the market. The results remain consistent after conducting various robustness tests: the Chinese price effect is still there and remains significant. Our message is that China influences its competitors' prices and hence will affect the import price index and the overall price level in the destination market. The great moderation refers to a period of strong growth and low inflation in the world economy, but is followed by great volatility in financial and asset markets. If Chinese productivity growth persists, China will continue to produce products at competitive prices, which will help to stabilise other exporters' prices as well.

2. The China Shock

2.1 Introduction

China is currently the world's second largest economy and its largest exporter in merchandise trade; it has also the world's largest population, at about 1.34 billion (World Bank, 2012). In 2009, China became the world's largest exporter of tradable goods. In 2010, China surpassed Japan to become the world's second largest economy, with a nominal GDP estimated at around USD 5.9 trillion (World Bank, 2012).[1] China has posted double-digit growth for the past three decades and its nominal GDP in 2010 was about 31 times higher than in 1980. With a GDP per capita of just over USD 4000[2] in 2010, China is still many times smaller than the USA and just about half the size of Mexico (World Bank, 2012). Nevertheless, China's per capita GDP is growing faster and at a greater scale than for any other country during its industrialisation stages (Dobbs et al., 2012). This relatively low income indicates that China is playing catch-up to other economies. Nevertheless, its extraordinary growth has made it one of the most important economies in the global market and it is providing a set of new opportunities and challenges for the rest of the world.

After 1978, China experienced major political reform and the country started to transform itself from a centrally planned economy towards a more relaxed, state-controlled system and a reformed economic system. These reforms improved its economic conditions and helped steer the country towards a stable economic growth path, accelerating productivity growth. In the early 1980s, China began reforms in the agricultural sector, under which collective agriculture was abolished; farmers gained more control of their own land and were allowed to sell their surplus in the market, which prompted them to work harder in order to get rich. The government also started to relax its control over small-scale enterprises, paving the way for non-agricultural private enterprises to expand, thereby creating more job opportunities to cater to

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[1] The data were obtained from World Bank Online Indicators. The GDP figures are listed in current US dollars and were converted from domestic currencies using single-year official exchange rates.
[2] GDP per capita is at current prices, as obtained from the World Development Index (WDI), World Bank.

China's abundant population, who were mostly engaged in the agricultural sector at that time. Rural to urban migration which was quite restricted before the transformation, also increased during that period because of the government's more relaxed approach. Furthermore, China's abundant labour began migrating away from the agricultural sector to find better job opportunities in factories, which provided a necessary start to the transformation of the Chinese economy into a manufacturing base (Maddison, 2007; Bromley and Yao, 2006).

At the same time, China also began to open its borders to the outside world when the government adopted an export-led growth model to promote the development of the stagnant economy. In 1980, the Chinese government developed four special economic zones, which were all located along the coast for ease of transportation. The special zones were designated as governed by a more liberalised system to spearhead the export-oriented economy. These special zones were aimed at creating employment, transferring high-technology industries, attracting Foreign Direct Investment (FDI), earning foreign reserves through exports and promoting economic and regional development (Yeung et al., 2009).

The cheap, abundant labour within the country, together with the government's aim to gradually privatise some of the previously state-owned monopolies, led to increased production efficiency in China. Many of the major state-owned enterprises are joint ventures and are mostly still controlled by the state. At the same time, China's open-door policy led to an influx of FDI, which has helped to build factories, created even more jobs, linked China to international markets and also led to transfers of technology. All of these factors have contributed to the increase in productivity within the country, which has made its growth strategy similar to that of Japan in the 1950s, focusing mainly on export-oriented growth with a current account surplus (Guo and N'Diaye, 2009).

China is one of the more successful stories for other developing countries to duplicate. Thus, in just three decades, it has transformed itself from a centrally planned economy to become one of the most important producers in the world today. We are interested in China because of its huge importance and the effect it has on other markets.

2.2 China Matters

2.2.1 Comparison with Other Countries

China's economic transformation and growth happened at a rate and scale that are unprecedented for any other country in the historical data. As shown in Table 2.1, it took the UK about 155 years to double its GDP per capita (in PPP terms), while China did that in just 12 years (1983-2005). China embarked on its transformation path at a later stage compared to other developed countries, but the scale and the rate at which it has grown have made it the subject of global research. China's growth is not a miracle but a resurrection, and China will again become the world's biggest economy by the year 2015 (Maddison, 2007).

Table 2.1: China Is Bigger and Growing Faster

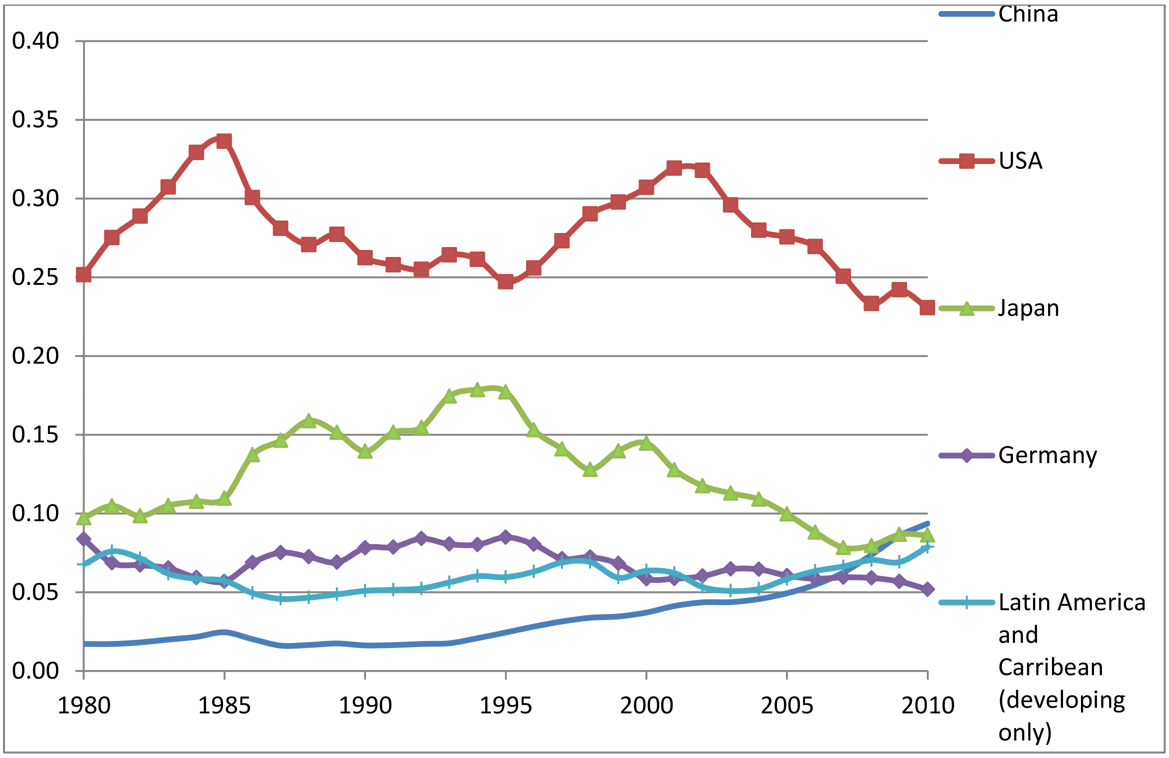
	Date of Doubling	Initial Population (millions)	Years to Double GDP per capita*
UK	1700-1855	9	155
USA	1820-1873	10	53
Germany	1830-1894	28	64
Japan	1906-1939	47	33
China	1983-1995	1023	12
India	1989-2006	822	17

*Time to increase GDP per capita (in PPP terms) from USD 1300 to USD 2600
Source: Angus Maddison, University of Groningen, McKinsey Global Institute 2011

Winters and Yusuf (2007) assert that using the current market price provides a better indicator than using prices in terms of Purchasing Power Parity (PPP) if we are looking at the impact of China on another country, as such international effects can be more accurately found via the international transfer of goods. PPP makes allowance for many untraded goods, especially services, which are cheaper in poorer countries. Using PPP is more appropriate if we are comparing welfare effects across countries, but, since we are dealing with international trade data to access the price effects of Chinese products, the current price is a better indicator.

We measured China's share in total world GDP to compare it with the other major economies as measured by the current market price. In 1980, China's share in world GDP at current market prices was only around 1.7%; by 2010, it was the second largest economy in the world with a share of 9.3%. China's share in world GDP has shown an upward trend, especially since the 1990s, as demonstrated in Figure 2.1. China's GDP had already surpassed the whole of the Latin America and Caribbean region [3] (developing countries) by 2000 and had overtaken Japan by 2010. We did not plot the GDP shares for the six East Asian Traders,[4] as data for Taiwan (ROC) is not available from the World Bank, but individually each country comprises just a small percentage of world GDP.

Figure 2.1: World GDP Share by Country (Current Prices)



Source: World Development Indicators online

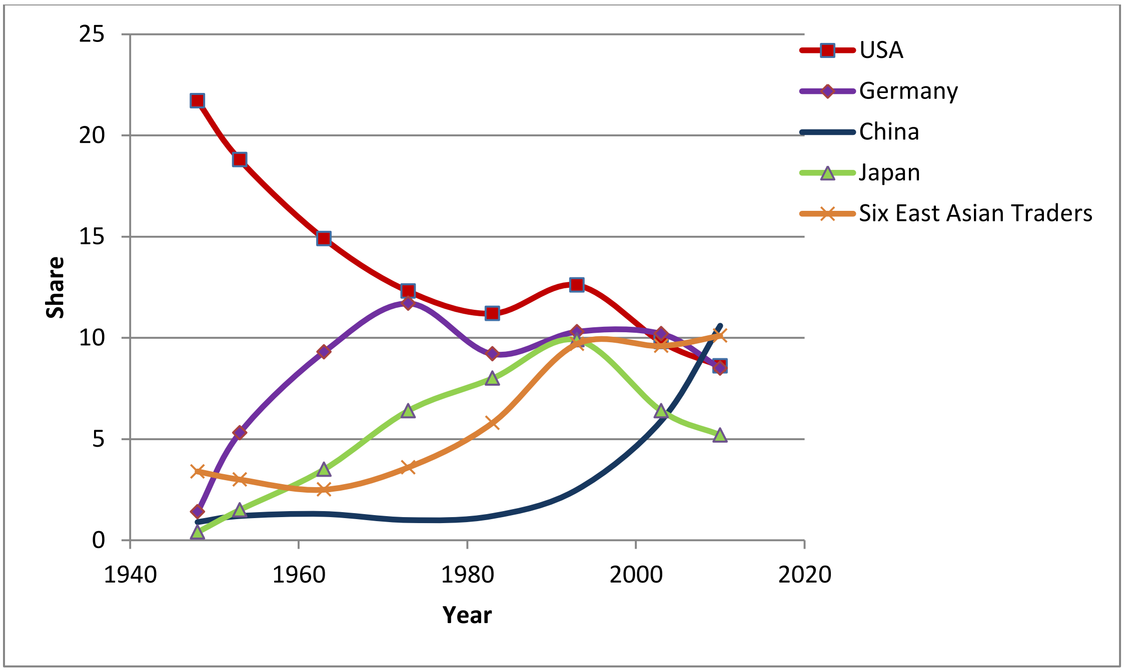
2.2.2 China's Export Shock

We are more interested in China's influence on other countries transmitted via its increasing role in international trade. In this thesis, we focus on China's exports, although it has had an equally profound effect via its imports. We provide some facts on

[3] The Latin America region is a collection of 29 countries, and their share in world GDP has risen just slightly since the 1980s.
[4] Six East Asian Traders refers to Taiwan (ROC), Hongkong (China), Singapore, Malaysia, South Korea and Thailand.

China's share in world merchandise goods from the 1950s. Figure 2.2 shows the global export shares of the major economies for every ten years since the 1940s. China was a very insignificant player in the world market before the 1990s, when its share in world merchandise goods was only around 1%, but that has now increased rapidly to around 10.6% in 2010. The case of China is interesting in the sense that the country has managed to transform itself into the largest exporter of merchandise goods in such a short period of time. In 2009, China surpassed Germany to become the world's largest exporter of tradable goods, with exports estimated at around USD 1.75 trillion.

Figure 2.2: Share of World Exports



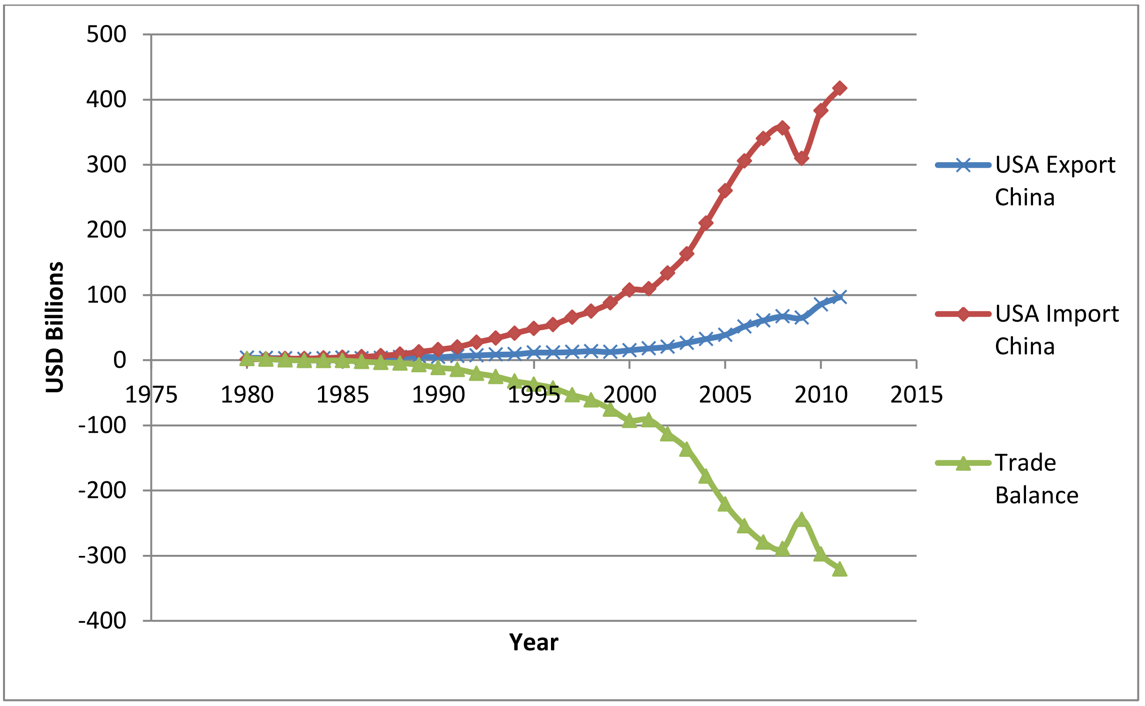
Source: WTO International Trade Statistics (2011)

From 1960 onwards, the exports of the six East Asian Traders grew dramatically, to a point where their combined export shares reached a peak of around 10% during the early 1990s, but they have remained rather stagnant since, with a 10.1% share in 2010. The 1990s also coincided with the rapid rise of Chinese exports, which led to questions about China displacing the exports of the other Asian countries (Greenaway et al., 2008). In Figure 2.2, it is apparent that China's export growth affected Japan and the six East Asian Traders more severely in the early 1990s. Japanese export growth started in the 1960s, with its export shares rising to about 10% in the early 1990s, but declined to only about 5% in 2010. This is not a surprise considering that many factories have been reallocated to developing countries, of which China has been the biggest recipient because of its cheaper labour and also its adequate level of infrastructure. We have omitted the other developing countries from our analysis as they only constitute a very small portion of world exports. We can see a shift in the world export pattern towards the Asian region, propelled by Japan and the six East Asian Traders from the 1960s and most recently China from the early 1990s. Developed countries such as the USA, Germany and Japan, which used to be the main exporters in the world, have all seen their export shares decline over the past few decades. Thus, China is possibly the biggest export shock we have witnessed over the last 30 years and it is projected to grow still further.

2.2.3 The US Market

Instead of looking at China's impact on the world economy as a whole, for the sake of concreteness we focus on the US market: our main proximate objective will be to identify the Chinese price effect in the USA. Being the world's largest consumer, the USA imported about 12.8% of the world's total exports of merchandised goods in 2010 (World Bank, 2012). As of 2010**,** China was the USA's biggest source of imports and second-largest trading partner. US bilateral trade with China started to increase after the two nations signed a bilateral trade agreement in July 1979, and provided for mutual most favoured nation (MFN) treatment starting from 1980. Thus, China was granted MFN status by the USA even before its official joining of the WTO in 2001. In Figure 2.3, we plot the flow of US trade with China from 1980. That year, the USA maintained a trade surplus of around USD 2.6 billion with China, but experienced a deficit of around USD 300 million in 1983. However, it was not until 1986 that China's exports started to enter the USA on a larger scale. The USA's trade deficit with China has worsened since the mid-1980s and was estimated at more than USD 300 billion for 2011.

Figure 2.3: US Merchandise Trade with China in USD Billions (1980-2011)



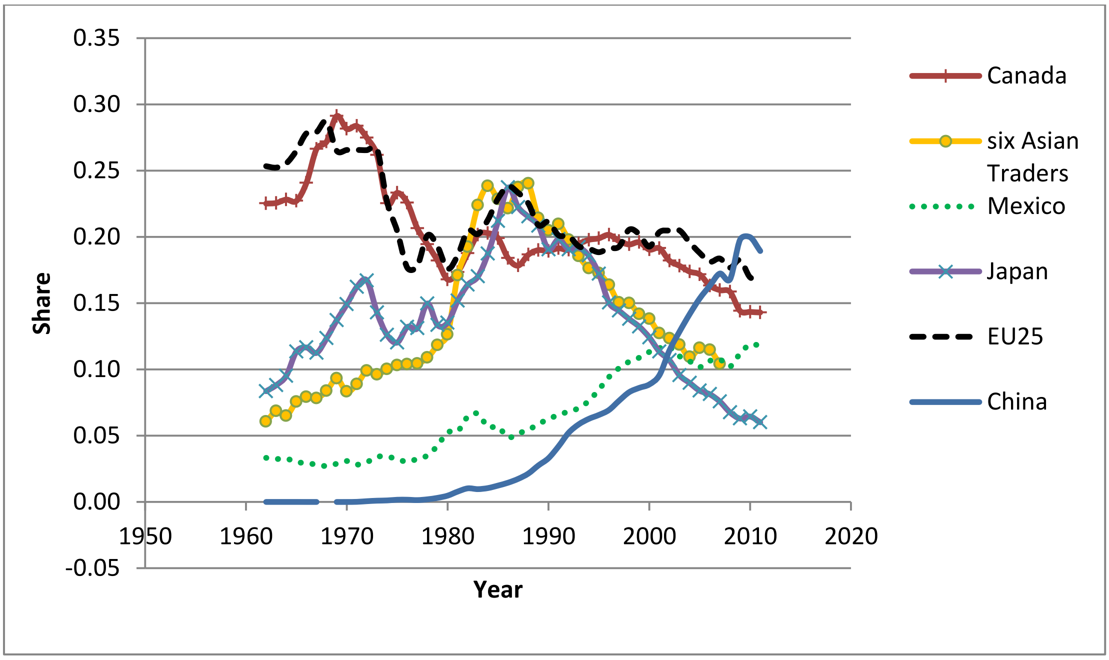
*Data obtained from UN Comtrade

2.2.4 China's Market Share in USA's Total Imports

China's share in the US market was almost non-existent before the 1980s, but has increased dramatically since and by 2010 it had an amazing 20% market share of the USA's total import basket. China overtook Canada to become the largest exporter to the USA in 2007. Its share of the US market even surpassed the entire EU-25 (17%) by 2010. Thus Chinese market share has increased at the expense of other countries, especially from the 1990s onwards. The developed countries like Canada and the EU experienced a decline in market share from the 1970s onwards, a pattern that marked the increasing importance of the USA to the developing countries, such as the East Asian Traders and Japan. Japan's share dropped significantly, from around 20% in the mid-1980s to only around 6% in 2010. There is an increasing trend in developing countries' share of US imports over time. From the late 1990s onwards, the other emerging markets like Vietnam and Cambodia (not shown in Figure 2.4) also experienced an increase in market share in the USA; however, unlike China, these countries are small, with a less than 1% share.

Mexico is also a major exporter to the USA; its market share has also shown a major increase, from around 6% during the 1980s to only about 12% in 2010. However, Mexico's share in the USA has not shown much increase, remaining relatively flat since 1997. Mexico seems likely to be particularly vulnerable to Chinese competition, as both are middle-income countries exporting labour-intensive products and both are major suppliers to the USA. As in Figure 2.4, Chinese market share is increasing faster than any other country's and overtook Mexico's in 2003.

Figure 2.4: Market Share in the USA



*Six East Asian Traders refers to Taiwan (ROC), Hong Kong (China), Singapore, Malaysia, South Korea and Thailand

The developed countries have probably lost for ever their comparative advantage in producing low-value-added manufacturing products. The newly emerging countries have significantly lower labour costs and can now meet global demand for many products like textiles, clothing and cheaper electronic products at a lower cost. However, many of these newly emerging countries are comparatively small; China is certainly the biggest shock. We again emphasise the importance of Chinese products in the USA, where about one fifth of US total imports are from China.

2.2.5 Importance of the US Market

The proportion of China's exports going to the USA is the ratio of 'China's exports to the USA' to 'China's total exports'. China and Mexico's exports to the USA are shown in Appendix 2.1. In 1980, China's total exports worldwide were only worth around USD 17.51 billion, of which about 7% (USD 1.16 billion) were to the USA. By 2011, China's exports to the US market were valued at USD 417.30 billion, comprising about 24% of its total exports. Mexico, on the other hand, sends almost all of its exports to the USA. In 2011, 74% of Mexico's total exports were to the USA, worth around USD 349 million. The US market is thus a very important export destination for both countries, especially Mexico.

2.3 How China Grew so Fast

2.3.1 Introduction

China is simply bigger and growing faster than any other country. Its economic growth has been achieved by pursuing an export-led growth policy. There must be some factors that made Chinese products relatively cheaper and we seek to identify these. We argue that the main reason for Chinese export growth should be attributed to the increase in the productivity of the real factors of production. China's abundant labour force and its reallocation to manufacturing industries, capital accumulation and FDI inflows are the important factors that have contributed to China's export boom, but the sustained increase in productivity was the main engine for sustained growth in the Chinese economy (Hu and Khan, 1997).

China's economic reform began in the 1980's when the government first allowed the farmers to trade in the market. The government aimed to expand the role of the private sector which further increased the domestic savings rate which was vital to spearhead China's growth (Woo, 1994). The increase in small scale enterprise helped to absorb the labour surplus from the agriculture sector leading to a reallocation promoting efficiency. The increase in the supply of labour to the urban sector means that these people are willing to work for a relatively low wages; while at the same time increases the efficiency for the agricultural sector. However rather than just increasing the quantity of workers, the Chinese government also focuses on improving the quality of labour mainly through education and training. The average level of education level for a person aged 15 years doubled from around 5 years in 1978 to more than 10 years by 2003 (Maddison, 2007).

In order to utilise its abundance of cheap labour, the Chinese government also implemented the Coastal Development Strategy, which allowed firms in coastal provinces to engage in export-processing contracts that had initially been confined only to special economic zones (Fukasaku and Wu, 1993; Fu, 2004). An increase in the number of workers can produce more output when they have more capital to work on. Hence in order to increase the output level, the country must invest heavily on machinery, better technology and infrastructure. Wood and Mayer (2011) attributed the rapid growth in the developing Asian countries mainly to the increasing labour participation rates and the accumulation of capital stock; with little progress in total factor productivity. Krugman (1994) further stressed that these developing countries will begin to slow down well before they catch up with the developed countries without such innovation and productivity gains. According to Krugman, economic growth is limited by simply increasing the physical inputs like labour and capital; there need to be increase in the output per unit of input (increase in productivity) in order to achieve sustainable growth. Other than just relying on domestic investments, the government provided financial incentives in order to attract more FDI, which is vital to promote the country's export-led growth strategy. The massive inflow of FDI has helped in the transfer technological and managerial skills, which further increases efficiency.

During the reforms, China invested heavily in capital stock; Hoekman et al. (2002) found that capital formation played a principal role in China's economic growth while there was nearly no technological progress from 1952 to 1980. Since the economic reformation, China has continued to grow since and studies have shown that the increasing Chinese productivity as the main contributing factor for growth (Gallagher and Porzecanski, 2008; Hu and Khan, 1997; Asian Productivity Organization, 2011; Holz, 2006). Before 1980, Hu and Khan (1997) found that capital accumulation alone accounted for about 65% of China's growth, but its role has reduced significantly after the economic reformation. Post 1980, Hu and Khan (1997) found that the increased

Chinese productivity accounted for about 42% of China's output growth while capital accumulation and labour made up the rest. Gallagher and Porzecanski (2008) also found that total factor productivity which was non existent before the reforms was growng at an annual rate of 3.8% post reform. The increasing Chinese productivity accounted for about 33% of the increase in China's output for the period 1979 until 1994. China's growth has been fuelled by factor accumulation but also an improvement in the quality of the workforce through education and training; this led to an improvement in the total factor productivity (TFP) as greater innovation and technological improvements are achieved by its people. It is the improvement TFP which has led to a positive output shock for China over the past few decades and increasing productivity is the vital factor for sustainable growth as stressed by Krugman (1994).

As China's exports continue to grow and the standard of living improves domestically, nominal wages are expected to increase, reflecting growth in the country's productivity. In the following section, we identify some of the important factors contributing to the increased level of productivity in China is the driving force behind its position as the largest exporter in the world. Before we move on to discuss its productivity, we will first review some of the literature regarding China's industrialisation.

2.3.2 Drivers of Productivity Growth in China

China's institutional and economic reforms towards a market-oriented system paved the way for its export-oriented growth. One of the main factors contributing to its growth is the initial effort of the government to reallocate resources towards the manufacturing sector and also to privatise many of the previously state-owned enterprises. China's total employment in the manufacturing sector for 2006 is estimated at 112.63 million, which is many times bigger than the 14.16 million in the USA (Lett and Banister, 2009). Lett and Banister further stress that the drop in manufacturing employment from 1996 to 2002[5] was caused by the privatisation of state-owned enterprises. Many workers were laid off during that period as private enterprises sought to become more efficient and productive. Privatisation, a method of reallocating assets and functions from the public sector to the private sector, is considered an important factor for economic

[5] Refer to Appendix 2.3 for China's manufacturing employment indicators.

growth. There are numerous studies considering the greater role of private-owned firms and their contribution to increasing productivity and efficiency in China (Naughton, 1994; Rawski, 1994; Lardy, 1995; Jefferson and Su, 2006; Hu and Khan, 1997). The introduction and success of town and village enterprises (TVEs) are among the important features marking the start of Chinese industrialisation, driving competition and leading to efficiency. The role of private enterprises increased during the mid-1990s and began to really take off during that period. The share of private employment in China's manufacturing sector (private plus state owned) increased from 4% in 1998 to 56% in 2007 (Song et al., 2011). During this period, the gross industrial output of the private sector exceeded that of the state sector. The Chinese government was focused on efficiency and closed many enterprises that were making losses, at the same time as transferring ownership to the private sector. However many of China's very large enterprises (China Unicom, China Construction Bank, China Mobile, ICBC and so on) are still very much controlled by the state, with minority private shareholdings. From 1993 to 2005, it is estimated that state employment in the manufacturing sector fell from 35 million to 6 million; and overall state employment in China also fell from 19% to only around 9% (Maddison, 2007).

The Chinese government also set up Special Economic Zones (SZEs) which have a more liberalized environment to conduct economic activities. These SZEs serve as the focal points which facilitated investments both domestically and also from abroad. These zones enjoyed special privileges such as investment, pricing, taxation, housing, and labour and land management policies and they are designated to promote high and new technology sectors (Defever and Riaño, 2012). Export subsidies were provided, encouraging firms to export. Because of heavy government subsidies, a majority of the manufacturing firms in China export almost all of their products (Defever and Riaño, 2012). China does not only rely on domestic investment but has also done very well in attracting FDI. It is now one of the top recipients of FDI in the world today, compared to the pre-1980s when FDI inflows were almost non-existent. China is the largest recipient of FDI among developing countries and is currently the third largest recipient of FDI overall, with an estimated value of USD 185 billion (World Bank, 2012). In 1998 about 60% of FDI was directed to the manufacturing sector and half of that went to labour-intensive industries, which are characterised by low technology and high competition (Tseng and Zebregs, 2002). Tseng and Zebregs explain that FDI is the main driver for China's strong economic performance and that China's case offers a learning experience for other developing countries.

China's political stability, liberalised investment regime and disguised 'foreign investment'[6] are the main reasons for it becoming the main destination for FDI (Lardy, 1995). In the early stages of its development, China attracted investors mainly from Hong Kong and Taiwan, but from the 1990s onwards foreign multinational corporations (MNCs) from Europe, the USA and Japan started to invest in China. Many of these FDI inflows are in the form of joint ventures, where foreign enterprises are allowed to gain access to the Chinese market in exchange for technology transfers. Two examples of such joint ventures in China are Shanghai Volkswagen car manufacturing and AMECO.

Liu and Daly (2011) found that the manufacturing sector accounted for more than 60% of total FDI in China during the period 1997-2008. During the initial stages of reform, most of the FDI inflows are still concentrated in low-technology industries. However, there has been a shift in the flow of foreign investment towards the high-technology, capital-intensive sector, as demand for high-technology products rose after the economic downturn in 2008. In their paper, Liu and Daly (2011) used the example of the textile industry, where foreign investments fell from USD 2.11 billion in 2005 to USD 1.39 billion in 2009. FDI in the higher-technology sectors like the pharmaceutical industry increased by 43.9% in 2009, with a value of USD 0.95 billion. If FDI inflows are now directed towards higher-technology products, it will mean that China starts to produce more sophisticated products and will probably be gaining more market share in the near future.

In order for China to increase its standard of living and to sustain its economic growth, it has to invest more on technological innovation; whether by adopting technologies from abroad or through its own innovations. Timmer et al. (2012b) stressed the important role collective indigenous R&D at the industry level as the main drivers for technological advancement leading to an increase in the total factor productivity in China. Although technology transfer adapted from FDI is important for a developing country, continued efforts into R&D by the host country are needed for sustainable

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[6] Because of tax incentives, money was sent overseas and then transferred back into China as 'foreign investment'.

development. China's 10th five year Development Plan, the country plans to achieve the goal of an "innovation economy" by the year 2015. During the 1990's China started to invest on Research and Development (R&D), but majority of the R&D was controlled by the state. By the year 2000, about 60% of the total R&D was conducted by the private sector (Timmer et al., 2012a). According to the World Bank Development Online Indicators, China's R&D ratio to GDP rose to 1.7% in 2009; this is comparable to the UK (1.8%) but still lacks behind the leaders like South Korea (3.6%) and Japan (3.4%).

FDI provides access to new technology, capital, R&D facilities and management know-how for a host region, which in turn increases economic development. Borensztein et al. (1998) argue that FDI plays a more important role than domestic investment for the transfer of technology, contributing to growth. Graham and Krugman (1993), however, mention that the ratio of FDI contribution in developing countries is simply too small to play an important role in capital accumulation and income growth. The macroeconomic indicators in Appendix 2.3 show that the ratio of FDI to GDP in China increased from only around 0.2% in 1982 to 3.1% in 2010, which is quite a significant increase, but its contribution to GDP is still relatively small as compared to the fixed capital to GDP ratio (45% in 2010). For comparison purposes, the FDI to GDP ratios for the USA and Mexico are estimated at 1.6% and 1.9% respectively in 2010, which are relatively lower than that for China. There exists a higher proportion of investment in China and the positive spillover from FDI magnifies this effect. FDI can contribute to GDP and income growth through technological improvement and capital accumulation (Zhuang, 2008). Capital accumulation as a percentage of GDP in China increased from 28% in 1982 to 41% in 2010. Kuijs and Wang (2006) found that during 1993-2004, capital accumulation contributed 62% of China's real GDP growth.

Chinese wages are still very low compared to those in developed economies, and are lower than many other middle-income countries like Mexico and Taiwan. The OECD defines Hourly Compensation Costs (HCC) as 'a wage measure intended to represent employers' expenditure on the benefits granted to their employees as compensation for an hour of labour'. Compensation costs include wages and also employers' contribution to benefits and social insurance. The Hourly Compensation Rate (HCR) is used as an indicator of the competitiveness of manufactured goods in world trade. The HCR for

China and a few other countries relative to the USA are tabulated in Table 2.2. Although China's HCR doubled from 2002 to 2008, it was only about 4% of that in the USA in 2008. Among the 32 economies calculated by the Bureau of Labour Statistics (BLS), China has the lowest HCR. The HCR for Mexico is almost five times more expensive compared to China. The HCR in India for 2007 was around 3.6% of that of the USA, which is still slightly higher than China's.[7] However, the BLS does not publish the HCR for Africa and also smaller emerging countries like Vietnam and Cambodia.

Table 2.2: Indices of Hourly Compensation Costs (HCC) in Manufacturing (Index USA=100)

Country or Area	Mexico	Taiwan	Korea	China
1996	13.55	31.60	43.12	
1997	15.06	30.56	40.61	
1998	15.21	26.96	28.66	
1999	16.73	28.27	36.43	
2000	18.80	29.24	39.21	
2001	20.64	27.29	34.75	
2002	20.43	24.97	37.88	2.08
2003	18.58	24.38	40.05	2.17
2004	17.93	24.83	43.41	2.25
2005	18.62	26.31	50.18	2.42
2006	19.28	26.41	57.56	2.66
2007	19.24	25.50	61.06	3.30
2008	19.75	26.49	50.35	4.15
2009	16.71	22.79	42.59	
2010	17.94	24.06	47.85	

Source: Bureau of Labour Statistics

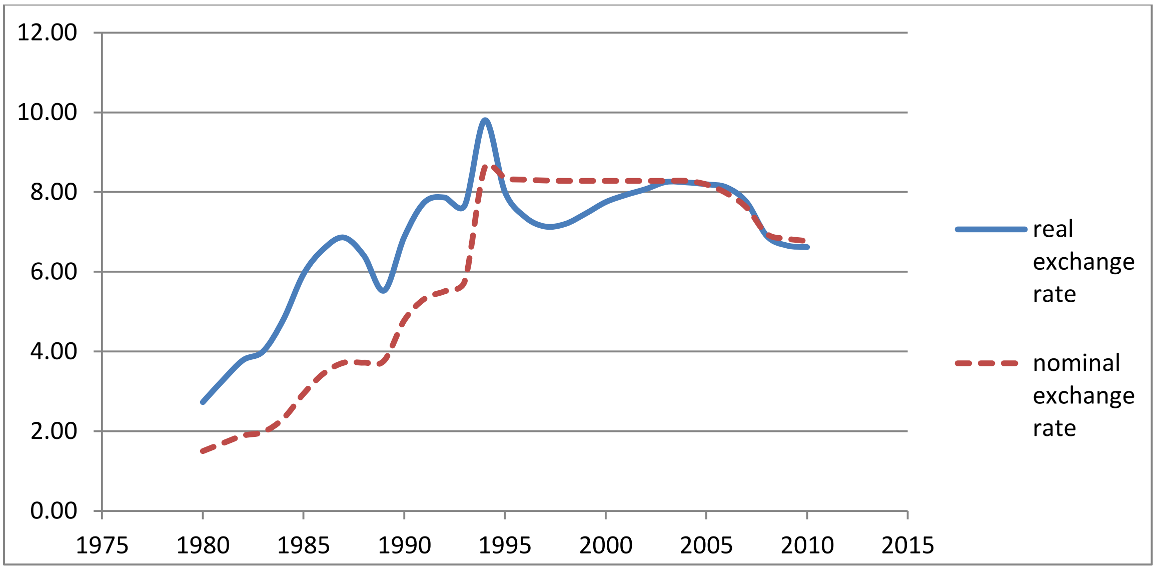
As China continues to grow and wages set to rise, one has to wonder if China will lose its competitive edge to the newly emerging developing countries. During the initial stages of reform, the relatively low wage rate is made possible due to the migration of labour from the countryside, which has managed to hold wages down. However as long as productivity increases faster than factor prices, China will still maintain a cost advantage.

[7] The BLS estimates for India include organized manufacturing only, whereas about 80% of employees are unorganized and earn less; this tends to overstate the HCC for India.

Naughton (2007) found that China's labour productivity was increasing at a rate of around 5.1% from 1978 to 2003 despite a reduction in the growth rate of labour input. Timmer et al. (2012a) argue that the increase in productivity has led to the increase in the output per worker to increase threefold from 1980 to 2004. We agreed that factor accumulation and the relatively cheap labour has contributed to China's GDP growth during the initial stages of reformation; however it is the reallocation of resources, technological innovation and the more efficient method of utilizing capital and labour that has led to China's sustained growth.

China's growth was initiated by adopting an export-oriented development program; hence despite its large domestic market has a relatively high export to GDP ratio. Thus China has to rely foreign demand in order to maintain its GDP growth; with the USA being the largest consumer of Chinese products. There are some who believe that it is the undervalued Renminbi (RMB) that makes Chinese products so competitive in the international market (Goldstein and Lardy, 2006; Cheung et al., 2010). Figure 2.5 shows the exchange rate of the RMB to the US dollar for the period 1980-2010. The RMB is considered undervalued because it has changed by less than has cost (productivity). Since the economic reform of China in the 1980s, the Chinese government somehow controlled the value of the RMB to the USD, until 1994 when it unified its exchange rate system by abolishing the previous dual exchange rate system. China's RMB fell from around RMB 5.76 per unit dollar to around RMB 8.62 per unit dollar, a depreciation of about 50%. The Chinese nominal exchange rate in 2010 appreciated to around RMB 6.77 per USD. The exchange rate is clearly an important part of the story, but the RMB has not risen fast enough to offset the productivity gain in manufacturing.

Figure 2.5: China's Exchange Rate (1980-2010)



Source: USDA Economic Research Service (real exchange rates are derived by multiplying the nominal exchange rate by the ratio of US to China CPI)

Theoretically speaking, an undervalued real exchange rate leads to inflation putting pressure on wages to rise. The real exchange rate is simply the nominal exchange rate after taking into account the difference in the inflation level between the two countries. Using data obtained from Banister (2007), Song et al. (2011) reiterate that wages have grown more slowly than output per worker in China.[8] An undervalued RMB should lead to domestic inflation; however, the annual average inflation level in China has been quite similar to that of the USA since 1997, as shown in Appendix 2.2. In 2011, China's inflation rate increased slightly to 5.4%, which is slightly higher than the 3.2% inflation in the USA. Chang and Hou (1997) argue that the Chinese inflation hike in 1994 was more of a structural rather than a monetary phenomenon, which is common among transitional economies. China's exports are increasingly competitive in the international market because productivity is rising faster than input costs; that is, rural urban migration, FDI inflows and capital investments are some of the important factors contributing to increased efficiency and productivity in the country. It is unlikely that the undervalued RMB is the main contributor to the cheapness of Chinese products. Increased productivity in China should be the main cause that is making Chinese products competitive by pulling down the unit costs of production.

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[8] The average annual wage rate in the urban manufacturing sector grew at a rate of 7.5%, while GDP per capita grew at 9% for the period 1992-2004.

2.3.3 Total Factor Productivity (TFP)

As mentioned above, Chinese government reforms towards reallocation, privatisation and attracting FDI were critical in spearheading China's export-oriented growth path, making the country the world's largest exporter in tradable goods. Exporting firms self-select into export markets and they tend to be bigger and more productive than non-exporting firms, although exporting does not always increase productivity (Bernard and Jensen, 1999). We hypothesise that the positive spillover effects from FDI and the increasing competition from privatisation increase firms' efficiency, leading to increasing Chinese productivity. Studies of the spillover effect of FDI in China include those conducted by Wei and Liu (2006) and Tian (2006). Using panel data at the firm level, both studies found a positive technology spillover effect of foreign investment in domestic firms. The pace at which both domestic and foreign firms started to enter the Chinese market led to increased efficiency in production. As China continues to grow and develop, it will experience an increase in the costs of the factors of production, which might be passed on to consumers, making Chinese products less competitive. However, as long as productivity increases faster than factor prices, this will help to reduce prices. Increasing Chinese productivity is the driving force for the surge in China's exports (Hu and Khan, 1997). Hu and Khan further found that Chinese productivity increased at a rate of 3.9% annually for the period 1979–94. This is remarkable considering that the productivity growth for the Asian Tigers[9] was around 2% for the 1966–91 periods.

In principle, we see increased productivity as the main exogenous driver of China's market expansion. Productivity is defined as the total output that can be attained from the total inputs, where inputs are often classified into capital and labour. The most common method to determine productivity is to use Total Factor Productivity (TPF), which takes into account all the factors of production. TFP is the portion of the change in output not explained by the amount of inputs (capital and labour) used in the production function, and is often attributed to change in technological progress. This can be better explained in the Cobb Douglas function (2.1), where Y (output), L

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[9] Asian Tigers refer to Hong Kong, Korea, Singapore, and Taiwan Province of China

(labour) and K (capital) can be measured directly. The exponents α and γ are the cost shares for labour and capital input respectively.

$Y = TFP * L^{\alpha} * K^{\gamma}$ (2.1a), $(\alpha + \gamma = 1)$

$TPF = {}^{Y}/_{(L^{\alpha} * K^{\gamma})}$ (2.1b)

Technological progress and institutional and organisational changes are just some of the important factors that could have caused an increase in the production function. 'TFP reflects the spill over externalities of some on-going research projects or it could simply reflect innovation and inspiration' (Hulten, 2001, p.41).

Other studies on the role of Asian productivity include those carried out by the Asian Productivity Organization (APO, Japan) focusing on productivity in the context of economic growth and development in the Asia-Pacific region. In order to calculate TFP, they defined output as GDP at current prices and factor inputs as labour, IT[10] capital and non-IT capital. They calculated labour input as measured by total hours worked per worker, and developed their own harmonised estimates for comparing productive capital stocks and services, as many of the Asian countries do not have a common system of accounting. Their calculation for capital stocks basically follows the methodology used in the OECD Productivity Database (Schreyer et al., 2003). McMillan and Rodrik (2011) calculated their own sectoral employment estimates using National Bureau Statistics (NBS) data and found their estimates almost identical to the ones calculated by the APO. It is not our objective to try to calculate the Chinese productivity level ourselves, but we will reference the TFP as obtained from APO.

According to the APO (2011), China's productivity performance was increasing at a rate of 3.1% per year during the period from 1970 to 2006. This is outstanding considering that the growth rate for Taiwan (ROC) was estimated at around 1.6%, while those for Japan and Korea are both estimated at around 0.5% during the same period. The increasing TFP in China is the main engine of economic growth, followed by capital accumulation and IT capital (APO, 2011). The Chinese TFP as calculated by the

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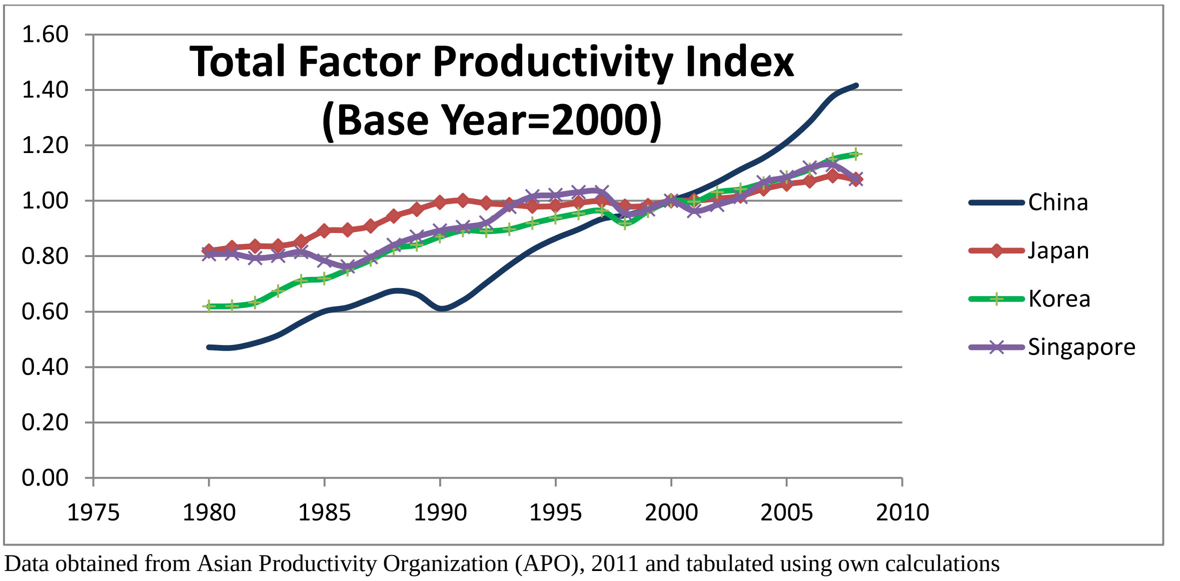
10 IT capital is defined as a composite asset of IT hardware (computers and copying machines), communications equipment and computer software.

APO is comparable to the estimated average growth rate of 3.8% for the Chinese economy during the period 1978–2005 (Holz, 2006). Holz (2006) estimated the TFP for the Chinese economy from 1994-2005 according to 39 different sector classifications.

Figure 2.6 shows the annual TFP index relative to its base year index in year 2000, for each of the four individual countries. The figure shows how the TFP for each individual country has grown since the 1980's. China's TFP was growing at a rate of around 4.5% from 1990-2008, while the TFP for Japan grew at a rate of just 0.5% over the same period. The TFP growth for Korea and Singapore is estimated at 1.6% and 1.1% respectively during the same period. The APO concludes that the rising level of TFP within China is most likely the most important stimulant for the surge of Chinese exports.

Figure 2.6: Total Factor Productivity Relative to Base Year Index (2000 =1)

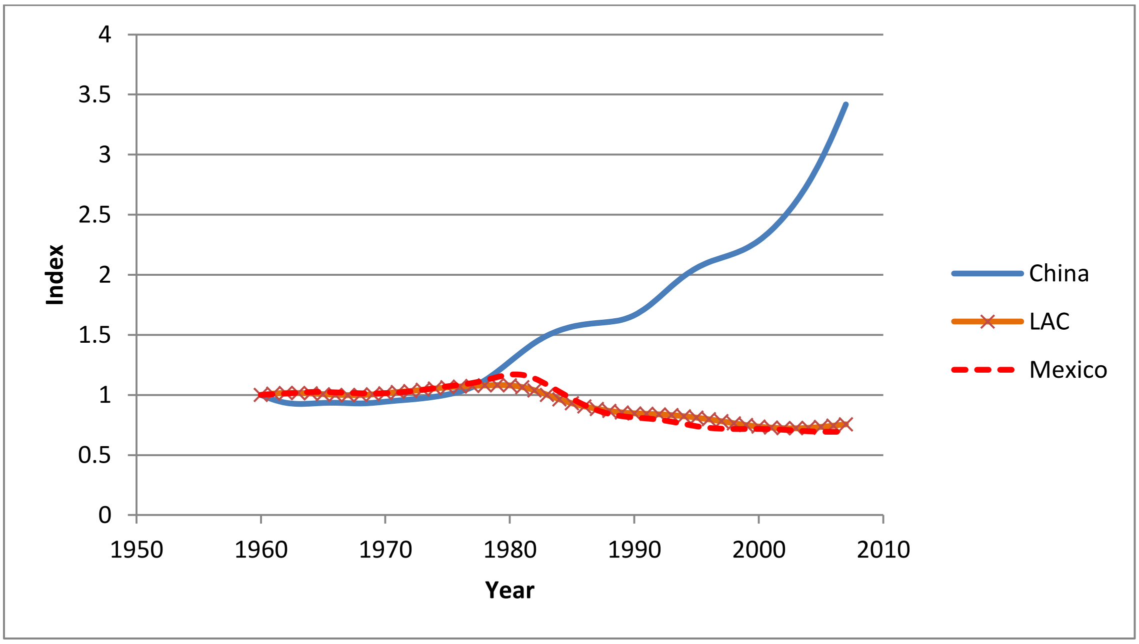


Data obtained from Asian Productivity Organization (APO), 2011 and tabulated using own calculations

The results published by APO also show that the manufacturing sector and the services sector are the main drivers for China's economic growth, with a contribution share of around 48% and 41% respectively. The agricultural sector has very little contribution to China's economic growth.

The Inter-American Development Bank (2010) has published TFP data for China and also the Latin American countries (LAC).[11] The productivity catch up for each country relative to the USA since 1960 is shown in Figure 2.7. The figure depicts the change in the characteristics of the TFP for each typical country (relative to the USA), where the index is normalised to 1 by 1960).[12] We can see that China's productivity growth is indeed astonishing as compared to other countries. The Chinese TFP only started to climb during the early 1980s and this coincided with the period during which China first embarked on its economic reforms. The productivity level for the LAC (relative to the USA) remained quite stable until the debt crisis in the 1980s; similarly, the TFP for Mexico (relative to the USA) has dropped since the 1980s. As shown in Figure 2.7, China's TFP relative to the USA in 2007 has increased by about 3.5 times since 1960, while Mexico's TFP in 2007 has dropped to only about 0.69 relative to its 1960 value.

Figure 2.7: Productivity Catch-Up (TFP Relative to the USA, 1960 Normalised to 1)



Source: Data are from Daude and Fernandez Arias (Inter-American Development Bank, 2010) based on Heston, Summers and Aten (2006), World Bank (2008), Barro and Lee (2000)

It is worth mentioning that although China's TFP is growing fast, the country is playing catch-up technologically with middle-income and higher-income economies. We are not

[11] The TFP for each country is calculated relative to the USA.

[12] The TFP in Figure 2.7 is calculated using the formula $\left(\dfrac{TFP_t^{China}}{TFP_{1960}^{China}} \Big/ \dfrac{TFP_t^{USA}}{TFP_{1960}^{USA}} \right)$

comparing TFP across countries, but assessing a country's productivity performance relative to the USA normalised to 1 in 1960. Using TFP data for each individual country as obtained from IADB, we found that China's TFP ratio to the USA was only around 16.7%, but that it rose to about 45% by 2007. China's productivity is also catching up fast to Mexico; its TFP relative to Mexico was about 72% in 2007, compared to just 17% in 1980. The TFP growth in China is the engine contributing to the Chinese shock. As Chinese TFP continues to increase relative to other countries, China will be able to counter rising domestic prices and keep its export prices competitive. In the context of international trade, the gains in China's productivity growth might also affect the welfare of other countries through the terms of trade effect. Using sectoral data from 1995 to 2007, Hsieh and Ossa (2011) found only a minimal spillover effect on the Chinese productivity growth to the Rest of the World (ROW). This further supports our hypothesis that China's productivity growth is an exogenous shock and is unique to China alone.

China's growth is attributed to increasing TFP and also to a high rate of capital accumulation. According to Bosworth and Collins (2007), China can continue to sustain its growth by reallocating its labour force from the agricultural sector to the manufacturing and services sectors, thereby increasing efficiency and productivity. Bosworth and Collins (2007) further stress the remarkable performance of the Chinese industrial sector, where the average output per worker has increased by about 10% annually since 1993, which is attributed to increase in TFP and capital accumulation.

In principle, we see the improvement in costs innovation, increasing productivity and scale as the main exogenous driver of China's market expansion. Although productivity growth through cost innovation pushes down prices, it will also lead to an increase in product quality and hence an increase in Chinese price. China's growth has evolved from low price manufactures and has moved on to product diversification and quality upgrading. China seemed to have shifted production to more sophisticated products; however its exports are still perceived to be of lower quality as compared to the developed countries (Schott, 2008). Broda and Weinstein (2010) found a massive reduction in the price per unit quality of Chinese products during the period 1992 to 2005; attributed mainly to product upgrading. However although Chinese products are getting more sophisticated, it is hard to quantify whether there is an improvement in the quality of the same product over time simply by comparing their unit price. If we assume quality for the same product to be constant over time, this will be differenced out in our fixed effect regression. As in Iacovone et al. (2013), we define increasing productivity as a firm which is able to produce similar quality products at a lower price. We suggest that increased Chinese competition is largely in terms of prices conditional on quality, driven by cost innovation, increasing productivity and scale in Chinese industry as producers started to catch up technologically with middle-income countries and absorbed large amounts of surplus labour from the hinterland and capital from the rest of the world.

2.4 China Exporting Deflation

One of the main motivations for doing this thesis was the comment regarding China exporting deflation. Many have attributed to China the exporting of deflation to the world by flooding the market with its cheaper products (Roach, 2002; Yam, 2002; Becker and Edmund, 2003). These cheaper Chinese products have greatly benefited US consumers, especially those in the lower-income group, making them more affordable and giving them more choice (Broda and Romalis, 2009). Schott (2008) found Chinese exports to be relatively cheaper than those of the other developing countries and its relative price to be falling over time. Using disaggregated data at the HS10 digit level, Amiti and Freund (2010) found that China's export price to the USA fell by an average of 1.5% annually for the period 1997-2005, while the USA's import price from the ROW rose by an average of 0.4% during the same period.

Although China is currently the world's biggest exporter, its exports still accounted for less than 3% of OECD countries' GDP in 2010. Looking at the US market, Chinese import penetration in the USA's total consumption was also slightly less than 3% in 2010. Thus we believe that the Chinese competitive effect arises not through its direct effect on price indices in the USA, but rather through its pressure on competitors exporting to the US market. Based on the theory of comparative advantage, the growth of Chinese exports will have less of an impact on developed countries, as they are producing different types of products. China as a labour-abundant country will be producing textiles and clothing, while a capital-intensive country like Japan will tend to produce pharmaceutical products and computer chips. The theory would suggest that the intense competition between China and the other developing countries will tend to drive down prices and will benefit developed countries like Japan, those in the EU and the USA (Schott, 2008).

We focus on the price effect of China on Mexico in the USA, the most important trading partner for both Mexico and China. Mexico is a developing country that shares a border with the USA and benefits from tariff exemptions after the signing of NAFTA in 1994, although it was granted Generalized System of Preferences (GSP) benefits even prior to that. Mexico and China could both be described as middle-income and labour-intensive developing countries that export many of their products to the USA. The cheaper Chinese products are more likely to put pressure on developing countries like Mexico as both try to compete for market share in a third country like the USA. We make our case for using Chinese prices as the influential channel affecting other countries' exports, as China has possibly been the biggest shock we have witnessed for the past few decades. Assuming that the same products are seen as close substitutes, the cheaper Chinese products will induce Mexico to drop its prices as well. We aim to find the percentage change in Mexico's prices induced by a change in China's prices in the USA. Mexican firms that cannot keep up with Chinese prices will lose market share and some will be forced to exit the market. The Mexican government has claimed that the *maquiladoras* have lost more than 200,000 jobs since 2001 as more factories have been relocated to China because of its relatively cheaper labour.

2.4.1 Processing Trade in China

China's manufacturing sector is the biggest of any country in the world and it has always been China's main export industry since the government started to adopt export-oriented growth. China began by producing less sophisticated manufactures like textiles, footwear/headgear and leather and furs during its early stages of growth. However, it seems that China has now ventured into high-end manufacturing and is seen by many as a global factory, to which companies all over the world outsource their products. Although it might have appeared that China has shifted its production to more sophisticated products, it is still a labour-abundant country. However, as we are investigating Chinese price effects on Mexico for a common set of products, the degree of a country's value added in the final product does not matter too much. Rodrik (2006) asserts that Chinese exports are more sophisticated compared to the country's own income level. However, a recent study has shown that developed countries still have control over many products, as China is mainly involved in the process of assembly due to its cheaper labour costs (Dedrick et al., 2010). Koopman et al. (2008) found that the domestic value added for Chinese exports is around 50% of the total value of the final product, and can be less than 20% for the more sophisticated products. Similarly, Kee and Tang (2012) also found that processing trade accounted for about 49% of China's exports in 2006.

This is especially true in manufactured products where many components are assembled together to form the final product. Many of the high-technology products are only assembled in China because of its low costs; due to this, the domestic content of the value added from processed trade has been very small. An example is Apple's iPod 3G model, where Linden et al. (2009) estimate that the value added attributed to producers in China is only valued at USD 4, while it costs around USD 150 to produce. However, when the iPods are imported from China where they are assembled, the full USD 150 is recorded as an import from China. The iPod is only one product and it might not correctly represent the actual Chinese contribution in manufactured products, however.

The World Input Output Database (WIOD) is a joint initiative by the OECD and WTO to help address the value added of a product by different producers globally using a world input-output table (Timmer et al., 2012a). It provides input and output tables covering 35 industries for the EU and 13 other countries, with data from 1995 onwards. Timmer et al. (2012b) found that the value added increases faster in emerging countries, especially China, as compared to more advanced countries. China's value added increased threefold from 2002 to 2006, and had almost caught up with the USA's by 2007.[13] China's increased role in the global production chain has captured a larger share in the value-added content of domestic production. Most of China's value-added production is exported to meet increased foreign demand. In the case of the iPod, China's value added is clearly at the bottom end of the production chain; however, at

[13] The value added for Mexico has also more than doubled since 2002.

the more aggregate level China exports a relatively higher value added than any other country.

Our study is more focused on the impacts of lower Chinese prices and their influence on competitors. China's price effect can be felt by its competitors even though it does not contribute fully to the cost of the whole product. Since we are finding out the Chinese price effects on Mexico for products that are in direct competition, a country's value added in the final product does not matter greatly. We are more interested in the prices of final products from China and their influence on other countries.

2.4.2 Case for Using Data at the Product Level

Thus far, we have identified and made the case that it is the unique increase in China's productivity that has made Chinese products so competitive in the world market. All the macro data above show that China's growth over the past few decades has generated a shock that is unprecedented in any other country during its heyday. However, we are confined by limited observations if we are to use macro-level data. Furthermore, by aggregating all the many products into an export basket, the average price of a basket of goods will be too crude to gauge the effect of Chinese products. China's export basket consists of different products and there is heterogeneity between the different products; for example, hairclips and laptops are different and this can be indicated by their price. Fortunately, there exist international data recorded at a more disaggregated level, which can be obtained from UN Comtrade; we will discuss the sources and structure of our data in the next chapter. Nevertheless, our point is that if Chinese products are indeed cheaper and continue to be so, it will have an effect on other countries, most probably at the product level. Our hypothesis is that if electronic products are all similar, China's entry into the electronics market will cause a price drop in the electronics sector for the other countries producing electronics. However, the competitive pressure is stronger the closer the products are to each other. Electronic products in general are a greatly aggregated product and can be further disaggregated into finer classifications. A simple television exported by China will be very different to a more sophisticated LCD screen exported by Japan. At a more aggregated level, all electronics products will be classified within the same category but be very different from each other. Thus at the finer level of product classification, less product heterogeneity exists, and this is especially important if we want to compare products between countries.

According to Schott (2008), if product codes are defined at too aggregated a level, it will create a problem when we try to find the degree of competition between countries, as products that are actually different might be classified together in the same group: ‘clocks and watches’, for example, might capture wristwatches, pocket watches, clocks and so on. On the other hand, even at the finer levels of aggregation, there still exists vertical differentiation of products: a wristwatch exported by Switzerland or Japan might be of a higher quality than a wristwatch exported by China. The heterogeneity between the different products is usually reflected in the difference in their prices. China and Mexico are middle-income countries and thus it is assumed that there will be a high degree of similarity for the same product exported by the two countries, as compared to the same product exported by a developed country like Japan. Our model is to compare changes in Chinese prices relative to Mexico’s prices, not to compare prices on level terms.

China’s export basket consists of many different products and there exist individual product-specific effects across products. According to Schott (2008), product-level data provide a much finer picture, as there exists heterogeneity across products even in the same industry, and using product-level data allows us to evaluate this heterogeneity using unit values.

In the next chapter, we will look at the level of disaggregation at which a ‘product’ is defined; it is important to get this definition correct, as we are looking at the Chinese price effect at the product level. Thus far, we have mentioned the growth of China and its threat to other countries. However, the rapid growth of China can nonetheless also provide potential opportunities for other developing countries, as China’s demand has been growing since 1990 (Lederman et al., 2009). While this should be noted, it is not the main focus of our study.

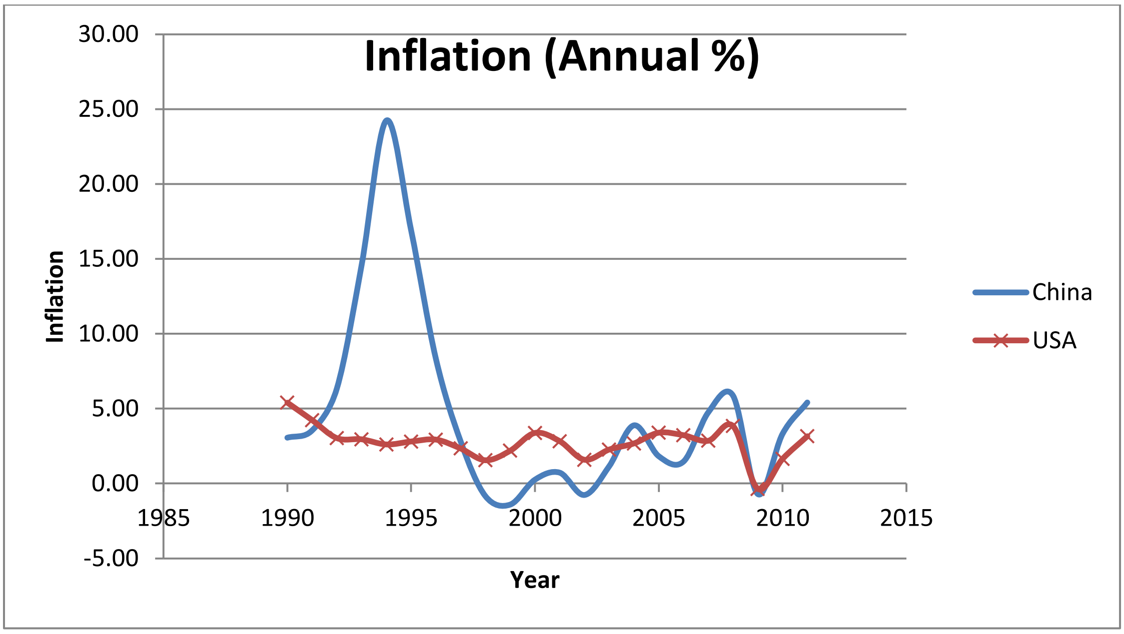
Appendices: Chapter 2

Appendix 2.1: Proportion of China's Exports to USA

	China Export World	China Export USA	USA/World	Mexico Export World	Mexico Export USA	USA/World
Year	(USD Billions)	(USD Billions)	Percentage	(USD Billions)	(USD Billions)	Percentage
1980	17.5	1.2	6.6	18.4	12.8	69.3
1981	21.2	2.1	9.7	23.9	14.0	58.6
1982	20.6	2.5	12.1	26.7	15.7	58.8
1983	21.1	2.5	11.7	28.0	17.0	60.7
1984	24.7	3.4	13.7	29.7	18.3	61.5
1985	28.0	4.2	15.1	29.0	19.4	66.7
1986	32.3	5.2	16.2	24.0	17.5	73.1
1987	43.5	6.9	15.9	28.9	20.5	71.1
1988	56.2	9.3	16.5	31.6	23.5	74.4
1989	71.5	12.8	18.0	35.9	27.4	76.5
1990	85.0	16.3	19.1	40.4	30.8	76.2
1991	107.0	20.3	19.0	42.1	31.8	75.5
1992	130.5	27.5	21.0	46.1	35.9	77.8
1993	150.8	33.7	22.3	50.4	40.7	80.7
1994	183.4	41.4	22.6	61.4	50.3	81.8
1995	222.0	48.5	21.8	78.1	62.7	80.2
1996	245.3	54.4	22.2	91.7	73.9	80.6
1997	276.7	65.8	23.8	106.6	87.0	81.6
1998	279.6	75.1	26.9	115.5	96.0	83.1
1999	315.7	87.8	27.8	132.1	111.0	84.0
2000	397.1	107.6	27.1	163.5	137.4	84.1
2001	410.6	109.4	26.6	159.0	132.7	83.5
2002	474.8	133.5	28.1	161.2	136.1	84.4
2003	592.8	163.3	27.5	167.3	139.6	83.4
2004	776.9	210.5	27.1	191.1	157.7	82.5
2005	970.4	259.8	26.8	214.4	172.2	80.3
2006	1171.2	305.8	26.1	250.6	199.5	79.6
2007	1425.9	340.1	23.9	274.8	212.2	77.2
2008	1629.8	356.3	21.9	291.0	216.8	74.5
2009	1371.0	309.5	22.6	233.8	175.3	75.0
2010	1748.2	383.0	21.9	308.3	227.9	73.9
2011	1752.6	417.3	23.8	349.0	259.7	74.4

*Data obtained from Comtrade and tabulated using own calculations

Appendix 2.2: Chinese Inflation



Source: World Development Indicators

* Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used.

Appendix 2.3: China's Stylised Data

Country Code	FDI Net Inflows (USD Billions	Gross Fixed Capital (USD Billions)	GDP current (USD Billions)	FDI (% of GDP)	Capital (% of GDP)	GDP PPP p.c. (USD)	Population (Billions)	Labour Force (Millions)	Manufacturing Employment (Millions)
1982	0.43	57.37	203.18	0.21	28.24	585.02	1.01		
1983	0.64	66.03	228.46	0.28	28.90	639.48	1.02		
1984	1.26	76.68	257.43	0.49	29.79	727.08	1.04		
1985	1.66	90.88	306.67	0.54	29.64	814.07	1.05		
1986	1.88	91.01	297.83	0.63	30.56	872.64	1.07		
1987	2.31	85.17	270.37	0.86	31.50	958.37	1.08		
1988	3.19	96.75	309.52	1.03	31.26	1049.63	1.10		
1989	3.39	89.46	343.97	0.99	26.01	1076.04	1.12		
1990	3.49	92.31	356.94	0.98	25.86	1100.66	1.14	643.08	105.10
1991	4.37	105.75	379.47	1.15	27.87	1185.63	1.15	656.39	108.75
1992	11.16	133.65	422.66	2.64	31.62	1337.50	1.16	666.60	114.23
1993	27.52	165.92	440.50	6.25	37.67	1507.32	1.18	673.54	122.37
1994	33.79	200.87	559.23	6.04	35.92	1685.62	1.19	681.39	119.26
1995	35.85	250.10	728.01	4.92	34.35	1849.15	1.20	687.75	124.85
1996	40.18	289.24	856.09	4.69	33.79	2012.86	1.22	695.30	126.08
1997	44.24	313.22	952.65	4.64	32.88	2177.65	1.23	702.37	108.13
1998	43.75	345.07	1019.46	4.29	33.85	2325.09	1.24	708.82	106.04
1999	38.75	368.76	1083.28	3.58	34.04	2480.23	1.25	716.43	103.89
2000	38.40	408.83	1198.47	3.20	34.11	2667.47	1.26	724.48	102.02
2001	44.24	456.13	1324.81	3.34	34.43	2867.96	1.27	732.25	101.08
2002	49.31	527.15	1453.83	3.39	36.26	3108.05	1.28	741.52	100.68
2003	47.08	646.25	1640.96	2.87	39.38	3397.63	1.29	749.94	102.54
2004	54.94	786.75	1931.64	2.84	40.73	3718.64	1.30	758.91	106.19
2005	117.21	905.91	2256.90	5.19	40.14	4114.57	1.30	767.14	110.59
2006	124.08	1103.09	2712.95	4.57	40.66	4611.30	1.31	775.31	112.63
2007	160.05	1366.40	3494.06	4.58	39.11	5238.68	1.32	782.45	97.01
2008	175.15	1844.24	4521.83	3.87	40.79	5712.25	1.32	786.79	99.01
2009	114.21	2293.99	4991.26	2.29	45.96	6206.26	1.33	793.88	
2010	185.08	2693.56	5926.61	3.12	45.45	6816.29	1.34	799.83	

Source: Data obtained from World Development Indicators

***** Manufacturing employment obtained from Banister and Cook (2011), and is the year-end total manufacturing employment in China.

3. Data Description and Issues

Our study focuses on one market, which is the USA, and another middle-income supplier, which is Mexico. The main idea is that Chinese competitive pressure occurs through its effect on other producers' prices, namely those of Mexico, and less so through its direct impact on the price index in the developed market, namely the USA. As mentioned in the previous chapter, competition is better identified at the product level and hence we need to provide a clear definition of a 'product'. This section of the thesis will provide more detailed information and stylised facts regarding China and Mexico's export structure in the US market at the product level. As we hypothesise that competition occurs largely through product pricing, we also need to define the unit price of a product. In addition, we report possible problems with the data sources and provide some suggestions to correct these.

3.1 Product Defined

In this paper, a product is defined at the Harmonised System 6 digit (HS6) level using the HS92 [1] system. The Harmonised System (HS) is a standardised system for classifying and coding goods for international comparison purposes that has been developed by the World Customs Organization (WCO). The HS system is used by over 200 countries and accounts for about 98% of total world trade (UN Comtrade). The HS system at the 6 digit level comprises approximately 5300 product descriptions, where the first 2 digits (HS2) represent the chapter in which products are classified, while the first 4 digits represent groupings within that chapter. An example of an HS6 product coded as 610462 is defined as women/girls' trousers shorts, knitted cotton. The first 4 digits (6104) are defined as women/girls' suits and the first 2 digits (61) represent articles of apparel and clothing. The HS6 digit system is the finest level of aggregation that is harmonised across countries.

[1] There have been four HS revision, namely 1992 (HS92), 1996 (HS96), 2002 (HS2002) and 2007 (HS2007), since the HS system was introduced in 1988.

Each country usually has a more disaggregated level of classification domestically, which is then aggregated to the HS6 level to enable it to be used for international comparison purposes. One of the most common issues in comparing products between different countries at a more aggregated level is product heterogeneity, even if the products are classified under a specific code. A finer degree of classification is more likely to capture the different product-specific effects. The finest level of disaggregation for international comparison purposes is at the 6 digit level, and for this reason we define a product at the HS6 digit level. We use the HS6 digit level as our data are obtained from several sources (reporting countries) and because of the possible endogeneity issues[2] involved in our model specification. The international trade data are obtained via Comtrade from the World Integrated Trade Solution (WITS)[3] online database.

3.1.1 Data Source from Import Country

This study will use the disaggregated trade data from the HS92 system at the 6 digit level as reported by the United States with China and Mexico as trading partners. Import data are generally thought to be more consistent, as the USA has a more reliable and efficient method for collecting and recording trade data compared to developing countries such as China and Mexico. Import data is also taken to be more reliable, as we would expect a developed country like the USA to be more vigilant in inspecting and ensuring duty collection on imports. Export data are recorded when products leave the border of the exporting country, hence there might be a timing difference between exporting countries regarding the time products arrive at the border of the market. Import and export data usually do not match, as exports are valued free on board (f.o.b.) while imports are usually reported cost including insurance and freight (c.i.f.). According to a study by Ferrantino et al. (2012), China's reported exports to the USA are smaller than the USA's reported imports from China. The Chinese authorities have reduced the Value Added Tariff (VAT) refund rates for many of their export products since 2003, and Ferrantino et al. (2012) found evidence that a reduction in the VAT

[2] Because of endogeneity in Chinese prices, we need to correct for it using Chinese prices to other markets. This is explained in detail when we proceed to our equation specification in the next chapter.
[3] Available at: http://wits.worldbank.org/wits/

rebate on exports increases the incentive to under-report at the Chinese border to avoid paying VAT.

Mexico and China might have a slightly different system of classifying products at the finer level and this might generate a problem when data are converted to the more aggregated HS6 level, although in practice the system should not vary that much. By taking data from just one reporter (USA), we are more confident that the finer classification of products collected at the domestic level can then be aggregated into the same product category at the HS6 digit level. Another important reason for taking reported data from the USA is the different units of measurement on some products used by different countries. The unit price of an HS6 digit product is simply the value of total imports divided by their quantity. The different units of measurement from different sources affect a product’s unit price, but the USA has a standard unit of measurement for imported products. The USA has trade data available on the HS system starting from 1991, whereas China’s recorded data at the HS level started from 1992. As we will be using China’s reported price as an instrument for analysing its price in the USA and other countries in later chapters, our study will make use of product-level data available using the sample from 1992 to 2008. We stopped at 2008 as this was the latest year available when this research began.

We note when using US reported data, there is also the concern of over-reporting at the US border, as multinationals try to avoid paying higher corporate income tax (Ferrantino and Wang, 2008; Ferrantino et al., 2012; Bernard et al., 2006). This is termed ‘transfer pricing’, which usually happens when two trading firms are controlled by a common authority, also known as a parent firm. However we do not think it is likely to change much through time and hence will go into the fixed effects. As shown in Diewert et al. (2005), only a small portion of trade between China and the USA involves related parties and that it affects Mexico more than China hence enters the residuals. Furthermore the US law tries to control for this problem and hence we do not pursue it in this work.

3.2 Stylised Facts at the Product Level

3.2.1 China's Product Coverage by Heading

Here we will look at the total number of product headings imported by the USA and those from both China and Mexico. Chinese exports to the USA have grown dramatically over the past few decades, in part due to the increased volume and also due to the export of new product headings. We provide some stylised facts on China and Mexico's product coverage in the USA in Table 3.1. In the early 1990s, Mexico exported more products to the USA, but Chinese export headings had already exceeded those of Mexico by 1999. In 1992, China exported about 2794 out of a possible 4993 products imported by the USA, with market coverage of around 56% of the US import basket. By 2006, China was exporting more than 4200 products and its coverage had increased to more than 88% of the total number of products imported by the USA. Mexico, on the other hand, exported about 3470 products to the US market in 2006, about 72% of the total product headings imported by the USA during that year. Mexico's export variety has declined slightly since 2000, while China's increased in every year until 2007. US total import variety also shows quite a substantial drop from 2007. In part, the recorded decline in 2007 might be due to HS conversion problems, which we will discuss in greater detail in a later section.

The common products in Table 3.1 summarise the total number of products that the USA imported from both China and Mexico for the period 1992-2008. The set of common products is the sample for our main focus, investigation of the Chinese price effect at the product level. China's competitive pressure on Mexico is represented by the last column in Table 3.1, which is the ratio of common products to Mexico's total product headings. This measures the 'extent' of the competition, not the 'depth'. In 1992, China competed in about 70% of Mexico's product headings to the US market; by 2008, the Chinese influence covered about 93% of Mexico's product headings, almost all of the product headings that Mexico exported to the USA. As a share of China's exports to the USA, the common products increased from 58% in 1992 to about 73% in the later 1990s and then declined a little.

Table 3.1: US Imports from China and Mexico by Product Heading

Year	US Total Import	From China	Ratio	From Mexico	Ratio	Common	China Influence
	Product Headings	Product Headings	(China/Total)	Product Headings	(Mexico/Total)	Product Headings	(Common/Mexico)
1992	4993	2794	0.56	2888	0.58	2016	0.70
1993	4994	2963	0.59	2990	0.60	2145	0.72
1994	4991	3084	0.62	3112	0.62	2299	0.74
1995	5000	3200	0.64	3394	0.68	2527	0.74
1996	4934	3212	0.65	3479	0.71	2588	0.74
1997	4931	3370	0.68	3522	0.71	2728	0.77
1998	4936	3450	0.70	3519	0.71	2780	0.79
1999	4936	3587	0.73	3552	0.72	2892	0.81
2000	4921	3723	0.76	3538	0.72	2991	0.85
2001	4926	3743	0.76	3475	0.71	2959	0.85
2002	4852	3857	0.79	3452	0.71	3038	0.88
2003	4847	3928	0.81	3427	0.71	3065	0.89
2004	4842	4015	0.83	3456	0.71	3123	0.90
2005	4841	4123	0.85	3484	0.72	3202	0.92
2006	4848	4251	0.88	3469	0.72	3231	0.93
2007	4583	4036	0.88	3346	0.73	3131	0.94
2008	4585	4002	0.87	3340	0.73	3106	0.93
Total	82960	61338		57443		47821	

*Data obtained from Comtrade based on own calculations

It is noted that the product headings are not necessarily similar every year, as some products might exit the market while new products enter in a certain year. In actual competition, we identify Chinese competition on just the common set of products which both countries export to the USA. Chinese competition might lead to exit for certain Mexican firms; hence competition here is not just constrained to survivors. Altogether there are 4907 products which both China and Mexico exported to the USA for our sample period. As trade data is noisy, products can dropped in and out of the export basket due to missing data; we found more than 2800 products Mexico stopped exporting at least once but continued to be exported later. We also identified 538 products which Mexico stopped exporting for 5 or more consecutive years due to Chinese competition. Iacovone et al. (2013) found that Mexican firms which exited the market are the smaller firms which could not keep up with Chinese competition, while larger firms which survived tend to be more productive. Although our sample takes into account the existing products by both countries; the study by Iacovone et al. (2013) shows that Chinese competition affects Mexico's production and hence its pricing.

Besedeš and Prusa (2006) found that differentiated products (i.e. manufactures) tend to have a higher survival rate as compared to products which are homogeneous. As differentiated products involves higher research and investment costs before entering the market, it is usually be undertaken by the larger firms making them more competitive. China's presence is especially felt in manufactured products which usually involves differentiated products. Our study does not take into account of Chinese competition on products where Mexico exited the market; and this might actually underestimate the extent of Chinese competition.

3.2.2 Export Structure by Sector

In order to get a better picture of China's export patterns to the US market, we look at the disaggregated trade data available by sector. We categorise the economy into 15 different sectors by a product's first two digit coding (HS2), which is the standard disaggregation representing the chapter under which products are classified. This is shown in Table 3.2.

Table 3.2: Description of Sector

Sector	HS2	Description
0	01-05	Animals Animal Products
1	06-15	Vegetable Products
2	16-24	Foodstuffs
3	25-27	Mineral Products
4	28-38	Chemicals Allied Industries
5	39-40	Plastics / Rubbers
6	41-43	Raw Hides, Skins, Leather, Furs
7	44-49	Wood and Wood Products
8	50-63	Textiles
9	64-67	Footwear / Headgear
10	68-71	Stone / Glass
11	72-83	Metals
12	84-85	Machinery / Electrical
13	86-89	Transport Equipment
14	90-97	Miscellaneous Manufactured Products

3.2.3 China Coverage by Sector

The total number of product headings as classified by their respective sectors for 1992 and 2008 are shown in Table 3.3. China's influence on Mexico is relatively weaker in the primary sectors like animals, vegetables and mineral products for both 1992 and 2008. China's influence over Mexico predominantly lies in the manufacturing sectors in 2008, where it exports almost everything that Mexico exports, especially in the machinery, textiles, miscellaneous manufactures and footwear sectors. China's influence on Mexico in the machinery sector grew from 78% (1992) to 98% (2008), where it exported 489 out of the possible 497 products that Mexico exported to the USA. In the textiles industry, China's coverage increased from 77% (1992) to 97% (2008). In the plastics, footwear and miscellaneous sectors, China's coverage was 100% of Mexico's exports in 2008. If China's influence is stronger in the manufacturing sectors, we postulate that Chinese competition occurs largely through the price channel at the product level.

Table 3.3: Import Headings from China and Mexico - Coverage by Sector

	1992				2008			
Sector	China	Mexico	Common	China Influence	China	Mexico	Common	China Influence
	Product Headings			(Common/Mexico)	Product Headings			(Common/Mexico)
Animals (0)	56	62	34	0.55	72	76	41	0.54
Vegetables (1)	119	139	64	0.46	188	179	129	0.72
Foodstuffs (2)	83	88	61	0.69	113	114	88	0.77
Minerals (3)	46	80	26	0.33	79	70	50	0.71
Chemicals (4)	302	338	171	0.51	534	357	338	0.95
Plastics (5)	70	112	62	0.55	183	166	166	1.00
LF (6)	30	31	21	0.68	43	37	36	0.97
Wood (7)	83	101	65	0.64	166	147	136	0.93
Textiles (8)	497	409	315	0.77	675	532	518	0.97
Footwear (9)	36	25	25	1.00	43	40	40	1.00
Stone (10)	58	69	52	0.75	121	103	99	0.96
Metals (11)	226	273	159	0.58	456	396	378	0.95
Machinery (12)	358	372	290	0.78	590	497	489	0.98
Transport (13)	24	40	18	0.45	83	79	67	0.85
Misc (14)	120	100	86	0.86	257	218	217	1.00
Total	2108	2239	1449		3603	3011	2792	

*Data obtained from Comtrade based on own calculations

3.2.4 China's Exports to the USA by Sector

China exports many of the products in the manufacturing sectors, and we now look at its trade volume in the USA. China and Mexico's exports to the USA at the product level are summarised for each sector for 1992 and 2008 in Table 3.4. China's export volumes to the US market by sector for 1992 and 2008 are shown in Columns 1 and 2 respectively. In 1992, China's biggest export sectors to the US market were the textiles, miscellaneous industry, machinery and footwear sectors, with a combined export value of more than USD 20 billion, comprising about 75% of China's exports to the USA for that year.

Table 3.4: China and Mexico, Export Structure to the USA

	(1)	(2)	(3)	(3)
Sector	1992	2008	1992	2008
	From China (USD Billions)	From China (USD Billions)	From Mexico (USD Billions)	From Mexico (USD Billions)
Animals (0)	0.53	2.2	0.58	0.98
Vegetables (1)	0.15	1.14	1.74	6.16
Foodstuffs (2)	0.17	2.66	0.61	5.36
Minerals (3)	0.66	3.01	5.23	43.1
Chemicals (4)	0.55	10.2	0.77	2.77
Plastics (5)	0.89	13.5	0.47	4.09
LF (6)	1.68	8.01	0.15	0.16
Wood (7)	0.42	8.15	0.51	1.49
Textiles (8)	5.72	33.2	1.49	5.6
Footwear (9)	4.31	18.1	0.26	0.3
Stone (10)	0.51	7.74	0.75	5.34
Metals (11)	0.91	25.9	1.35	9.68
Machinery (12)	4.67	150	12.8	78.7
Transport (13)	0.23	7.61	5.22	32.9
Misc (14)	5.65	60.7	2.44	13.8
Total	27.06	352.12	34.36	210.43

*Data obtained from Comtrade based on own calculations

By 2008, the machinery/electronics sector had clearly become the largest industry for Chinese exports. Chinese exports in machinery/electronics to the USA were only around USD 4.67 billion in 1992, but exports in this sector had increased tremendously to USD 150 billion by 2008, the machinery/electronics sector alone making up 43% of China's total exports to the US market. The miscellaneous and textiles industries are the next two largest industries for China to the USA in 2008, with export values of USD 61 billion and USD 33 billion respectively. The share of the textile industry in China's total exports declined to just 9% in 2008, as China's exports are now more concentrated in the electronics and machinery sectors. Chinese exports seem to have evolved over time from the more labour-intensive manufacturing industry to the more sophisticated electronic/machinery products. The primary sectors made up only a very small proportion of China's exports to the USA during the entire period from 1992 to 2008.

Mexico's total exports to the USA are shown in Columns 3 and 4 of Table 3.4. Mexico's biggest export industry is also the machinery/electrical industry and this sector comprises about 37% of Mexico's total exports to the USA in 2008. Mexico exported about USD 12.8 billion worth of machinery/electronics in 1992, increasing to USD 78.7 billion by 2008. The mineral product industry is Mexico's second largest export sector, with exports of USD 43.1 billion, making up 20% of its exports, in 2008. Transport equipment is Mexico's third largest export sector; it exported about USD 32.9 billion worth of this product (16%) to the USA in 2008. Transport and mineral products are important industries in Mexico, as shown in Table 3.4; however, they only constituted a very small proportion of China's total exports for 1992 and 2008.

3.2.5 China's Dominance in the US market

We have shown that the Chinese influence is stronger for manufactures and that China's export structure to the USA has evolved into more sophisticated manufactures like machinery/electronics. We now examine China's importance in the US market as represented by its market shares. This will help us identify those sectors in which China's influence is strongest or otherwise. The figures in Table 3.5 show the relative size of each export sector as represented by its share in US total imports. The sector share is calculated using US imports from China relative to US total imports at the sectoral level, using Equation (3.1)

$$s_k = x_k^{US\ Import\ from\ China} \Big/ x_k^{US\ Total\ Import} \qquad (3.1)$$

Where s_k is China's sectoral share in the USA, $x_k^{US\ Import\ from\ China}$ is US imports from China in sector k and $x_k^{US\ Total\ Import}$ is the USA's total imports from the world in sector k. As shown in Table 3.5, China's presence is bigger for the machinery/electrical sector, which has a 0.29 share of US total imports in 2008. It is astonishing that the USA imported about 75% of its footwear from China in 2008. The other sectors in which China had a big market share in the USA in 2008 are leather and furs (0.68) and miscellaneous manufactures (0.40). The machinery/electronics sector is the USA's largest import sector with total imports of USD 512 billion in 2008, where China has a 0.29 share (USD 150 billion). China also has a incredible 0.40 share in the miscellaneous products sectors. The figures in Table 3.5 show the reliance of the US market on consumer products imported from China, which is assumed to be relatively cheaper. US total imports increased fourfold for the period 1992 to 2008, but US total imports from China increased by about 13 times during the same period. Chinese import share was insignificant for the primary sectors like animals and vegetable products over the entire period 1992-2008. Chinese export shares increased for almost all sectors in the US market over the period 1992-2008, although China was very insignificant in the primary sector. China's influence in the USA has thus grown significantly, especially in the manufacturing sector.

We also calculated the share of each sector relative to China's shares in the USA's total imports, as in Table 3.5; this method is quite similar to measuring the Revealed Comparative Advantage (RCA) for each sector. China's market share was only around 5% of US total imports in 1992, but had increased to about 17% in 2008. Although this index is rather sketchy, very loosely speaking a value greater than 1 indicates that China's share in that particular is more than its overall market share in the USA. Thus an index greater than 1 would suggest that China has a comparative advantage in that sector. The results shown in Table 3.5 indicate that China's advantage lies in the manufacturing sectors, where footwear/clothing, machinery, textiles, miscellaneous and leathers/furs all have a value greater than 1. The results also indicate that China does not have an advantage in the primary sectors like vegetables, animals, minerals and transport.

Table 3.5: China's Market Share in US Total Imports

	1992				2008			
Sector	US Total Imports	US Import China	Sector Share	Sector Share/Total Trade	US Total Imports	US Import China	Sector Share	Sector Share/Total Trade
	USD Billions	USD Billions	Proportion	Index	USD Billions	USD Billions	Proportion	Index
Animals (0)	9.8	0.53	0.05	1.07	21.5	2.2	0.10	0.61
Vegetables (1)	9.94	0.15	0.02	0.30	35.1	1.14	0.03	0.19
Foodstuffs (2)	13.8	0.17	0.01	0.24	45.1	2.66	0.06	0.35
Minerals (3)	61.8	0.66	0.01	0.21	511	3.01	0.01	0.04
Chemicals (4)	27.4	0.55	0.02	0.40	162	10.2	0.06	0.38
Plastics (5)	14.2	0.89	0.06	1.24	59.4	13.5	0.23	1.36
LF (6)	5.78	1.68	0.29	5.77	11.8	8.01	0.68	4.05
Wood (7)	19.9	0.42	0.02	0.42	44.9	8.15	0.18	1.08
Textiles (8)	38.6	5.72	0.15	2.94	101	33.2	0.33	1.96
Footwear (9)	12.3	4.31	0.35	6.95	24.2	18.1	0.75	4.46
Stone (10)	18	0.51	0.03	0.56	66.4	7.74	0.12	0.70
Metals (11)	27.9	0.91	0.03	0.65	129	25.9	0.20	1.20
Machinery (12)	148	4.67	0.03	0.63	512	150	0.29	1.75
Transport (13)	87	0.23	0.00	0.05	224	7.61	0.03	0.20
Misc (14)	42.2	5.65	0.13	2.66	153	60.7	0.40	2.37
Total	536.62	27.05	0.05		2100.4	352.12	0.17	

*Data obtained from Comtrade based on own calculations

Although Mexico is also a major exporter to the USA, its dominance pales in comparison to China. Following Equation (3.1), we calculated Mexico's market share in the US market for each individual sector; the results are tabulated in Table 3.6. In 1992, Mexico had a 0.18 share in the vegetable products sector, followed by the machinery/electronics sector (0.09) and mineral products (0.08). By 2008, Mexico still had a large share in primary sectors like vegetable products and foodstuffs, with a market share of 0.18 and 0.12 respectively. The manufacturing sector has also gained importance in the US market, especially machinery (0.15), transport equipment (0.15) and miscellaneous products (0.09). China and Mexico accounted for a combined 44% (machinery) and 49% (miscellaneous products) share of US total imports in 2008.

Loosely speaking, if we take results for the sector share relative to Mexico's share of total trade as a rough indicator of comparative advantage, Mexico's comparative advantage is also in the machinery/electronics sector, as well as in vegetables, foodstuffs and transportation equipment. Mexico, however, does not have an advantage in soft manufactures like textiles, plastics and miscellaneous manufactures.

Table 3.6: Mexico's Market Share in US Total Imports

	1992				2008			
Sector	US Total Imports	US Import Mexico	Share	Sector Share/Total Trade	US Total Imports	US Import Mexico	Share	Sector Share/Total Trade
	USD Billions	USD Billions	Proportion	Index	USD Billions	USD Billions	Proportion	Index
Animals (0)	9.8	0.58	0.06	0.94	21.5	0.98	0.05	0.50
Vegetables (1)	9.94	1.74	0.18	2.81	35.1	6.16	0.18	1.80
Foodstuffs (2)	13.8	0.61	0.04	0.62	45.1	5.36	0.12	1.20
Minerals (3)	61.8	5.23	0.08	1.25	511	43.1	0.08	0.80
Chemicals (4)	27.4	0.77	0.03	0.47	162	2.77	0.02	0.20
Plastics (5)	14.2	0.47	0.03	0.47	59.4	4.09	0.07	0.70
LF (6)	5.78	0.15	0.03	0.47	11.8	0.16	0.01	0.10
Wood (7)	19.9	0.51	0.03	0.47	44.9	1.49	0.03	0.30
Textiles (8)	38.6	1.49	0.04	0.62	101	5.6	0.06	0.60
Footwear (9)	12.3	0.26	0.02	0.31	24.2	0.3	0.01	0.10
Stone (10)	18	0.75	0.04	0.62	66.4	5.34	0.08	0.80
Metals (11)	27.9	1.35	0.05	0.78	129	9.68	0.08	0.80
Machinery (12)	148	12.8	0.09	1.41	512	78.7	0.15	1.50
Transport (13)	87	5.22	0.06	0.94	224	32.9	0.15	1.50
Misc (14)	42.2	2.44	0.06	0.94	153	13.8	0.09	0.90
Total	536.62	34.37	0.06		2100.4	210.43	0.10	

*Data obtained from UN Comtrade and tabulated using own calculations

3.2.6 Classification of Important Products by Their Market Share in the USA

In the previous sub-section we looked at the relative importance of each sector for China in the USA. Here, we identify the top ten US imports from China (by export volume) and their calculated product shares. Table 3.7 shows the top ten US imports from China for 2008. The product share for each and every product is calculated using Equation (3.2) and ranked accordingly, and the top 10 product headings are shown in Table 3.7.

$$s_{it} = \left[x_{it}^{US\ Import\ China} \Big/ x_{it}^{US\ Import\ World} \right] \qquad (3.2)$$

where $x_{it}^{US\ Import\ China}$ is total US imports from China and $x_{it}^{US\ Import\ World}$ is total US imports globally.

Table 3.7: US top 10 Imports from China (2008)

Rank	Product Description	Value (USD Billions)	Product	Product share (Imports from China/Total USA Imports)
1	Digital computers with CPU and input-output units	20.24	847120	0.69
2	Transmit-receive apparatus for radio, TV, etc.	12.39	852520	0.38
3	Colour television receivers/monitors/projectors	11.84	852810	0.35
4	Toys	9.62	950390	0.88
5	Parts and accessories of data processing equipment	9.09	847330	0.49
6	Video games used with a television receiver	8.37	950410	0.98
7	Computer input or output units	6.96	847192	0.75
8	Telephonic or telegraphic switching apparatus	6.87	851730	0.39
9	Footwear, sole rubber, plastics uppers of leather	5.39	640399	0.71
10	Printing machinery	4.73	844350	0.56

* Data obtained from UN Comtrade and tabulated using own calculations

The USA's top imports from China at the HS6 product level are digital computers, with an import value of USD 20.24 billion and a Chinese market share of 0.69. The USA also imported about 88% of its toys and 98% of videos games used with a television receiver from China. In 1992, the USA's top imports from China were mainly in the footwear and soft manufactures sectors. The top ten US imports from China for 1992 are shown in Appendix 3.1.

We have sought to classify products as we assume that Chinese competition varies by product heading. We might expect a stronger pressure for products in which China has a strong market presence. The market share for each product (HS6) is calculated using Equation (3.2), which is the ratio of US imports from China relative to its total imports of the product. We classify products into four different groups according to their market share in the US market. The four groups are defined by product headings, which have market share (s) represented by s<0.1, 0.1≤s<0.2, 0.2≤s<0.5 and s≥0.5 respectively. In Table 3.8, we classify products by market share according to the four different groups.

Table 3.8: Classification of US Imports from China by Product Share

	Product Headings								
	Total	s<0.10	% of Total	0.1≤s<0.2	% of Total	0.2≤s<0.5	% of Total	s≥0.5	% of Total
1992	2794	2077	74.34	282	10.09	315	11.27	120	4.29
1993	2963	2162	72.97	312	10.53	331	11.17	158	5.33
1994	3084	2244	72.76	327	10.60	349	11.32	164	5.32
1995	3200	2342	73.19	311	9.72	382	11.94	165	5.16
1996	3212	2320	72.23	321	9.99	378	11.77	193	6.01
1997	3370	2382	70.68	355	10.53	433	12.85	200	5.93
1998	3450	2421	70.17	369	10.70	441	12.78	219	6.35
1999	3587	2470	68.86	402	11.21	460	12.82	255	7.11
2000	3723	2537	68.14	421	11.31	501	13.46	264	7.09
2001	3743	2473	66.07	466	12.45	504	13.47	300	8.01
2002	3857	2443	63.34	492	12.76	568	14.73	354	9.18
2003	3928	2377	60.51	507	12.91	627	15.96	417	10.62
2004	4015	2325	57.91	535	13.33	696	17.33	459	11.43
2005	4123	2178	52.83	601	14.58	839	20.35	505	12.25
2006	4251	2132	50.15	619	14.56	899	21.15	601	14.14
2007	4036	1917	47.50	626	15.51	898	22.25	595	14.74
2008	4002	1808	45.18	595	14.87	941	23.51	658	16.44

* s represents the Chinese share in total US imports
* Data obtained from UN Comtrade and tabulated using own calculations

In 1992, the USA imported a total of 2794 product headings from China, of which 74% of had a market share of less than 10%. By 2008, China's total number of product headings in the USA had increased to 4002, out of which 1808 (45%) products had less than 10% of US market share. In other words, 55% of the Chinese products in the USA had a more than 10% share in 2008. The number of products with shares in the range of 0.1≤s<0.2 increased from 10% in 1992 to about 15% in 2008. There were only about 4% of Chinese product headings with more than 50% of US market share in 1992, but by 2008 the percentage had gone up to 16%. All these figures suggest the growing importance of Chinese exports to the US market.

We further split the lower band (those products with less than 10% US market share) into three different categories to better understand those products in which China has a weak market share. The lower-band groups are defined by products that have market share (s) represented by s<0.01, 0.01≤s<0.05 and 0.05≤s<0.1. In 1992, about 40% of those products in the lower band had a less than 1% share in the US market, but by 2008 only 16% of China's products had a less than 1% share in the USA. The exact figures and percentages for each lower-band category are shown in Appendix 3.2.

Similarly, we also tabulated Mexico's exports according to their market share in the US market; the results are shown in Table 3.9. In 1992, 77% of Mexico's product headings had less than 10% of US market share and by 2008 there were still 73% of Mexico's products with less than 10% of US market share. In 1992, about 9.6% of Mexico's products had shares in the range of 0.1<s<0.2 and this percentage had increased slightly to 11.4% in 2008. Only 4% of Mexico's products had a more than 50% share in the US market and this stayed the same from 1992-2008. The proportion of Mexico's products with a significant share in the US market looks to have remained quite similar over time, whereas there is a greater ratio of Chinese products that have gained share rapidly

Table 3.9: Mexico's Exports to USA by Product Share

Year	Product Headings								
	Total	s<0.10	% of Total	0.1<s<0.2	% of Total	0.2<s<0.5	% of Total	s>0.5	% of Total
1992	2889	2226	77.05	278	9.62	265	9.17	119	4.12
1993	2991	2298	76.83	304	10.16	273	9.13	115	3.84
1994	3113	2396	76.97	308	9.89	285	9.16	123	3.95
1995	3395	2589	76.26	352	10.37	302	8.90	151	4.45
1996	3480	2576	74.02	384	11.03	364	10.46	155	4.45
1997	3523	2574	73.06	395	11.21	384	10.90	169	4.80
1998	3520	2558	72.67	404	11.48	389	11.05	168	4.77
1999	3553	2590	72.90	388	10.92	404	11.37	170	4.78
2000	3539	2529	71.46	413	11.67	432	12.21	164	4.63
2001	3476	2472	71.12	426	12.26	408	11.74	169	4.86
2002	3453	2494	72.23	397	11.50	416	12.05	145	4.20
2003	3428	2494	72.75	414	12.08	379	11.06	140	4.08
2004	3457	2521	72.92	406	11.74	384	11.11	145	4.19
2005	3485	2552	73.23	396	11.36	392	11.25	144	4.13
2006	3470	2532	72.97	391	11.27	401	11.56	145	4.18
2007	3347	2449	73.17	375	11.20	389	11.62	133	3.97
2008	3341	2429	72.70	382	11.43	394	11.79	135	4.04

*Data obtained from UN Comtrade and tabulated using own calculations

3.2.7 Export Similarity Index between China and Mexico in the USA

The Export Similarity Index (ESI) is a method used to compare the trade structure between two countries to find the distinctive patterns of different products in the total exports of a country (Finger and Kreinin, 1979). The formula used to calculate the ESI can be calculated using Equation (3.3):

$$ESI = \sum_{i=1}^{n} min\left({x_i^{C,K}}/{X^{C,K}}, {x_i^{M,K}}/{X^{M,K}} \right) * 100 \qquad (3.3)$$

where ${x_i^{C,K}}/{X^{C,K}}$ is the share of product *i* in country C's total exports to market K, and ${x_i^{M,K}}/{X^{M,K}}$ is the share of product *i* in country M's total exports to market K. The ESI will take a value of 0 if there is no similarity in products between the two countries and a value of 1 if there is complete similarity. One of the disadvantages is that the index will vary according to the level of disaggregation used, the index falling as the data is more finely disaggregated. We will be using data at the HS6 digit level and we will compare the ESI between China and Mexico for the period 1992-2008. For comparison purposes, we will also use Brazil and Canada as case studies. If the index rises over time, this indicates a greater degree of similarity between the two countries in the third market.

The ESI between China and the other countries is tabulated in Table 3.10. Not surprisingly, the ESI is highest between China and Mexico, as compared to Canada and Brazil. The ESI between China and Mexico has shown an upward trend since 1992, which indicates a rising similarity between the products of the two countries. The ESI between China and Brazil has increased just slightly since 2000, but is still relatively smaller than Mexico. The degree of similarity between China and Canada was very low in 1992, but the ESI has increased over the years. Japan is a developed country producing sophisticated products; China's similarity index with Japan seems to have risen considerably over the sample period. China and Mexico are both middle income countries and their export structures to the USA are mostly concentrated in manufactured products.

Table 3.10: Export Similarity Index between China and Other Countries

	ESI			
Year	Mexico	Brazil	Canada	Japan
1992	19.45	15.15	9.83	13.39
1993	18.93	15.36	9.42	14.68
1994	20.04	14.97	10.82	16.40
1995	21.32	14.43	12.34	19.11
1996	22.30	14.42	12.74	19.92
1997	23.79	13.56	13.12	20.82
1998	25.32	14.27	14.12	22.32
1999	25.82	14.35	14.47	23.83
2000	26.36	16.03	15.42	25.54
2001	26.10	16.72	15.42	23.36
2002	26.91	17.32	15.18	24.25
2003	25.69	17.54	14.88	23.53
2004	25.98	17.31	15.52	24.36
2005	28.24	18.49	16.17	25.00
2006	28.30	17.42	16.73	24.07
2007	28.93	16.32	16.90	22.81
2008	29.59	13.08	15.86	23.42

*Data obtained from UN Comtrade and tabulated using own calculations

This is an indication of China's industrialisation and fast growth in keeping up with developed countries. Rodrik (2006) and Schott (2008) showed that China's exports are relatively sophisticated, considering that it has a low GNP per capita and that Chinese products are also relatively cheaper. Schott (2008) found that China has a huge trade overlap with the OECD, but that the premium people are willing to pay for OECD products is a substantial one. The quality difference would make it hard to compare the same products between the two regions.

3.3 Summary of Trade Data

China's competitive pressure on Mexico's products has increased over the years as the total number of product headings that China exported to the USA has increased. As China grows, the set of common products with Mexico also expands. The more the common set of products that both countries export to the USA increases, the larger the influence that China has on Mexico. The trade overlap between these countries has increased over time; in 1992 China exported about 70% of the total product headings that Mexico exported to the USA, and this increased to about 93% by 2008. China's influence is even stronger in the manufactures sector; in 2008 China exported every product heading (100%) in the miscellaneous products and footwear sectors that Mexico exported. The machinery/electronics sector is the biggest export sector for both countries, where China's influence covers 98% of what Mexico also exported to the USA. In terms of trade volume, common products constitute about 96% of Mexico's total exports to the USA.

Although China exported many of the product headings, we would expect less influence where it occupies a smaller share in the market. However, China is a huge exporter and many of its products have a big share in the US market. Thus, we assume that China's wide product coverage together with its huge share in the market will have a competitive effect on Mexico. China's comparative advantage lies mainly in the manufacturing sector, where it has evolved from soft manufactures to more sophisticated ones over time. Our study is based on this idea of price competition between countries at the disaggregated product level, where products are identified at the HS6 digit level. Although at the HS6 level products are still not as finely categorised as they should be, it is the most detailed description available for international comparison purposes.

3.4 Data Issues

3.4.1 The Problem of HS Revision

The HS system started in 1988 and is revised every four to six years; amendments were introduced in 1992 (HS92), 1996 (HS96), 2002 (HS2002) and 2007 (HS2007). The 'native' HS92, HS96, HS02 and HS07 classification involves only products that are recorded in the periods 1992-1995, 1996-2001, 2002-2006 and 2007-2008 respectively. Table 3.11 shows the different types of data sources from the various HS systems and their conversion to the earlier HS system. The HS92 classification data can only be found for the period 1992-1995, while those exports from 1996 onwards are collected on the new system, namely the HS96, HS02 and HS07 classifications, which are then converted back to HS92 by UN Comtrade. All conversions from later HS versions to earlier HS versions are done using direct conversion, which involves, for example, comparing the HS2007 code directly with the HS92 code. The direct conversion method is more accurate as compared to cascading conversion, which uses the relationships between two subsequent versions of the HS[4] (United Nations Statistics Division: United Nations Department of Economic and Social Affairs, 2009).

As shown in Table 3.11, the number of product headings that China exported to the USA at the HS 6 digit level has increased since 1992, but there seemed to be a slight drop from 2007 onwards. We also found that the total number of product headings imported by the USA (from the world) dropped in 2007. One possible reason for the sudden drop in export headings could be the conversion from the HS07 system to HS92 system. There exists a potential problem with reclassification, because there might not be an exact match between every product from the different HS systems. Before we proceed to the dynamics of China's exports at the product level, therefore, we discuss the problems of HS revision.

Table 3.11: China's Export Headings to the USA (Various HS Revisions)

Year	HS 92	HS 96	HS 02	HS 07
1992	2,794 (native)			
1993	2,963 (native)			
1994	3,084 (native)			
1995	3,200 (native)			
1996	3,212 (Converted from HS96)	3,279 (native)		
1997	3,370 (Converted from HS96)	3,444 (native)		
1998	3,450 (Converted from HS96)	3,528 (native)		
1999	3,587 (Converted from HS96)	3,656 (native)		
2000	3,723 (Converted from HS96)	3,818 (native)		
2001	3,743 (Converted from HS96)	3,835 (native)		
2002	3,857 (Converted from HS02)	3,943 (Converted from HS02)	4,038 (native)	
2003	3,928 (Converted from HS02)	4,021 (Converted from HS02)	4,122 (native)	
2004	4,015 (Converted from HS02)	4,117 (Converted from HS02)	4,220 (native)	
2005	4,123 (Converted from HS02)	4,231 (Converted from HS02)	4,333 (native)	
2006	4,251 (Converted from HS02)	4,364 (Converted from HS02)	4,466 (native)	
2007	4,036 (Converted from HS07)	4,124 (Converted from HS07)	4,225 (Converted from HS07)	4,325 (native)
2008	4,002 (Converted from HS07)	4,091 (Converted from HS07)	4,191 (Converted from HS07)	4,286 (native)

*Data obtained from UN Comtrade and tabulated using own calculations

The change in HS classification poses a problem for our study if we are interested in how the variation in Chinese prices affects the variation in Mexico's price at the product

[4] Cascading conversion from HS07 to HS92, (HS07 →HS02 → HS96 → HS92).

level over the period 1992-2008. We are worried that a dropped product might be a ‘disguised’ one, as it might simply have been assigned a different code during conversion. Suppose that China exported ‘meat of reptiles’ in 2007 (HS07 system), but that the relevant authorities assigned it a different code during conversion from HS07 to HS92, say to ‘other frozen meats’. Although it is recorded that China no longer exported ‘meat of reptiles’ in 1996 (HS07 system), this could be misleading, as reptile meat could merely be mapped back to ‘other frozen meats’ in HS92.

It is possible to do a conversion from a later HS system to an earlier HS system, but not the other way round; thus, not all product headings exported in 1992-1996 will appear in the HS96, HS02 and HS07 systems. Thus, in order to increase the number of observations in the sample, our study involves using the data reported by the USA at the HS92 6 digit level of aggregation. We are using the readily converted HS92 revision available from UN Comtrade in the WITS system, where the conversions have been developed by the United Nations Statistics Division (UNSD). UNSD provides both correlation and conversion tables between the different HS systems for inference purposes. Before the actual conversion, UNSD refers to the relationship between product codes in the different HS systems through the correlation tables; a product code in a newer HS system (e.g. HS07) might be correlated with more than one product code from an earlier HS system (e.g. HS92). The correlation tables as provided by UNSD provide four possible types of relationship between a product code at the current HS system and its previous HS system, from HS07 to HS92, namely (1) 1:1 relationship, (2) n:1 relationship, (3) 1:n relationship and (4) n:n relationship. The conversion tables as provided by UNSD then assign a product code in the newer HS to one and only subheading of the earlier HS version; UNSD does the conversions using either the Quantitative Method or the Retained Code Method.

UNSD will assign a product code in the HS07 to one and only subheading of the earlier HS version. In Table 3.12, we provide some examples of a conversion from HS07 to HS92 using both the conversion and correlation tables. The correlation table shows that the product 051199 (HS07) has three correlates in the HS92 system; however, it cannot be assigned to all three subheadings during the conversion, but only to the subheading 051199 (HS92). A similar explanation follows for product 071190 (HS07), which has many correlates (HS92); it will be assigned to one and only one subheading in the HS92.

Table 3.12: Conversion and Correlation Tables

Conversion Table	Correlation Table		
Assigned Code (HS07 →HS92)	HS07	Relationship	HS92
840710→840710	840710	1:1	840710
190490→190490	190490	n:1	190490
190430→190490	190430	n:1	190490
051199→051199	051199	1:n	050300
		1:n	050900
		1:n	051199
071190→071190	071190	n:n	071110
	071190	n:n	071130
	071190	n:n	'ex'071190

*'ex' means that the product code in the HS92 is correlated with another code in the native HS system (HS07)

For products with a 1:1 relationship, an HS07 product code is correlated with one and only one product code in the HS92 system. For products with an n:1 relationship, several product codes in the HS07 are correlated with just one product code in the HS92. Under a 1:n relationship, a product code in the HS07 system is correlated with several product codes in the HS92 system. Finally, for products with an n:n relationship, several product codes in the HS07 are correlated with several product codes in the current system, HS92.

For all 1:1 and n:1 relationships, there is no problem matching the codes from the different HS systems, as a product code (HS07) is not split up; that is, it has only one correlate in the HS92 system. As shown in Table 3.12, product 840710 (HS07) has only one correlate in the HS92 and hence is assigned the same code, 840710 (HS92). In another example, both products 190490 (HS07) and 193430 (HS07) have just one correlate in the HS92 system and hence both products are assigned product code 190490 (HS92) during the conversion. A product code in the current HS system (HS07) can be converted into one and only one subheading of the earlier HS version, meaning that it cannot be split. However, two product codes in the HS07 can be incorporated under the same product code (HS92) during the conversion. As has been said, UNSD does the conversions using either the Quantitative Method or the Retained Code Method; however, the final decision is taken by comparing product descriptions. Appendix 3.3, taken from a UNSD document, provides a more detailed example of how the conversion from HS07 to HS92 is conducted by using the Quantitative Method and the Retained Code Method (Statistics Division: United Nations Department of Economic and Social Affairs, 2009).

Although there have been several HS revisions since the HS92 version, there seemed to be an apparent concordance issue for the HS07 version, since US total import headings from China started to drop after 2006. The USA imported a total of 4848 product headings in 2006, but these dropped to 4583 headings in 2007, a fall of 265 product headings imported. We need to investigate whether a product in the HS92 system was actually dropped or was contained in a different product code during the conversion. To do this, we compare product headings in the HS92 classification for the years 2006 and 2007 to get a better understanding of whether products were actually dropped. As shown in Table 3.13, China's export headings to the USA totalled 4252 in 2006 and 4037 in 2007, a net reduction of 215 product headings. In the HS92 revision, there are a total of 382 product headings that China exported in 2006 but no longer exported in 2007, which we term 'dropped' products. There are also 167 products emerging in 2007, which we call 'new' products.

Table 3.13: New and Dropped Products between 2006 and 2007 (HS92)

Under HS92 System	Product Headings
New Products in 2007	167
Dropped Products in 2007	382
Product Headings Exported in both 2006 and 2007	3869
Total Headings in 2007	4036

We need to classify those new and dropped product headings into four main classifications, namely 1:1, 1:n, n:1 and n:n, to check whether the headings have been dropped or have just undergone an HS revision and hence are contained in another heading. We first provide a breakdown of the new and dropped products, in Table 3.14.

Table 3.14: Breakdown of New and Dropped Products (HS92)

Relationship	1:1	1:n	n:1	n:n	Total
New Products in 2007	134	7	10	20	171
Dropped Products in 2007	126	148	8	101	383
Products Exported in both 2006 and 2007	3020	158	426	522	4126
Total	3280	313	444	643	4680

For those products with a 1:1 classification, there is no change in coding at the HS6 digit level from HS07 to HS92, thus we assume that all 126 product headings that ceased to be recorded in the year 2007 are no longer being exported. Products in the n:1 category do not pose a problem for identifying dropped products, since many product headings in the HS07 are merged into one HS92 heading. If the HS92 coding records zero trade, we know that there is no trade in any of the component HS07 categories. We will need to check for products in the other two categories, namely 1:n and n:n, by matching each dropped product heading with the concordance tables obtained from UNSD.

The example in Table 3.15 provides some indication as to whether these products have actually been dropped or undergone some kind of reclassification. We make use of the product code 050300 (HS92) to better explain our checking process. China exported product 050300 to the USA every year since 1992, but the product was dropped in 2007. We want to check if it might be contained in another subheading under the HS92 system during the conversion. Product code 050300 is one of three correlates for the subheading 051199 (HS07). This product 051199 (HS07) when converted to HS92 is only assigned to the code 051199, using the retained code procedure. Under the HS92 system, product 050300 is no longer used, as trade is added into 051199 in 2007 and hence it is considered a dropped product in 2007 (HS92).

Table 3.15: Dropped Products

HS07	HS92 Correlates	Assigned Code (HS92)
051199	050300 (1:n)	051199
	050900 (1:n)	
	051199 (1:n)	

* 050300 - Horsehair waste, whether or not put up as a layer with/without supporting mat
* 050900 - Natural sponges of animal origin
* 051199 - Animal products not elsewhere specified, dead animals, unfit for human consumption

However, there is no way of being certain whether product 050300 was actually dropped in 2007 or was contained under a different product, 051199. We cannot rule out the dropped products, but we cannot rule them in either. The same rationale applies to products with an n:n relationship, where we cannot be certain whether a product has actually been dropped or is still contained in the export basket under a different product code.

For dropped products with a 1:n relationship, there are 148 product headings in the HS92 system that China apparently stopped exporting to the US market in 2007. Although these headings do not appear in the export basket in 2007, they correlate with 114 product headings in the HS07 system. We found that 102 out of the 114 headings were still exported by China to the US market in 2007 (HS92). For the n:n category, there were 101 dropped product headings in 2007 and these correlate with 220 headings in the HS07 system. In the HS92 system, we managed to find 73 out of these 220 headings that were still in China's export basket to the USA in 2007. For those headings for which correlates can be found in the export basket in 2007 under the HS92, we cannot be certain whether a product has actually been dropped.

There are relatively fewer observations for 'new' products in 2007 under the n:n and 1:n categories; most of these products emerging in 2007 seem genuinely to be new products and not to reflect a change in classification. There are only seven new headings in the 1:n system and we did not find any of their correlates (HS07) appearing in 2006, so we can confirm that these are China's new exports to the USA. For the 20 new headings in the n:n category, we found only 2 headings out of the possible 32 correlates (HS07) appearing in China's exports to the US market in 2006.

The concordances as prepared by Comtrade are only approximate, however, so we repeated some of our estimates on a sample of 'clean' products that have had only unambiguous 'one heading to one heading' conversions (1:1) in all three of the classification changes since 1992. This is to be certain that the sample set contains products that have not undergone any HS revision changes. This is the sample set that falls into the 1:1 category type and has not undergone any HS changes for all three HS revisions. We termed this the clean sample set, and there will not be a classification issue using the product fixed effects for our regression analysis.

3.4.2 Clean and Mixed Products (1992-2008)

The set of ‘mixed’ products refers to the set of ‘clean’ products plus the set of uncertain cases, and it provides us with more observations. However, for a small portion of products the concordances are only approximate, whereas the ‘clean’ sample does not have this problem. The conversion is direct and the set of clean products are those that have a 1:1 relationship, thus have not experienced a change in HS coding during each conversion. The following examples explain the procedure to derive the list of clean products from 1992 until 2008 at the HS6 digit level. The clean products for the periods 1996-2001, 2002-2006 and 2007-2008 are those that have a 1:1 relationship during the conversion from HS96, HS02 and HS07 revisions respectively. Altogether, we managed to find 3664 clean products overall at the HS6 level.

3.4.3 Problems Using the Clean Data Sample

The main advantage of using only the clean set of data is that we can be certain that all the products are distinct for every period by their product code. As shown in Table 3.16, we still keep more than 70% of the total product headings exported by China and Mexico to the USA if we use the clean sample. The main disadvantage of using just the clean set of products is that we lose many observations, about 30% of the product headings.

In terms of trade volume, the loss in data becomes more apparent, as indicated by the ratio of clean to total trade volume in Table 3.17. By looking at exports to the US market for the period 1992-2008, we lose about 50% of the total value of China’s exports to the USA if we use only the sample of clean products.

Table 3.16: Ratio of Clean Products to Total Product Headings (USA)

	China Product Headings		Ratio	Mexico Product Headings		Ratio
Year	Total	Clean	(Clean/Total)	Total	Clean	(Clean/Total)
1992	2795	2044	0.73	2889	2128	0.74
1993	2964	2150	0.73	2991	2197	0.73
1994	3085	2246	0.73	3113	2298	0.74
1995	3201	2320	0.72	3395	2496	0.74
1996	3213	2336	0.73	3480	2577	0.74
1997	3371	2466	0.73	3523	2601	0.74
1998	3451	2518	0.73	3520	2614	0.74
1999	3588	2614	0.73	3553	2635	0.74
2000	3724	2704	0.73	3539	2625	0.74
2001	3744	2728	0.73	3476	2580	0.74
2002	3858	2840	0.74	3453	2579	0.75
2003	3929	2908	0.74	3428	2562	0.75
2004	4016	2971	0.74	3457	2576	0.75
2005	4124	3059	0.74	3485	2607	0.75
2006	4252	3144	0.74	3470	2590	0.75
2007	4037	3152	0.78	3347	2603	0.78
2008	4003	3122	0.78	3341	2589	0.77

* Data obtained from UN Comtrade and tabulated using own calculations

For Mexico, we lose about 30% of total export volume by using the clean sample. It is interesting to do the breakdown between clean and mixed products by sectoral classification (HS 2 digit level). The ratio of clean to total trade value by sector is shown in Appendix 3.4; we found that the classifications tend to change in the manufacturing sectors, which are often the most dynamic and most sensitive. Looking at US imports from China, we will lose a lot of data in the footwear and machinery sectors if we use only the clean sample for the sample period 1992-2008. We will lose about 76% of China's exports in the machinery/electronics sector (the biggest for Chinese exports); about 78% of China's total trade value in the footwear/headgear sector; and about 27% of the information in the miscellaneous sector as well. These are important exports for China and we should not drop them because the costs of making the clean sample the main sample are too high.

Table 3.17: Ratio of Clean Products to Total Trade

	China			Mexico		
Period	Total Value (Billions)	Clean (Billions)	Ratio (Clean/Total)	Total Value (Billions)	Clean (Billions)	Ratio (Clean/Total)
1992	27.1	15.8	0.58	34.4	25.4	0.74
1993	33.4	19.1	0.57	39	29	0.74
1994	41	22.9	0.56	48.4	36.2	0.75
1995	48.1	26.1	0.54	60.2	45.5	0.76
1996	54	28.8	0.53	71.4	53.3	0.75
1997	65.3	34.3	0.53	83.9	62.6	0.75
1998	74.4	38.3	0.51	92.2	66.6	0.72
1999	86.8	45.1	0.52	106	76.6	0.72
2000	106	55.7	0.53	132	93.8	0.71
2001	108	57.5	0.53	127	89.2	0.70
2002	132	69.1	0.52	130	93.7	0.72
2003	161	82.4	0.51	134	97.5	0.73
2004	208	102	0.49	151	108	0.72
2005	257	127	0.49	166	119	0.72
2006	302	150	0.50	193	138	0.72
2007	336	170	0.51	205	141	0.69
2008	352	179	0.51	210	144	0.69

*Data obtained from UN Comtrade and tabulated using own calculations

3.4.4 **Sample Data**

The HS classification problem arises because we are comparing products across different years that were recorded under three revised HS systems, then converted back to HS92 by UNSD. The loss in information is too big when using just the clean set of products, especially so in the manufacturing sectors; thus for majority of this thesis we will use the ‘mixed’ product set as obtained under the HS92 system for further analysis. However, for inference purposes we will also use the set of clean products to compare results between clean and mixed products. Our sample data is unbalanced panel data, as there exist some products that are dropped every year while new products are developed. With two key variables, Mexico and China’s unit prices, we are concerned with how the Chinese price affects Mexico’s price at the product level. By applying product effects, we can control for all possible characteristics of the products in the sample, provided that those characteristics are constant over time. In other words, we have got rid of all time-invariant unobserved heterogeneity between products. It is important that products are classified correctly over time, as our sample consists of many different products with individual product-specific effects.

We seek to identify the Chinese price effect using different samples; that is, the established product sample and also the balanced sample. The established sample can be referred to as the set of products that China exported to the USA continuously for five years or more. The balanced set of products contains the common products that are present for all years; although we lose many observations, it will be interesting to check the Chinese price effect for these samples. These two samples will be discussed in more detail in our next chapter, when we do the regression analysis. Another possible way to solve this HS classification problem is to take the native classification for the different HS systems and pool them together to get a larger sample. Thus, we will be using HS92 data for the period 1992-1996, HS96 data for the period 1996-2001, HS02 data for the period 2002-2006 and HS07 data for the period 2007-2008. The trade-off is that we will have different product effects for each HS revision. This method will involve more changes compared to only using data obtained from the HS92 system and so we do not pursue it in this work.

3.5 Dynamics of China's Exports

In the above section, we investigated and worked through the classification changes. We can now discuss China's export dynamics more confidently. China's dominance in the US market arises not only because its products are cheaper than those of its rivals, but also because of China's size and its export of new varieties, as indicated by its trade volume and the number of product headings exported. Every year there are some new products that China started exporting to the US market, but there are also some products that it stopped exporting to the USA. Table 3.18 shows the total number of products that China started to export to the USA (new products) and also products that China stopped exporting to the USA (dropped products[5]) from 1992 to 2008. There are 444 new products that China exported to the US market in 1993 and 275 products that China exported in 1992 but did not export in 1993. The new products in 1993 totalled USD 82.2 million, while the value of the dropped products in 1992 is USD 64.9 million.

[5] Dropped products are from the previous year.

Table 3.18: China's New and Displaced Products in the USA (Mixed Products)

	New Products		Dropped Products from Previous Year	
Year	Product Headings	Millions (USD)	Product Headings	Millions (USD)
1992	-	-	-	-
1993	444	82.20	275	64.90
1994	399	48.60	278	51.10
1995	419	90.40	303	105.00
1996	352	80.30	340	92.90
1997	423	68.00	265	51.50
1998	349	91.60	269	39.40
1999	383	203.00	246	17.70
2000	375	168.00	239	209.00
2001	275	74.60	255	39.60
2002	342	50.10	228	109.00
2003	277	64.10	206	50.70
2004	275	236.00	188	30.30
2005	274	79.80	166	73.20
2006	259	199.00	131	52.90
2007	167	533.00	382	11,700.00
2008	123	52.40	157	71.50

*Data obtained from UN Comtrade and tabulated using own calculations

Altogether there are 3928 dropped products for the period 1992-2008, which may drop in and out several times. Out of the dropped products, we found 1634 that dropped in and out five times or more during the period. By comparing product headings from one year to another, it can be seen that a product that is classified as new in 2000 might already have been exported a few years before. Similarly, a product that is classified as dropped in 1994 might reappear after a few years. However, these figures do provide us with a rough idea of the dynamics of Chinese exports.

There seem to be an exceptionally high number of products that China stopped exporting to the US market in 2007, the value of which is estimated at around USD 11,700 million. As discussed above, there was an HS revision for 2007 and it could be the different classification that gives rise to the large volume of dropped products. We found that 256 out of the 382 products are those that have undergone HS revision, with a value of around USD 11,600 million, which meant that China's dropped products that are 'clean' are only valued at around USD 100 million. Here we focus solely on products that have undergone HS revision, as we can be sure that the clean products are dropped.

We categorised the dropped products in 2007 into 15 different sectors to pin down the extraordinarily high value for the dropped products in that year. As summarised in Table 3.19, we found that most of the Chinese exports that were dropped in 2007 were in the machinery/electrical and miscellaneous sectors. These two sectors accounted for 95% of the total value of the dropped products. We can think of these sectors as consisting of complicated products in areas where technology changes quite fast.

From our explanation above, some Chinese exports do drop in and out of the basket because they are dynamic and the most dynamic sectors are in manufactured products. We could also look at a longer period to get a better picture of how the export structure has evolved; by comparing the export structure between 1992 and 2008, we identified new and dropped products as shown in Appendix 3.5. In the mixed sample, there are 1435 new products that China exported to the USA in 2008 as compared to 1992, out of which 1129 headings are clean products. For the mixed products, China dropped 227 products in 2008, only 51 product headings of which are in the clean sample. The sectors that are the most dynamic are chemicals, textiles, metals and machinery/electronics.

Table 3.19: China's Dropped Products in 2007 by Sector (Mixed Products)

Sector	Product Headings	Trade Value (USD Millions)
Animals (0)	4	13.7
Vegetables (1)	16	7.07
Foodstuffs (2)	2	0.04
Minerals (3)	5	7.22
Chemicals (4)	43	47
Plastics (5)	2	15.2
LF (6)	9	1.57
Wood (7)	17	298
Textiles (8)	51	78.4
Footwear (9)	6	25.1
Stone (10)	4	0.25
Metals (11)	24	41.3
Machinery (12)	39	4,460.00
Transport (13)	3	28.3
Misc (14)	31	6,590.00
Total	256	11,613.15

*Data obtained from UN Comtrade and tabulated using own calculations

3.6 Conclusion

This chapter provides the motivation for investigating the Chinese price effect in the next chapter. China's extraordinary export growth over the past few decades has been felt in most countries and its influence has been especially strong in the USA. Out of the major exporters to the USA, we find that China and Mexico have had an increasing share since the 1990s; and China is the only country whose import share in the USA is still rising from the early 2000s. The findings also show the importance of the US market to Chinese exporters, as well as the reliance of the USA on Chinese products. We also laid out the problems associated with the HS system when products are converted back to an earlier HS revision. There is the problem that products might not actually be dropped, just incorporated in another code during the conversion. Thus, we cannot rule out disappearance, but we cannot rule it in either. One way to solve the classification issue is to use the set of 'clean' products, as discussed above, but by doing so we lose a lot of data, usually on the more dynamic products. China and Mexico's main exports are mainly in manufactured products, with the machinery/electronics sector being the largest for each country, hence we find a big trade overlap for these products between the two countries. This trade overlap is referred to as the common set of products and we will find the Chinese price effect on Mexico for the common products in the next chapter.

Appendices for Chapter 3

Appendix 3.1: USA Top Ten Imports from China (1992)

Product Description	Value	Product	China Shares	Sector
Footwear, outer soles/uppers of rubber or	1.07	640299	0.74	Footwear
Footwear, sole rubber, plastics uppers of	1.02	640399	0.27	Footwear
Toys	0.92	950390	0.65	Miscellaneous
Pullovers, cardigans etc of material knit	0.81	611090	0.70	Textiles
Dolls representing only human beings	0.57	950210	0.64	Miscellaneous
Stuffed toys - animals or non-human creatures	0.55	950341	0.66	Miscellaneous
Boots, sole rubber or plastic upper leather, nes	0.52	640391	0.30	Footwear
Petroleum oils, oils from bituminous minerals,	0.52	270900	0.01	Minerals
Women, girls blouses shirts, of silk, not knit	0.46	620610	0.76	Textiles
Radio receivers, portable, with sound	0.46	852711	0.31	Machinery

Appendix 3.2: Lower-Bound Classification by Product Share

	Total	Headings		Headings		Headings	
		s<0.01	% of Total	0.01≤s<0.05	% of Total	0.05≤s<0.1	% of Total
1992	2794	1127	0.40	642	0.23	308	0.11
1993	2963	1155	0.39	683	0.23	324	0.11
1994	3084	1200	0.39	721	0.23	323	0.10
1995	3200	1249	0.39	727	0.23	366	0.11
1996	3212	1164	0.36	803	0.25	353	0.11
1997	3370	1182	0.35	808	0.24	392	0.12
1998	3450	1192	0.35	834	0.24	395	0.11
1999	3587	1185	0.33	858	0.24	427	0.12
2000	3723	1155	0.31	921	0.25	461	0.12
2001	3743	1105	0.30	913	0.24	455	0.12
2002	3857	1050	0.27	895	0.23	498	0.13
2003	3928	1006	0.26	869	0.22	502	0.13
2004	4015	957	0.24	878	0.22	490	0.12
2005	4123	863	0.21	818	0.20	497	0.12
2006	4251	798	0.19	814	0.19	520	0.12
2007	4036	712	0.18	706	0.17	499	0.12
2008	4002	653	0.16	679	0.17	476	0.12
Total	61338	17753		13569		7286	

*Data obtained from UN Comtrade and tabulated using own calculations

Appendix 3.3: Conversion from HS07 to HS92

The following example as provided by a UNSD document will offer us a better understanding of how the conversion from HS07 to HS92 was done (Statistics Division: United Nations Department of Economic and Social Affairs, 2009).

		Correlation Table		Conversion Table
	HS07	HS92 (correlates)	Import Shares (92-95)	Assigned Code (HS92)
Example 1	080550	080530	95.67	080530
		ex080590	4.33	
Example 2	070951	'ex'075951		075951
	070959	'ex'070951	98	
		070952	2	079952

*'ex' means that the product code in HS92 is correlated with another code in the native HS system (HS07)

The Quantitative Method assigns an HS07 code to that heading in HS92 that accounted for 75% or more of the total trade of all the possible correlates in HS92. The correlation table shows that the product 080550 (HS07) under the n:n category is correlated with both 080530 (HS92) and 080590 (HS92), but can only be converted to one and only one product heading at the HS92 system. The two correlates, namely 080530 and 080590, accounted for 95.67% and 4.33% shares of total trade for the period 1992 to 1995. Finally, product code 080550 (HS07) is converted to 080530 (HS92), as this product code comprises more than 75% of total trade between the two correlates.

However, there are cases when the Quantitative Method cannot be used, even if the code comprises more than 75% of trade value. This happens when the product code in HS92 is correlated with another code in the native HS system (HS07), represented by the designation 'ex'. An example of when the Quantitative Method is not used is illustrated in Example 2, in which the code 079959 (HS07) is correlated with both 'ex'079951 (HS92) and 079952 (HS92). Product 079951 (HS92) accounted for 98% of total trade between the two correlates, but is not assigned because it is a correlate for its own code 070951 (HS07). As there can only be a unique solution during the conversion, product code 075951 (HS92) is reserved for its own code 075951 (HS07). Note that although a product code in the HS07 system can have many correlates, it can be assigned to one and only one code in the HS92 system under Comtrade conversion methods. There are some cases where the Quantitative Method and the retained code do not apply, as the product description has changed; the UNSD does the final conversion by comparing product descriptions.

Appendix 3.4: Ratio of Clean to Total Trade Value (By Sector)

US Imports from China (1992-2008)

Sector	Total US Imports from China	Clean	Ratio
	USD Billions	USD Billions	Clean/Total
Animals (0)	16.4	7.85	0.48
Vegetables (1)	7.82	4.39	0.56
Foodstuffs (2)	14.1	9.28	0.66
Minerals (3)	19.7	18.6	0.94
Chemicals (4)	50.4	33.8	0.67
Plastics (5)	88.1	68.1	0.77
LF (6)	77.5	76.5	0.99
Wood (7)	53.7	33	0.61
Textiles (8)	228	213	0.93
Footwear (9)	193	43.4	0.22
Stone (10)	59.7	49.1	0.82
Metals (11)	138	102	0.74
Machinery (12)	911	219	0.24
Transport (13)	45.2	33.7	0.75
Misc (14)	492	312	0.63

*Data obtained from UN Comtrade and tabulated using own calculations

Appendix 3.5: Comparing 2008 and 1992 (Longer Run)

	Product Headings		Product Headings	
Sectors	Mixed Products		Clean Products	
	New products in 2008	Dropped products in 2008	New products in 2008	Dropped products in 2008
Animals (0)	28	7	23	4
Vegetables (1)	91	26	76	9
Foodstuffs (2)	39	6	29	5
Minerals (3)	44	5	38	3
Chemicals (4)	286	31	225	12
Plastics (5)	89	1	75	0
LF (6)	10	9	2	0
Wood (7)	71	15	31	1
Textiles (8)	236	29	196	5
Footwear (9)	0	6	0	0
Stone (10)	48	5	37	3
Metals (11)	207	18	144	3
Machinery (12)	199	33	175	4
Transport (13)	37	5	37	2
Misc (14)	50	31	41	0
Total	1435	227	1129	51

*Data obtained from UN Comtrade and tabulated using own calculations

4. Actual Competition

The rapid growth of the Chinese economy, and in particular its exports, since the early 1990s led to suggestions that China partially underpinned the late lamented 'great moderation' and, less charitably, that it has exported deflation globally (Kamin et al., 2004; Feyzioglu and Willard, 2008; Broda and Weinstein, 2010). If these suggestions are true, they do not arise from China's direct impact on the price indices of developed countries, because in 1980 Chinese exports accounted for only about 0.1% of OECD countries' absorption. Although China's exports have increased tremendously, its exports accounted for less than 3% of OECD countries' GDP in 2010.[1] Focusing on the US market, Chinese import penetration of the USA's total consumption was slightly less than 3% in 2010. We postulate that the effect must rely on the competitive pressure that China exerted on other manufacturing producers' prices – its competitive effect.

Previous studies have investigated changes in China's trade share to assess its competitive effect, although generally with little success. Here, we seek to identify price effects directly. We want to find the effects of China's exports on Mexico in the USA through the price channel, as we believe that it is cheaper Chinese prices that have led to its dominance of global merchandise trade. This chapter investigates the effect of changes in China's export prices on Mexico's export prices in the US market. Mexico seems likely to be particularly vulnerable to Chinese competition, as both are middle-income countries exporting labour-intensive products and both are major suppliers to the USA; moreover, despite enjoying preferences under NAFTA, Mexico has been losing market share in the US to China.

As mentioned in the previous chapter, our study uses disaggregated product-level data at the HS6 digit level (HS92), which is obtained from UN Comtrade. There are about 5000 different products classified at the HS6 digit level and there exists heterogeneity across these products; that is, hairclips and laptops are different products. Hence it is important to investigate and study the Chinese competitive effect using product-level

[1] Data obtained from UN Comtrade and tabulated with own calculations.

data, which allows us to evaluate some of this heterogeneity using unit values. However, unit prices are noisy and are subject to measurement errors, therefore we need to identify the outliers in our sample. Our study focuses on the direct Chinese price effect on Mexico by using disaggregated product data at the Harmonised System 6 digit level (HS6), the finest level of product classification commonly used at the international level. Although there exist product classifications defined at a finer level, they are not harmonised internationally. This precludes our using them, as we need data sources from different countries as Instrumental Variables (IV) to correct for endogeneity in Chinese prices in later sections.

Our study is based on the assumption that China can affect Mexico's prices based on the product headings that both countries export to the US market, termed here ‘actual competition’. A simple price model to investigate China’s direct price effect is derived, where our equation specification is closely related to the simple Bertrand model. China’s export profiles seem to be quite similar to Mexico’s and thus there is plenty of scope for price competition between the two countries. Theoretically, it is assumed that the increasing share of China’s exports in the US market is due to the cheaper Chinese products brought about by increasing Chinese productivity, which is exogenous to the behaviour of other markets. In this model, we make use of the final price (tariff-inclusive price) for our main regression, where we want to find how China’s final price affects Mexico’s final price in the USA. Our results show that there is little variation in the tariff schedules for both countries, but this is not considered a major problem, as we are concerned with the use of final prices (tariff-inclusive prices) for our main regression.

Our study is focused on actual competition in this chapter, where countries compete in terms of pricing on their common set of exports to a third country. We then proceed to select the sample data for our study and discuss the problems associated with it. A product is defined at the HS6 digit level and we will use the unit price as an indicator for price changes between countries. We discuss the problems associated with Ordinary Least Squares (OLS) pooled regression and provide the arguments for fixed effects (FE) regression in our panel data to get rid of the individual product-specific effects. The regression results for the different samples in our study are tabulated and analysed. To help correct for the endogeneity in Chinese prices, we introduce the use of Instrumental

Variables (IV). Our results show that the elasticity of Mexico's price with respect to China’s price is around 0.30 to 0.75 for our equation specification; that is, that a 1% reduction in China’s price will induce Mexico to reduce its price by 0.3% to 0.75%.

4.1 Literature Review

4.1.1 Literature on Chinese Competition (Quantity Effects)

There are two main channels according to which Chinese competition can be assessed: quantitative effects and price effects on other countries. There are many studies looking at the effect of Chinese competition in displacing the market shares of other countries (Iranzo and Ma, 2006; Freund and Özden, 2009; Iacovone et al., 2013; Hanson and Robertson, 2010; Greenaway et al., 2008; Mattoo et al., 2012). As our focus is on price, we provide only a quick review of a few of these studies in this section.

Greenaway et al. (2008) found that Chinese exports have displaced the demand for exports from other Asian countries; the displacement effect is stronger for more developed countries as compared to middle-income countries. Using disaggregated data at the HS4 digit level, Hanson and Robertson (2010) found an increasing export overlap between China and developing countries, but only a small effect on the demand for their exports. Freund and Özden (2009) used disaggregated data at the SITC 4 digit level from 1985 to 2004 to measure the changes in Latin American and Caribbean (LAC) exports and Chinese exports in a third market (USA). Their results showed that Mexico is one of the countries that is affected the most by the surge in Chinese exports, especially in manufacturing goods, namely textiles, electronics and electrical appliances, and telecommunications equipment. Freund and Özden acknowledge that using more aggregated data will tend to overstate the Chinese effect, as different products might be classified under the same sector. Iacovone et al. (2013) matched international harmonised trade data with Mexican firm-level data to find Chinese competition on Mexican sales in both Mexico and the USA. Recognising the heterogeneity across firms, they found a negative effect of increasing Chinese market share on both sales in Mexico and on Mexico’s exports in the US market.

Mattoo et al. (2012) used changes in Chinese real exchange rate to investigate exports of other countries exporting to the destination market aggregated at the HS4 digit level. Their results showed that a 10% appreciation of the RMB will on average lead to a 1.5% to 2% increase in the exports of its competitors. There is a higher degree of competition between China and the developing countries, hence the gradual appreciation of the RMB since 1994 has provided a boost for developing countries' exports. The spillover effect from RMB fluctuation can get as high as 6% for countries with a high degree of competition with China.

4.1.2 Literature on Price Competition

The Chinese competitive effect will also affect other producers' prices. Because of heterogeneity across products, studies are usually conducted at the disaggregated product level and the hypothesis is that an increase in China's market share will tend to constrain the price charged by other producers. However, there are surprisingly few studies addressing price competition directly. China is large and its export growth and variety have resulted in a huge increase in the supply of low-priced goods, making products more affordable for everyone, especially lower-income groups. Some of the literature on the price effects of Chinese competition is outlined below.

Kamin et al. (2004) related US sectoral import price indices to China's market shares and found little evidence that the surge in Chinese exports led to a reduction in US prices. They found that Chinese products had a small effect on import prices, but a negligible one on the CPI, presumably due to China's small share in the US consumption basket. Likewise, they did not find any correlation between China's import shares and the US producer price index. In order to look at China's effect on US import prices, they hypothesised that if China's price is lower than others, then an increase in the share of Chinese exports in a particular sector will tend to constrain the import price of that particular sector, which they tested using US-reported data disaggregated by end-use sector. They did not estimate further, but acknowledged that China could have affected the import price even if its shares remained unchanged, especially for homogeneous products. That is, the lower Chinese price could have pushed down other competitors' prices, leading to negligible changes in Chinese import shares, thereby underestimating the impact of Chinese exports on the US import price.

Auer and Fischer (2010) developed an alternative method to establish the causal effect of imports from nine low-income countries on the US price level. They recognised the endogeneity of import supply and included industry labour intensity as an instrument to correct for this issue. They argued that as labour-abundant countries grew, exports would be concentrated mainly in labour-intensive products. Thus, using IV regression, they found that a 1% increase in import penetration of low-income countries (including China) led to a 2%-3% reduction in US relative price in that particular sector.

With a more direct parallel to our own work, Broda and Romalis (2009) reported a strong correlation between finely disaggregated US consumer goods prices and the change in Chinese trade over the period. Their analysis used till-level product data from US retail outlets matched with trade data at the HTSUSA 10 digit level, and so operated at a more disaggregated level than we are able to achieve. However, Broda and Romalis apparently do not separate the direct effect arising from sales of Chinese-produced goods from the competitive effect that we seek. They found that Chinese exports have risen most in non-durable low-quality products consumed mainly by low-income families, and attributed the fact that the inflation level for the poor had been 6 percentage points lower than that for rich households over 1994-2005 in the cheaper Chinese products. They found that cheaper Chinese products benefited poorer households and made goods more affordable for them. A poorer household can now consume similarly coded but not identical products that are around 20% cheaper than the premium paid by the rich households.

Broda and Weinstein (2010) considered the argument about China ‘exporting deflation’ directly in the case of Japan; they concluded strongly that China has not done so. They used finely detailed data at the 9 digit level for the period 1992-2005. Their results raise at least a couple of questions, however. First, they combine mainland China and Hong Kong into a single entity and admit that if they do not, the time profile of prices with which they seek to identify price effects looks quite different – it declines much more strongly through time. Second, their main test on existing export commodities involves asking whether China’s export price pattern differs from those of other exporters of the same (finely defined) product. They do not find a differing trend, although Chinese products are cheaper than those of the other exporters; this could merely reflect other exporters following China's pricing lead, the phenomenon that we are specifically investigating. They also include interesting results on the effects of quality and new products on Japanese cost of living indices, but these are not the subject of the current paper.

Bugamelli et al. (2010) acknowledge that the rise of China is one of the most important shocks to global trade affecting Italy's manufacturing sector, which is more oriented towards labour-intensive and low-technology manufactures. Using firm-level data from Italy, they found that increasing Chinese import penetration has caused a significant reduction in the prices of domestic firms. After controlling for the endogeneity in Chinese market shares, they found that Chinese pressure is more prevalent in less technologically advanced sectors like the textiles and leather industries.

There are surprisingly few studies trying to measure the price effect directly for China; to our knowledge. Most of these studies trace tariff shocks on import and export prices as an indicator for price changes (Feenstra, 1989; Winters and Chang, 2000; Chang and Winters, 2002). Although these studies look at the effects of Chinese competition through tariff shocks on the price charged by other producers, few economists have addressed changes in Chinese prices directly.

Using unit price data from 1974-1987, Feenstra (1989) found a pass-through rate of unity in the case of imported Japanese motorcycles in the US market, but only a 0.58 pass-through rate[2] for trucks, the difference reflecting varying levels of competition for the two products. During the early 1980s, the USA imposed a 25% tariff on Japanese compact trucks and a 45% declining tariff on Japanese heavyweight motorcycles to protect its domestic market. For compact trucks, the competition from US producers might have prevented Japan from passing the full amount of the tariff on to consumers and the USA accounted for a small share in total exports; also, the demand may have been a constraint. Thus, for every 10% increase in Japanese tariff, Japanese producers were willing to absorb about 4.2% of the burden while passing on only about 5.8% to US consumers, leading to a terms of trade gain for the USA. For motorcycles, the tariffs were applied to both Japanese imports and Japanese plants operating in the USA. Japan

[2] Pass through refers to the Japanese price response to increase in import tariffs

accounted for 90% of US market share for motorcycles, where the only domestic competition comes from Harley-Davidson (US produced). The whole burden of the price increase was therefore passed on completely to the consumer. Although this study looked at Japanese competition in the USA, it provides us with an approach for investigating Chinese price competition.

Winters and Chang used a model closely related to the Bertrand competition model to investigate terms of trade changes when a trading block is formed. In separate studies done for MERCOSUR (2002) and the European Communities (2000), they found that 'non-member firms'[3] export prices to the export market will be influenced not only by the tariffs that they face, but also by the tariffs that their rivals in member countries face, via the effect of the latter on the rivals' prices. The tariff preference given to member countries will increase their competitiveness, and non-member countries can respond by reducing their price as well in order to make their products more competitive.

In the Winters and Chang papers, the driver examined was preferential tariff reductions for members of trading blocs, which increased the competitive pressures on non-member suppliers. Using data at the HS6 digit level, these researchers showed that the preferred countries tended to increase their pre-tariff prices while reducing their post-tariff prices, and that, as a result, non-member countries, which experienced no tariff reduction, tended to decrease their prices. Non-member countries will tend to absorb some of the loss of competitiveness induced by the tariff cuts, with only a portion passed on to consumers. These studies measure direct price competition between rival suppliers. Preferential tariffs given to Mexico under NAFTA can also be seen as a control factor that we need to take into account in our model. Romalis (2007) found that Mexico's exports to the USA are very responsive to the preferential tariff treatment Mexico received and that its market shares increased most in products for which tariffs were reduced the most. However, he found smaller effects on the price response in member and non-member countries of NAFTA.

[3] Countries which do not belong to the trading block; for MERCOSUR, the non-member country is the USA with Argentina (member) as the competitor to the Brazil market. In a separate study, they also investigated the price response of the non-members namely USA and Japan on the Spain joining the European Community.

The study that is closest to our own is a recent paper by(Fu et al., 2012; Fu et al., 2011), which examined the effects of Chinese exports on different groups of countries as measured by their real GDP (low-, middle- and high-income countries) using disaggregated trade data at the HS 8 digit data for US and EU market and HS 6 digit for Japan. These researchers hypothesised that China's surging exports will have different effects on goods with different technological intensity. In their model, prices are affected by Chinese prices, the shares of China's exports and the prices of other markets. They used a balanced dataset for the 1989-2006 period that covers only the top 300 exports from China, where these are established Chinese exports for the whole 18 years. Their results indicate that Chinese exports affect mostly prices of low-income countries before the 1990s, but that it was the middle-income countries that were most affected after 1997. China’s exports also affect low-technology products in high-income countries, which they suggest implies that China's manufacturing has evolved from low-cost products to more sophisticated products.

4.2 Our Model

4.2.1 Our Approach

Our study focuses on one market, namely the USA, and on competition with one other middle-income supplier, namely Mexico. Our objective is to assess China’s price and its impact on Mexico’s price for the set of common products that both countries export to the USA. Here, we will measure the Chinese price effect directly by using changes in costs.[4] In reality, there are many other countries exporting to the USA, and this of course raises concerns about the external validity of our results. However, without claiming that outcomes are identical, we would argue that understanding China-Mexico competition in those countries’ main market offers a good deal of insight into other markets and other competing suppliers. Our approach to investigating the effect of Chinese price competition is sparser than Fu et.al (2012), which looked at the Chinese price influence in the US, EU and Japan combined. They create balanced samples of products for each import market over the period 1989-2006 by looking at China’s top

[4] We argue that cheaper Chinese exports are brought about by the increase in Chinese productivity (lower costs), which is exogeneous of the other countries.

300 exports to the market and 2006 and keeping those products for which China and at least one country in each country group exported in each of the 18 years. As many of the more dynamic Chinese export drop in and out of the export basket, we can provide more information for the full set of products. The compensating benefit of focusing on one country is that our chains of causation are better identified and we avoid the complex interactions and endogeneities of Fu et al. (2012).[5]

Our organising framework for actual competition is to assume that firms compete on price and that this may be schematically modelled as Bertrand-type competition between two countries selling differentiated but substitutable goods in a third market. We assume only two main exporters to the US market, ignore local production in the USA and try to avoid any effects from Chinese-Mexican competition in other markets. (Given their shares of exports to the USA, it is plain that this is the main field on which their rivalry is played out.) The methodological tradition of this work is the pass-through literature as applied to international trade policy analysis, as mentioned in our literature review above.

As described in Iacovone et al. (2013), the rise of China in international trade can be seen as a situation that dealt a sudden and massive shock especially to the Mexican economy, where it was described as a unilateral trade shock and not a mutual trade expansion. Our objective here is to assess China's price and its impact on pricing decisions in Mexico for the common set of products that China and Mexico both export to the USA. We suggest that Chinese competition over the period 1992-2008 was largely in terms of prices, driven by rapidly increasing productivity and scale in Chinese industry as producers started to catch up technologically with middle-income countries, absorbed large amounts of surplus labour from the countryside and attracted FDI from the rest of the world. In principle, we see this advance in productivity and scale as the main exogenous driver of China's market expansion.

[5] Although Fu et al. use GMM to deal with endogeneity, it is far from clear that lagging endogenous variables really removes the problem in cases where horizons are long and market behaviour might be anticipated.

4.2.2 Bertrand Model

In the Bertrand duopoly model, two firms compete and decide on the price while letting consumers decide the quantity to be purchased. This model has a very strict restriction, in which there are only two firms with symmetrical costs selling a homogeneous product: there is only one price and firms have identical costs. The assumption is that both firms are large enough to supply the whole market. The market demand function can be generally represented by Equation (4.1):

$$Q = {}^{a}/_{b} - {}^{1}/_{b}\,P \qquad (4.1)$$

where Q and P are the market equilibrium quantity and price respectively.

If products are homogeneous, consumers will always purchase from the cheaper source. However, when the prices charged by the two firms are identical, consumers will be indifferent between purchasing from the two firms, and the assumption is that each firm will share the market equally and each possess half the market share. Under these conditions, the quantity of demand faced by Firm 1 is represented by Equation (4.2):

$$q_1 = 0 \; if \; p_1 > p_2 \qquad (4.2a)$$
$$q_1 = (a - p_1)/2b \;\; if \; p_1 = p_2 \qquad (4.2b)$$
$$q_1 = (a - p_1)/b \; if \; p_1 < p_2 \qquad (4.2c)$$

where subscripts 1 and 2 denote Firms 1 and 2 respectively.

As costs are constant, it can be seen from Equation (4.2) that demand switches when either firm tries to undercut the other. It shows that demand for Firm 1 is zero when $p_1 > p_2$, while Firm 1 gets the total market demand when $p_1 < p_2$ and each firm gets half the market demand when $p_1 = p_2$. Because costs are linear, the discontinuity in the demand causes a discontinuity in profits. Given that the profit function is not continuous, we need to identify the Nash equilibrium to obtain the equilibrium price.

Both firms will try to undercut the other if price is above marginal costs. Price competition between the two firms will lead to zero economic profit, and it is also assumed that these firms are large enough to supply the whole market. The Nash equilibrium for the Bertrand model occurs when $p_1 = p_2 = c$. This is the only equilibrium price at which neither firm has the incentive to deviate. Thus, in a pure Bertrand model, the price charged by both firms should be the same and both will share the market equally. Each firm will try to maximise profits by adjusting its own price given the price set by its rivals, taken to be given. The profit function for Firm 1 is a function of its own price given the price of its rival, which is taken to be given and is as in Equation (4.3), where π is the profit function:

$$\pi_1(p_1, p_2) = (p_1 - \mathrm{c})q_1(p_1, p_2) \qquad (4.3)$$

4.2.3 Our Model

The pure Bertrand model as explained is an unrealistic assumption in the real world, as products are differentiated by country of origin. Hence, we introduce differentiated goods into the model. This implies that when products are differentiated, one firm will not necessarily gain the entire market by undercutting the other. Also the undercutting firm might not necessarily have the capacity to supply the entire market. In this model, both countries set their price iteratively to maximise profits given what the other firm does. Firms control the price and let consumers decide how much to purchase. Based on the Bertrand price model, firms are involved in price competition where we believe that Mexico's price will be affected by China's price.

Under Bertrand imperfect competition, we came up with a simple model by assuming that there are only two countries, China and Mexico, exporting to the US market. We assume that there is a representative firm that produces output in both China and Mexico and products are differentiated by country of production. By assuming differentiated products, we can now calculate the first-order conditions with respect to price for each firm and solve them simultaneously to obtain equilibrium prices. The products are assumed to be produced solely for the purpose for exporting to the USA and this market is independent of all other markets. It is assumed that costs are constant and that each firm has a cost function that is homogeneous of degree one in its input price. The two firms compete with each other in the US market independently, without worrying about their strategies in other markets.

The demand functions for Mexico and China are given by Equations (4.4a) and (4.4b) respectively, where the demand for each firm depends not only on its own price, but also on the price set by its rivals. Note that for simplicity we have the same demand function for each country.

$$q^{M} = f(P^{M}, P^{C}) \qquad (4.4a)$$

$$q^{C} = f(P^{C}, P^{M}) \qquad (4.4b)$$

Simple economic theory would suggest a negative relationship between a firm's own price and its quantity demanded, and a positive relationship between its rival's price and the quantity demanded for its own products. The demand functions for Mexico and China are represented using Equations (4.5a) and (4.5b) respectively. As products between the countries are seen as substitutes, an increase in China's price will cause a reduction in the quantity demanded for Mexico's product; as Mexico's price increases, the quantity demanded of its products will fall.

$$q^{M} = \alpha - \beta P^{M} + \delta P^{C} \qquad (4.5a)$$

$$q^{C} = \alpha - \beta P^{C} + \delta P^{M} \qquad (4.5b)$$

The two firms compete against each other in the US market based on price competition to maximise profits in their own currency. The US demand for Mexican products depends on the prices of both Mexico and China. Taking China's price as given, Mexico will decide on its own price in order to maximise profits. The profit-maximising condition is to equate its marginal revenue to marginal costs. Mexico's marginal costs are assumed to be constant and are thus independent of the total amount demanded for its products in other markets. Similarly, the same explanation is offered for China's case. The average cost function can be written as c^{M} and c^{C} for Mexico and China respectively. The profit function for Mexico and China can be represented by Equations

(4.6a) and (4.6b) respectively. After substituting for q, the profit function are represented by Equations (4.7a) and (4.7b) respectively. The first-order condition for profit maximising for each country with respect to its own price given its rival's price is as represented by Equations (4.8a) and (4.8b).

$$\underset{p}{Max}\,\pi = \{Total\,\mathrm{Re}venue - TotalCosts)$$

$$\pi^M(P^M, P^C) = (P^M - c^M)q^M \qquad (4.6a)$$

$$\pi^C(P^M, P^C) = (P^C - c^C)q^C \qquad (4.6b)$$

$$\pi^M = (P^M - c^M)(\alpha - \beta P^M + \delta P^C) \qquad (4.7a)$$

$$\pi^C = (P^C - c^C)(\alpha - \beta P^C + \delta P^M) \qquad (4.7b)$$

$$\partial\pi^M / _{dP^M} = \alpha - 2\beta P^M + \delta P^C + \beta c^M = 0 \qquad (4.8a)$$

$$\partial\pi^C / _{dP^M} = \alpha + \delta P^M - 2\beta P^C + \beta c^C = 0 \qquad (4.8b)$$

The reaction functions for both Mexico and China are derived from their demand function. We solve for Equations (4.9a) and (4.9b) to get the reaction price functions for Mexico and China, which are given by R^M and R^C respectively.

$$R^M \equiv P^M = {}^1/_{2\beta}\,(\alpha + \delta P^C + \beta c^M) \qquad (4.9a)$$

$$R^C \equiv P^C = {}^1/_{2\beta}\,(\alpha + \delta P^M + \beta c^C) \qquad (4.9b)$$

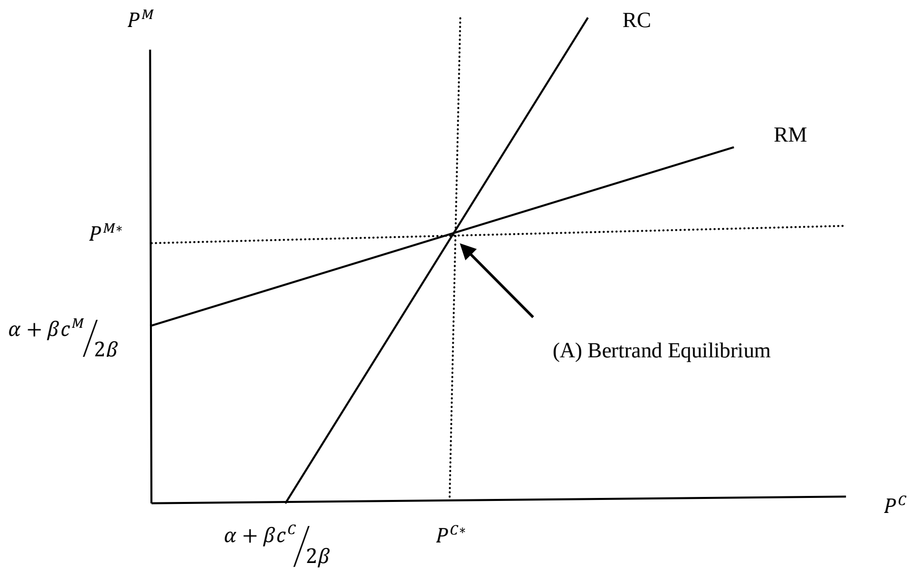
The slopes of the reaction function can be found by totally differentiating (4.9a) and (4.9b) with respect to P^C and P^M respectively. The reaction function for Mexico and China can thus be represented by Equations (4.10a) and (4.10b) respectively:

$$Slope\ of\ R^M \equiv \frac{dP^M}{dP^C} = {}^\delta/_{2\beta} \qquad (4.10a)$$

$$Slope\ of\ R^C \equiv \frac{dP^M}{dP^C} = {}^{2\beta}/_{\delta} \qquad (4.10b)$$

For the model to be stable, China's reaction function should be steeper than Mexico's reaction function $(\beta > {}^{\delta}/_{2})$. The vertical axis depicts Mexico's prices, while the horizontal axis shows China's prices. The reaction functions for China and Mexico are shown in Figure 4.1. The slope of the two countries' reaction function is assumed to be positive, as their exports are seen as substitutes. The positively sloped reaction function R^M means that a price decrease by China will induce Mexico to reduce its price as well. The intersection of the reaction function for both firms is the Bertrand equilibrium point. The firm in Mexico maximises profit given that China's firm sets its price at P^{C*}. The same explanation holds for China. Both firms will have no incentive to change their price given the rival's price.

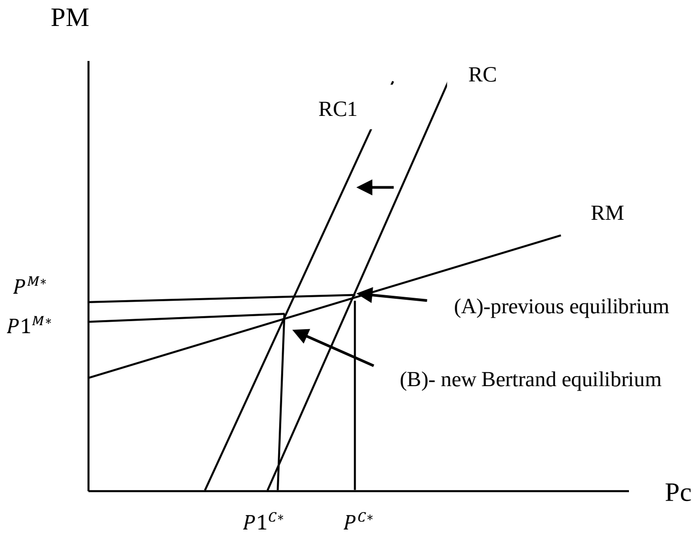
Figure 4.1: Reaction Function for China and Mexico



Studies have shown that Chinese productivity has been growing tremendously over the years and the productivity increase in the country has lowered the costs of production, leading to cheaper Chinese exports. In Figure 4.2, a drop in China's cost (c^C) will cause a leftward parallel shift in the Chinese reaction curve from RC to RC1. The fall in

China's costs will lead to a new Bertrand equilibrium point, which is now represented by point B. The increase in Chinese productivity means that China can charge a lower price for any given level of Mexico's price. Under the new Bertrand equilibrium, Chinese prices have fallen from P^{C*} to $P1^{C*}$ and more demand will shift towards the cheaper Chinese products, while Mexico's price fell from P^{M*} to $P1^{M*}$.

Figure 4.2: Increase in Chinese Productivity



Our main interest lies in the responsiveness of Mexico's price to changes in Chinese costs. To summarise, as China's costs falls, China will reduce its price for every level of output and more demand will be shifted towards Chinese products. Mexico will respond by lowering its own price, illustrated by a movement down in its reaction function RM. Our main interest lies in the change in Mexico's prices to a corresponding change in Chinese prices brought about by changes in China's costs.

The above is a simple model showing the reaction functions for Mexico and China, where we include only the final prices in terms of the importer’s currency. We denote P^M and P^C as the tariff-inclusive price (final prices) in their own currency for Mexico and China respectively and this is represented by Equation (4.11):

$$P^M = \lambda^M * \overline{P}^M \ , \ P^C = \lambda^C * \overline{P}^C \qquad (4.11)$$

where $(\lambda^{M} = 1 + tariff^{M})$ is the ad valorem tariff factor and $\overline{P}^{M}$ is the pre-tariff price for Mexico; a similar explanation applies for China. The functions $q^{M}(P^{M}, P^{C})$ and $q^{C}(P^{M}, P^{C})$ are the demand functions in the USA for China and Mexico's products respectively. The nominal exchange rates are denoted by e^{M} and e^{C} for Mexico and China respectively, where e^{M} and e^{C} are given by Peso per unit US dollars (Peso/$) and Yuan per unit US dollars (Yuan/$) respectively. Mexico and China will try to maximise their profit function, as represented by Equations (4.12a) and (4.12b) respectively:

$$\pi^{M}(P^{M}, P^{C}) = \frac{\mathrm{e}^{\mathrm{M}}}{\lambda^{\mathrm{M}}} P^{M} * q^{M} - C^{M}(q^{M}) \qquad (4.12a)$$

$$\pi^{C}(P^{M}, P^{C}) = \frac{\mathrm{e}^{\mathrm{C}}}{\lambda^{\mathrm{C}}} P^{C} * q^{C} - C^{C}(q^{C}) \qquad (4.12b)$$

Similarly to the simpler model, the first-order profit-maximising conditions are solved with respect to their own price for Mexico and China respectively, which we denote by $\varphi^{M} = \frac{\mathrm{e}^{\mathrm{M}}}{\lambda^{\mathrm{M}}}$. Mexico's profit-maximising price is a function of the Chinese price, the Peso exchange rate, US-imposed tariffs on its products and also its marginal costs, as represented by Equation (4.13a):

$$\frac{\partial \pi^{M}}{\partial P^{M}} = \varphi^{M} q^{M} + \frac{\partial q^{M}}{\partial P^{M}} \varphi P^{M} - C'^{M} \frac{\partial q^{M}}{\partial P^{M}} = 0 \qquad (4.13a)$$

$$\frac{\partial \pi^{C}}{\partial P^{C}} = \varphi^{C} q^{C} + \frac{\partial q^{C}}{\partial P^{C}} \varphi P^{C} - C'^{C} \frac{\partial q^{C}}{\partial P^{C}} = 0 \qquad (4.13b)$$

At the equilibrium, Mexico and China's first-order profit-maximising condition must be satisfied; the reaction functions for both Mexico and China can be represented by (4.14a) and (4.14b) respectively,:

$$P^{M}\left(1 + \frac{1}{\varepsilon^{M}}\right) = \frac{1}{\varphi^{M}} c'^{M} \qquad (4.14a)$$

$$P^{C}\left(1 + \frac{1}{\varepsilon^{C}}\right) = \frac{1}{\varphi^{C}} c'^{C} \qquad (4.14b)$$

given that $\varepsilon = \frac{\partial q^M}{\partial P^M} * \frac{\mathrm{P^M}}{\mathrm{q^M}}$ is the partial elasticity of demand and C'^M is the marginal cost of Mexico, which we assume to be constant. Note that $q^M = f(P^M, P^C)$ and $q^M = f(P^M, P^C)$ as products exported by China and Mexico are considered as substitutes; also, as products are differentiated, prices need not be the same for both countries. Similar to the simple equation, we used the two countries' first-order conditions to derive the reaction functions, using Mexico's first-order condition to find a reaction function that shows Mexico's profit-maximising price as a function of China's final price, the Peso exchange rate, tariffs imposed on its own products and also its own marginal costs of production.

$$P^M = f(P^C, e^M, \lambda^M, c'^M) \qquad (4.15a)$$

$$P^C = f(P^M, e^C, \lambda^C, c'^C) \qquad (4.15b)$$

We assume constant marginal costs with respect to quantity; Mexico's price function in the log linearised form is specified as Equation (4.16), where the data for each product are appended over time to form panel data:

$$lnP^M_{i,t} = \alpha + \beta lnP^C_{i,t} + \partial lne^M_t + u_i + \varepsilon_{i,t} \qquad (4.16)$$

The variable u_i is the set of time-invariant unobservables that can affect Mexico's price. The variable $\varepsilon_{t,i}$ is the idiosyncratic error, as it represents the time-varying unobservables that can affect Mexico's price. The index *i* refers to the unit of observation for each product at the HS6 level, *t* refers to the time period, while the superscripts M and C refer to Mexico and China respectively. The coefficient ∂ in Equation (4.16) measures the exchange rate elasticity for Mexico with respect to its own price. However, as the data on annual exchange rates are constant for all observations in a particular year, they will be differenced out in our fixed effects regression and thus will be represented by the annual λ_t time dummy variables as shown in Equation (4.17), where λ_t represents the annual time dummies, one for each year from 1992 until 2008. The time dummies represent the constant shift in the intercept term for each period.

$$lnP^M_{i,t} = \alpha + \beta lnP^C_{i,t} + \lambda_t + u_i + \varepsilon_{i,t} \qquad (4.17)$$

In Equation (4.17), the final price can be further categorised into two components, namely the pre-tariff price ($\bar{P}$) and the ad valorem tax (1+t). This is shown in Equations (4.18) and (4.19), where we break down the final price into its two main components to investigate their individual effects. The main interest lies in the coefficient β_1, which measures the size of the effect that Chinese prices are having on Mexican prices. In Equation (4.18), the coefficient β_1 measures the Chinese price effect on Mexico's price, while β_2 and β_3 measure the elasticity of Mexico's price with respect to US-imposed tariffs on Mexico and China respectively.

$$ln\bar{P}^M_{i,t} = \alpha + \beta_1 ln\bar{P}^C_{i,t} + \beta_2 \ln\left(1 + t^C_{i,t}\right) + \beta_3 \ln\left(1 + t^M_{i,t}\right) + \lambda_t + u_i + \varepsilon_{i,t} \qquad (4.18)$$

$$lnP^C_{i,t} = ln\bar{P}^C_{i,t} + \ln\left(1 + t^C_{i,t}\right), \; lnP^M_{i,t} = ln\bar{P}^M_{i,t} + \ln\left(1 + t^C_{i,t}\right) \qquad (4.19)$$

There is also the issue that Chinese producers will react to Mexican prices just as Mexican producers react to Chinese ones. That is, the Chinese price is likely to be endogenous and we will address this problem by using Instrumental Variables. However, even at this stage it is worth observing that in terms of competition between China and Mexico in the USA, the major shock over the period 1992-2008 was undoubtedly the emergence and growth of China, which may be plausibly taken to be independent of anything that Mexico did. We have argued that Chinese export growth is mainly attributed to the increase in productivity of the real factors of production, rather than nominal rigidities. China’s abundant labour force and their reallocation to manufacturing industries, its FDI inflows and its capital accumulation provide the support that is often needed during the initial stages of development. China is one of the major recipients of FDI and we believe that the positive spillover effects from FDI and the increasing competition from privatisation increased firms’ efficiency, leading to increasing Chinese productivity. In principle, we see this advance in productivity and scale of growth as the main exogenous drivers of China’s market expansion.

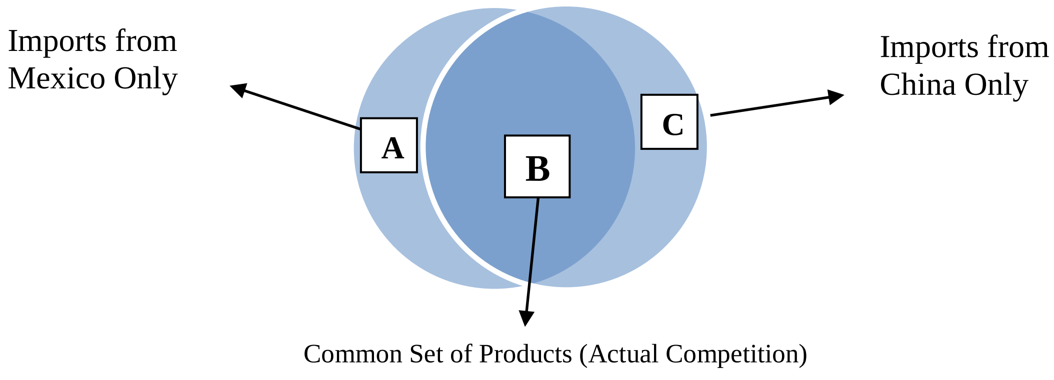
To summarise, the Bertrand duopoly model as derived is a simple representation of price competition between two countries in the US market; where our main object of interest is the Chinese price effect. The USA is the world’s consumer and hence in reality involves many competitors; hence Mexico's price might also be affected by other major players in the US market. The Bertrand duopoly model could be extended to accommodate the other sources of imports by including the global unit price as a control variable. This will get rid of the general trend in product price and better isolate the effects of the Chinese competition. As the annual exchange rates are constant for all observations in a particular year, they will be differenced out in our fixed effects regression and thus will be represented by the annual time dummy variables. As there is likely to be simultaneity in the Bertrand model, we will use Instrument Variables (IV) to control for the endogeneity for the Chinese price. Our specification test will control for these elements of competition to test for the significance and robustness of the Chinese price competition.

4.3 Experiment and Data

4.3.1 Sample Selection (Identify Common Set of Exports)

This study will use trade data disaggregated at the HS6 level (HS92), as reported by the United States with China and Mexico as trading partners, where a product here is defined at the HS 6 digit code level. There are just over 5000 products defined at the HS6 digit level. As explained in the previous chapter, we use import data from the USA because import data are generally held to be more consistent than export data; developed countries have better data than developing countries; and by taking data on Mexico and China from a common source, we leave less room for differences in definitions, recording practices or units of measurement.

Figure 4.3: US Imports from China and Mexico at the HS6 Level (1992-2008)



We need to match all the common products that both China and Mexico exported to the US market in the period 1992 to 2008, represented by the Venn diagram in Figure 4.3. The overlap area 'B' is the set of common product headings for both countries at the HS6 level. The areas A and C show the product years in which US imported from only Mexico and only China respectively. Our sample is an unbalanced panel, where new products are introduced while others are dropped in certain years. The unbalanced sample provides more observations and greater relevance,[6] but we will do a separate exercise on the balanced set as well.

The total number of products that the USA imported from China and Mexico for the period 1992-2008 is tabulated in Table 4.1. We get slightly fewer observations here as compared to the earlier chapters; we have to drop those product years with positive trade value but where quantity data are missing; we lose some observations in doing so. Here, we provide a brief summary of the export structures of both countries. China seemed to have increased the number of products it exported to the USA for every year until 2007. As we have discussed in the previous chapter, in part the recorded decline in 2007 was due to the drop in the total number of product headings imported by the USA and also the concordances used to span the revision in the HS classification,[7] but detailed matching across the revisions failed to eliminate it.

The total number of common products that the USA imported from China and Mexico can be represented by 'B' in the Venn diagram in Figure 4.3. China's trade overlap with Mexico has increased annually from 65% of Mexico's total export headings to the USA in 1992 to around 93% in 2008. It would be unrealistic to have a 100% trade overlap between China and Mexico and it is approximately at maximum during the early 2000s. The high degree of trade overlap implies that China exports many of the products that Mexico also exports, assuming that the products are substitutes. The trade overlap indicates that both countries have very similar export structures. The trade overlap

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[6] Refer to the discussion in Chapter 3 on the rationale for using the unbalanced sample (we lose too much data, especially on the manufactured products, if we use the clean sample).

[7] For example, two HS02 headings, A and B, may be mapped onto one heading in HS07, say C. If A greatly outweighs B in value, C is typically mapped back just to A, and B apparently disappears even if imports in 2006 (which are recorded in HS02) and in 2007 (recorded in HS07) are identical in every respect.

between Mexico and China's exports to the USA is greater than one would expect to arise merely from chance, because they both export labour-intensive manufactures, but changes in the degree of overlap are almost perfectly predicted just from the changes in the numbers of products that the two countries export. There are slightly over 5000 products at the HS6 digit level; China exported about 41% of them to the USA in 1992 and Mexico 44%. If the product selection were random, we would expect to find about 18% of products in common (which is the probability of both China and Mexico exported to the USA i.e. (0.44*0.41)), whereas the actual figure is about 29% (we take the common products divided by the total number of HS6 headings i.e. (1448/5032)). Repeating this exercise in all years, the correlation between the actual and expected overlaps is 99.4%. Thus, the export bundles of China and Mexico to the USA have not become materially more or less biased towards each other over the period 1992-2008.

Given that neither China nor Mexico would be able to produce and export every HS6 heading to an open market like the USA, the figures in Table 4.1 should help to assuage concerns that the results below are seriously disturbed by a selectivity problem. That is, even in 1992 there was not much possibility of selection by China of which products to export (or by Mexico), and by the middle of the period there was probably room for very little. In addition, the parallel between the overlap and the total numbers of products exported suggests that there was little spill-over from Mexico's performance to China's set of exported products.

The common products are compiled for a particular year and appended together to form a panel data set, with the aim of investigating the response of Mexico's prices to changes in Chinese prices.

Table 4.1: US Common Products from China and Mexico

	Product Headings Imported			Ratio of Common to Total Imports	
	From China	From Mexico	In Common	Common/ China	Common/ Mexico
1992	2,108	2,239	1,448	0.69	0.65
1993	2,261	2,339	1,551	0.69	0.66
1994	2,380	2,458	1,691	0.71	0.69
1995	2,552	2,805	1,970	0.77	0.70
1996	2,630	2,954	2,091	0.80	0.71
1997	2,784	2,983	2,224	0.80	0.75
1998	2,865	2,975	2,267	0.79	0.76
1999	2,990	3,012	2,373	0.79	0.79
2000	3,635	3,459	2,922	0.80	0.84
2001	3,659	3,407	2,893	0.79	0.85
2002	3,781	3,389	2,983	0.79	0.88
2003	3,858	3,365	3,011	0.78	0.89
2004	3,944	3,400	3,070	0.78	0.90
2005	4,073	3,445	3,164	0.78	0.92
2006	4,180	3,412	3,178	0.76	0.93
2007	3,821	3,151	2,940	0.77	0.93
2008	3,603	3,011	2,783	0.77	0.92
Total	55,124	51,804	42,559		

There are 55,124 product-year observations for China's exports to the USA for the period 1992-2008, while there are 51,804 observations for Mexico's exports in the same period. Our selected sample for 'actual competition' between the two countries comprises a total of 42,559 observations. Our dataset is an unbalanced panel, where products are sometimes dropped from the selected sample 'B' when either of the two countries stopped exporting for a specific year or had not entered the market. Thus, there will be some products in which China competes with Mexico for a longer period of time and also some for shorter periods.

4.3.2 Detecting Outliers

The unit price for a product-year observation is obtained by dividing the total trade value in that product by the quantity of exports. The unit price for a product differs between countries. A product is identified at the HS6 digit level, while an observation is referred to as a product-year. The unit price data obtained at the product level are very noisy due to measurement errors; however, they do provide us with an indication of the price movements for internationally traded goods.

In the presence of outliers, the sample means and variances will be influenced, which can distort our estimates. Outliers can create a problem because we want our estimates to reflect the fitted data, not only single observations, which can have an influence on the fitted model. Thus, we need to purge our sample of the obvious outliers, as we found certain observations that have exceptional values. There is a worry when we try to detect outliers by using just the absolute relative price, as we might drop all observations within a product where China is always much cheaper or more expensive than Mexico. One way to get over this problem is to reference the distance of the relative price for each product from its median to the ratio of its interquartile range. This is better described in Equation (4.20):

$$\frac{lnX - lnMedian}{lnQ75 - lnQ25} \equiv \ln\left(\frac{X}{Median}\right) \Big/ \ln\left(\frac{Q75}{Q25}\right) \qquad (4.20)$$

where X is the relative price $P_{i,t}^{C} / P_{i,t}^{M}$, the median and the interquartile range $(lnQ75 - lnQ25)$ are product specific and allow for some products to have a much greater degree of natural variability than others. However, there is the problem of the denominator in Equation (4.20) having a zero value or a value very close to zero for some products, which will wrongly identify outliers. If the interquartile range has a value of zero or very close to zero, the ratio of the distance will be undefined or magnified. This problem can be overcome by adding one to the absolute value in both the numerator and denominator, as in Equation (4.21):

$$Deviation = \ln\left(1 + \frac{X}{Median}\right) \Big/ \ln\left(1 + \frac{Q75}{Q25}\right) \qquad (4.21)$$

The distance from the median relative to its interquartile range will help to detect outliers in this case. An observation that shows extreme variation can be potentially marked as outliers, but we need a cut-off point to identify them. We trimmed the top 1% and bottom 1% of the distribution of the observations. Altogether we dropped 852 observations and after getting rid of outliers our sample now consists of 41,707 observations. The example in Table 4.2 shows a product (551219) that China and Mexico export to the US market for the following period. An observation is considered as an outlier if it is marked 0 in the outlier column in Table 4.2. There is only one observation within the product that was dropped, which is in 1992, as its deviation is in the top 1%. Although the value of the relative price is only 10 in 1992, this observation is dropped as the ratio of its deviation from the median to the interquartile range exceeds the threshold.

Table 4.2: An Example of an Outlier for Product (551219)

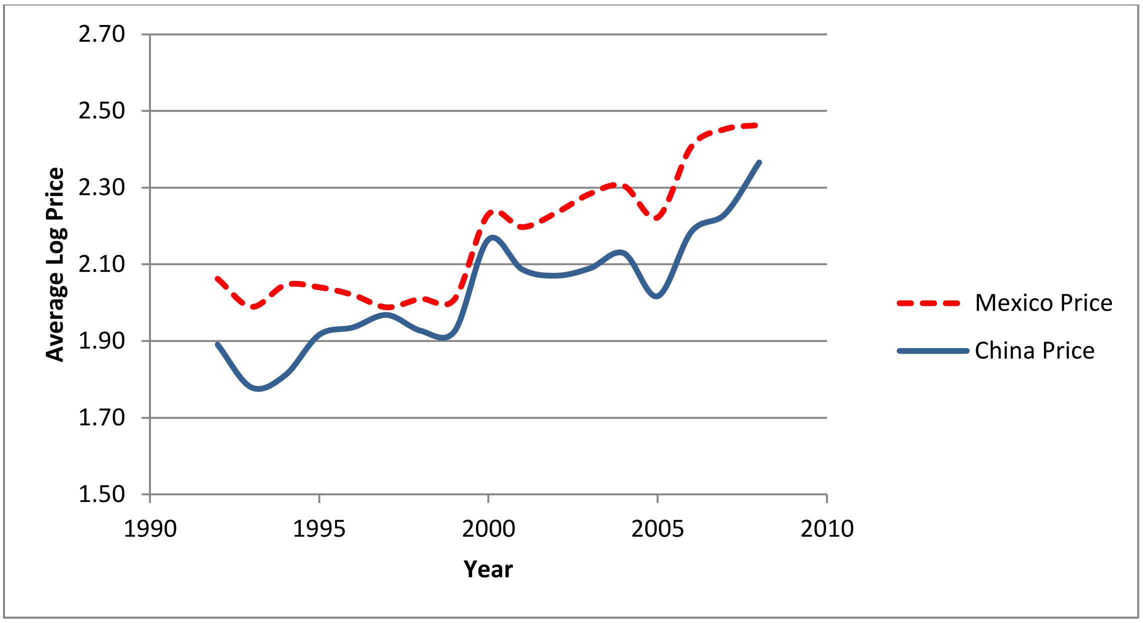
Period	X (Relative Price)	Median	ln(1+(X/Median))	ln(1+(Q75/Q25))	Deviation	Outlier (1% threshold)
1992	10.06	0.55	2.97	1.29	2.30	0
1995	2.24	0.55	1.63	1.29	1.26	1
1996	4.10	0.55	2.14	1.29	1.66	1
1997	0.50	0.55	0.65	1.29	0.50	1
1998	1.10	0.55	1.11	1.29	0.86	1
1999	0.55	0.55	0.69	1.29	0.54	1
2000	0.57	0.55	0.72	1.29	0.56	1
2001	0.40	0.55	0.55	1.29	0.43	1
2002	0.10	0.55	0.17	1.29	0.13	1
2003	0.77	0.55	0.88	1.29	0.68	1
2004	0.47	0.55	0.62	1.29	0.48	1
2005	0.42	0.55	0.57	1.29	0.44	1
2006	0.48	0.55	0.63	1.29	0.49	1
2007	0.11	0.55	0.18	1.29	0.14	1
2008	1.00	0.55	1.04	1.29	0.81	1

Note: Outliers are marked as 0 in the Outlier column
*****Product: Woven fabric >85% polyester staple fibres, (551219)

4.3.3 Overview of China and Mexico's Unit Prices

Chinese products have gained increasing market share in the global market because of their lower prices, made possible by the increase in Chinese productivity. The average logged price levels for each year is shown in Figure 4.4. This is consistent with our hypothesis where the result shows that on average China's prices were consistently lower than that for Mexico for the period 1992-2008. We also compared their logged average unit price by sectors, and the results showed that Chinese products are consistently lower than Mexico almost all the sectors except for the primary sectors like animal products, vegetable products, chemical and mineral products sectors. As we are dealing with an unbalanced panel, the logged average annual price is just an indicator of the average price of Chinese exports for each year.

Figure 4.4:Average Annual Price for China and Mexico in the USA



We hypothesise that China's price movement put pressure on other exporters. It is useful to see how prices evolve, especially in the case of Mexico. We will look at Chinese prices relative to Mexico in the US market. In order to compare relative prices across years, the starting year has been normalised to 1. The natural logs of the relative average price in each year can provide us with an illustration of whether Chinese products are actually getting cheaper over the years. The price pattern in Figure 4.4 is plotted based on Equation (4.22):

$$\frac{1}{N_t}\sum_{i=1}^{N_t}\ln\left(\frac{P_{i,t}^{C}/P_{i,t}^{M}}{P_{i,t-1}^{C}/P_{i,t-1}^{M}}\right) \qquad (4.22)$$

where P_{it}^{C} is China's unit price and P_{it}^{M} is the unit price of Mexico denoted in US dollars.[8] The subscripts i and t indicate the product and year respectively. The products are similar in years t and (t-1), but are different for (t-1) and (t-2). In Table 4.3, we show that the total number of common products is different for each year and that it is increasing until 2006, probably due to the HS07 revision problem. For each product, we took the relative price in period t relative to its price in period t-1. We then took the average of $\ln(\frac{P_{i,t}^{C}/P_{i,t}^{M}}{P_{i,t-1}^{C}/P_{i,t-1}^{M}})$ for each year, which is shown in Column (2) in Table 4.3. This way, the relative price index is relative to the previous year, so we transform each year's index by accumulating for every year to make it relative to base 1992; this is what we get in Column (3).

Table 4.3: Relative Price Pattern

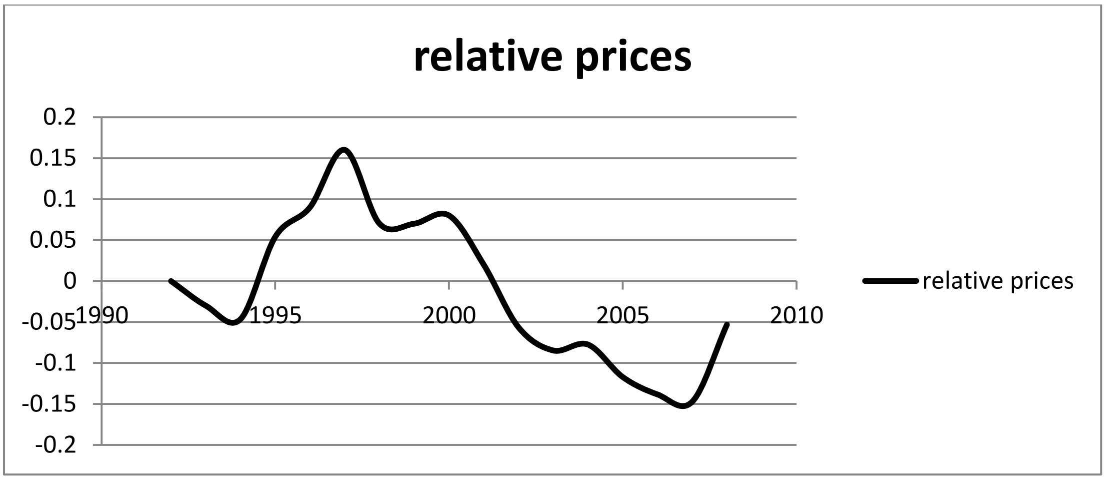
(1)	(2)	(3)	(4)
Year	Price Pattern	Accumulated	Observations
1992	-	0.00	0
1993	-0.03	-0.03	1115
1994	-0.02	-0.05	1205
1995	0.10	0.05	1362
1996	0.04	0.09	1564
1997	0.07	0.16	1742
1998	-0.09	0.07	1866
1999	0.00	0.07	1925
2000	0.01	0.08	2006
2001	-0.06	0.02	2517
2002	-0.08	-0.06	2544
2003	-0.03	-0.08	2605
2004	0.01	-0.08	2655
2005	-0.04	-0.12	2745
2006	-0.02	-0.14	2780
2007	-0.01	-0.15	2594
2008	0.09	-0.05	2441

Chinese prices relative to Mexico's are sketched in Figure 4.5. There is a downward trend in relative prices over the period, especially after 1997, an indicator that Chinese

[8] We use post-tariff price for the unit price.

prices are getting relatively cheaper, and supporting the case for China's increasing market share over recent years. The relative price is seen to have experienced a sudden jump in the period 1994 to 1997, which includes the year in which the peso crashed and Mexico's exports became relatively cheaper. From then on, relative prices exhibit a downward trend until 2007. Relative prices rose in 2008, which is probably due to the peso's depreciation in 2008. Overall, we observe that over time Chinese prices are getting relatively cheaper compared to Mexico's

Figure 4.5: Chinese to Mexico Relative Prices (1992-2008) - Unbalanced Panel



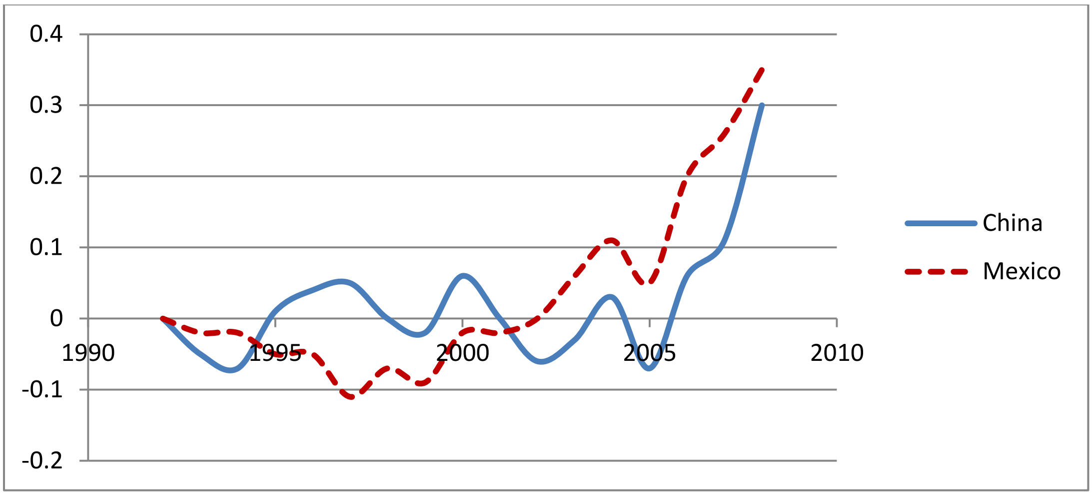
Other than the sudden jump in the relative price in 1994, we wanted to justify that the decline in relative prices is not due to the Chinese RMB fluctuation. As in Figure 4.5, the drop in relative price is more prevalent especially after 1997, we would expect a depreciation of the RMB during this period if the relative prices are driven by the exchange rates. However the RMB has remained relative stable since 1995 as shown in Figure 2.5 above, and has actually appreciated amidst pressure by the USA.

Using the same equation specification as in Equation (4.22) and a sample size similar to Figure 4.5, we use the specification in Equation (4.23) to derive China's price pattern in order to check on how Chinese prices have evolved over time.

$$\frac{1}{N_t}\sum_{i=1}^{N_t} \ln(P_{i,t}^C / P_{i,t-1}^C) \qquad (4.23)$$

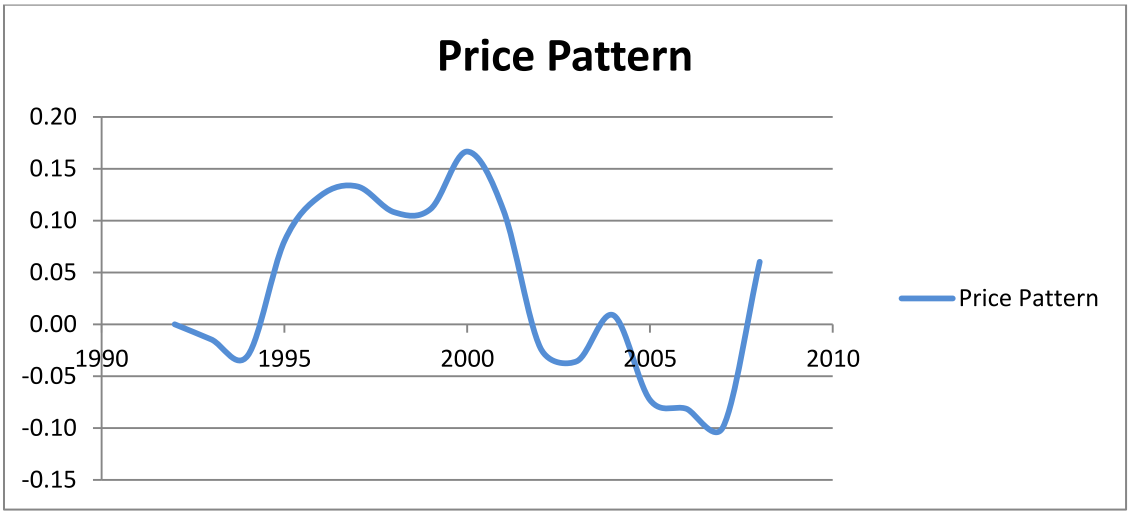
Similarly, we also derive the individual price pattern for Mexico. The individual price pattern for both countries is shown in Figure 4.6. Both countries show quite similar upward trends from 2002. If they both follow a trend, the first difference method will get rid of the specific time trend.

Figure 4.6: Individual Price Patterns - Unbalanced Panel



To check that the results are not driven merely by entry and exit, we included only those common products that are present in all years for both markets. The balanced set of products is very restricted and we are left with just 682 products that China and Mexico exported to the US market every year from 1992-2008. The price pattern for the balanced set is derived using Equation (4.22) but segmented to only the balanced panel. We get two slightly different relative price patterns when comparing the balanced panel and the unbalanced panel. Using the balanced panel sample in Figure 4.7, the relative price shows an increasing trend from 1994 until 2000; however, the Chinese price seems to have fallen relative to Mexico after 2000. Both samples show an initial upward trend in their relative price, but the unbalanced sample started to trend down from 1997, while the balanced sample shows a relative price drop starting from 2000. The difference in price pattern shows the problem with, which focused on the balanced panel alone. The balanced panel is a special set of products in which we are comparing similar products over 17 years. However, the relative unit price does provide us with some indication that Chinese prices are getting cheaper over time.

Figure 4.7: Chinese to Mexico Price Pattern (1992-2008) - Balanced Panel



We look at some of the properties of the balanced sample in Appendix 4.1. The balanced set consists of only 11,594 observations, compared to 41,707 for the unbalanced set; this is only about 28% of the observations in the unbalanced set (the sample we will use for regression analysis). In Appendix 4.1, we also provide the share of trade in the balanced sample relative to the unbalanced sample. We find that the relative trade share is very high in the textiles and machinery sectors: 79% in the textiles sector and 57% in the machinery sector. It is not a surprise to see high volumes of trade in these two sectors, considering that the balanced sample is considered to include established products for China; these are also the country's two dominant sectors.

4.3.4 Tariff Data

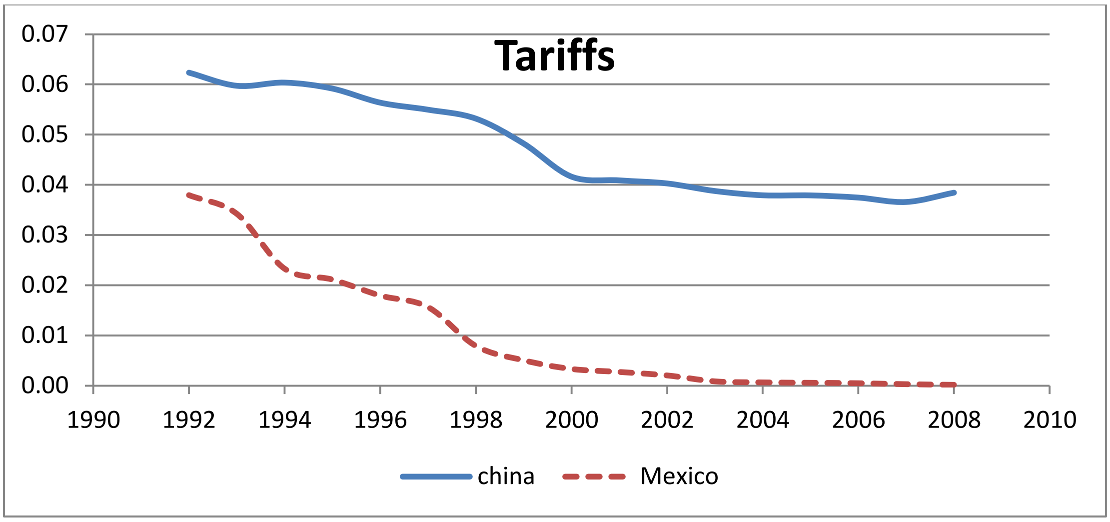
Because competition between Mexico and China takes place inside the USA's territory rather than at its border, we need to consider tariff-inclusive prices and China and Mexico face different tariff regimes. The North American Free Trade Agreement (NAFTA) was signed on 1 January 1994. From 1989 to 1993, US tariffs on Mexican goods were actually lower, on average, than tariff rates applied to imports from China (McDaniel and Agama, 2003). Even before NAFTA, Mexico had the Generalized System of Preferences (GSP) benefits, but China did not have these from 1989 to 1993. The formation of NAFTA in 1994 was likely to create an adverse effect on China's terms of trade, because it reduced Mexico’s post-tariff prices. However, Chinese exports continued to grow rapidly even after NAFTA was formed, largely attributed to higher productivity growth. The relatively higher tariffs imposed on Chinese exports tend to make Chinese products relatively more expensive and will most probably affect Mexico’s prices. Our Bertrand-like model makes use of the changes in post-tariff prices, but we are also interested in checking whether decomposing tariffs and pre-tariff prices separately makes any difference to our estimates. Nonetheless, we need tariff data to create tariff-inclusive prices and to check whether the pass-through of tariffs is the same as that of price changes.

The tariff schedule for NAFTA lists products according to the Harmonised System (HS) and specifies a phase-out period for each product. It classifies products into different categories and associates with each group its tariff phase-out period. The tariff phase-out period took place immediately for certain categories, while the others were assigned equal-sized annual reductions of 5, 10 or 15 years. International trade data is recorded at the HS6 digit level; however, tariff data are set at the finer HS8 digit level and then aggregated to the HS6 level using simple averages. Also, the tariff data as obtained from TRAINS in the WITS online database are given at their native HS level, namely HS92, HS96, HS02 and HS07 classifications, and thus we need to transform all of them into a single HS92 classification by using the conversion tables obtained from Comtrade. We thus obtained the tariff rates for Mexico and China at the HS6 level at the HS92 revision after transformation.

There are no tariff data for US imports under WITS for 1994, thus we look at the tariff data provided by Romalis for that specific year. Also, there seemed to be an error in the tariff rates from Comtrade for 1992, 1993 and 1998, which reported similar tariffs enjoyed by both China and Mexico, which is not correct, as Mexico had GSP status for 1992 and 1993 and had NAFTA privileges by 1998. Thus we will obtain the tariff data for the selected years from data provided by Romalis. Tariff data provided by Romalis are only available for the period 1989 to 2001. The finest tariff data can be obtained from WITS at the HS6 level, while tariffs from Romalis are recorded at the HS8 level. Therefore, we need to convert the Romalis tariff data to the HS6 level by aggregation of its simple mean at the HS8 to HS6 level.

We use the simple annual average tariff rates as an indicator for the tariff levels faced by both countries. The simple average tariff rate for the period 1992-2008 is shown in Figure 4.8. The diagram shows the simple average tariff of all products from China and Mexico over the period 1992 to 2008. Mexico had also been granted a lower tariff than China even before NAFTA was introduced. Both are declining and the (average) wedge between the two is more or less constant after 1994. We need to transform the tariff data into a single HS92 classification in order to have panel data that will match our trade data.

Figure 4.8: Simple Tariff Aggregation



4.3.5 Problem with OLS

We build a dataset to investigate how Mexico's pricing responds to China's pricing within products and over time. The panel data consist of many observations which are product specific and is an unbalanced panel, as there exist some products that are dropped every year while new products are developed. If we were to run our sample data using Ordinary Least Squares (OLS), we would have a pooled dataset that assumes there are no significant product-specific effects. However, our sample consists of many different products, for example hairclips and laptops that have many potential differences between them, for example different units and different average prices, so fixed effects regression is necessary. As products are different, we have to control for the variables which differ between products i.e. the different level of sophistication for hairclips and laptops. In using fixed effects, we are only interested in the variables that change over time; variables which are time invariant will be differenced away. The fixed effects method categorises products into groups and takes into account the variation in the mean prices for each product while controlling for the different characteristics between products; this way we can get rid of the product specific omitted variable bias which could not be measured and is constant through time. The fixed effects method get rids of all time-invariant unobserved heterogeneity between products and hence restricts all actions in the regression to be within the product. This makes it more plausible to compare our basket of goods comprising many different products of different unit prices. In fixed effects panel regression, we constrain all products in our sample to share a common slope. With fixed effects, we are exploring the different relationships between deviations from means. Thus, we have eliminated the key source of omitted variable bias, namely, unobservable across-product differences in quality, sophistication and so on.

The fixed effects method can be illustrated more clearly with an example, as follows:

$$lnY_{it} = \beta_0 + \beta_1 lnX_{it} + u_i + e_{it} \qquad (4.24)$$
$$\overline{lnY_\iota} = \beta_0 + \beta_1 ln\overline{X_\iota} + \bar{u} + \overline{e_\iota} \qquad (4.25)$$

where $\overline{lnY_\iota}$, $ln\overline{X_\iota}$,$\bar{u}$ are the means for lnY_{it}, lnX_{it}, u_i respectively.

By subtracting Equation (4.25) from Equation (4.24), we get the time-demeaned data for Y and X, as in Equation (4.26),

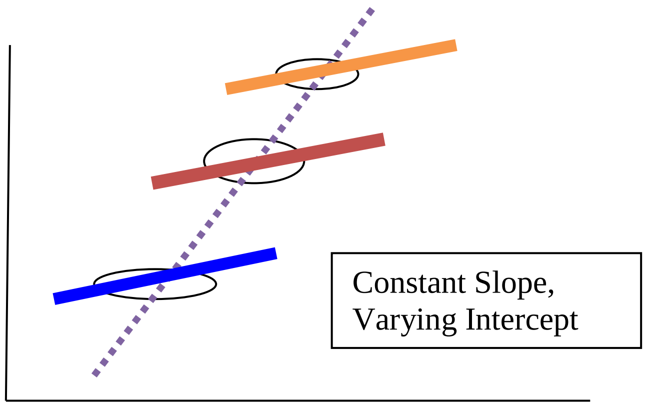
$$\ddot{Y}_{\mathrm{\imath t}} = B\ddot{X}_{\iota t} + \ddot{e}_{\iota t} \qquad (4.26)$$

where $\ddot{Y}_{\iota t} = Y_{it} - \overline{\mathrm{Y}_\imath}$ and $\ddot{X}_{\iota t} = X_{it} - \overline{Y_\iota}$ and similarly for $\ddot{e}_{\iota t}$.

Our panel specification is that there is an unobserved product-specific effect u_i that enters linearly in the regression. The time-invariant product-specific u_i are differenced out in the fixed effects regression. OLS regression will be unbiased under the assumption that the products i are mutually independent where e_{it} and u_i are independent, and that $E(X_{it}, u_i) = 0$ and $E(X_{it}, e_{it}) = 0$. However, the fixed effects model has differenced out the unobserved heterogeneity across products u_i and we no longer need the assumption that $E(X_{it}, u_i) = 0$ to hold.

As shown in Figure 4.9, if we had used OLS, all the observations would be pooled together and generate a regression of the dotted line through all those data points, which could be misleading. Both China and Mexico have high unit values for laptops and low unit values for hairclips. The regression using OLS is represented by the dotted line with the steeper slope. The fixed effects regressions for the three products are represented by the three bold regression lines with similar slopes.

Figure 4.9: Problem using OLS



There are other factors such as exchange rate fluctuations and political influences that could influence Mexican prices; these factors vary over time, but are constant across products. These factors are controlled for by including year dummies for each year for the period 1992-2008 in our specification. Thus we can control for across-product heterogeneity and time heterogeneity using the fixed effects model.

Our data consist of the whole population and are not just a random sample selection; therefore it will not be appropriate to use random effects. We are trying to find China's price effect on Mexico in the USA; this is not merely a random sample selection and thus it will not be appropriate to use random effects. If we were trying to find Chinese price effects in different cities in the USA, then we would quantify by using random effects. In this case, a city would be considered a random sample of all cities in the population. However, in this study, we have identified the USA as the main market and we are interested to find the Chinese price effects on Mexico in this market.

4.3.6 Summary Statistics

We present the summary statistics of the variables included in our main equation in Table 4.4. After dropping outliers, we have 41,707 observations for our panel data from 1992-2008. The summary statistics are all in demeaned log form and thus all variables at a product level have a zero mean. As part of doing a multiple regression analysis, we created a correlation matrix among the variables in the regression model. The standard deviations for the demeaned logs of the final and pre-tariff prices for China and Mexico both have quite similar values, of around 0.82 and 0.87 respectively, and there does not seem to be much variation for the tariff schedules for both countries. There appears to be little correlation between China's tariffs and Mexico's prices and also little variation in both countries' tariff schedules. The most notable feature is the negative relationship between the Chinese tariff and the price variables. This implies that products tend to have higher than average tariffs when they have lower than average prices. The small variation in the tariffs plays a very insignificant role in the determination of prices, and also there exist many products with zero tariffs for both countries. The figures in Table 4.4 are calculated using the full sample, which includes both zero and non-zero tariffs.

Table 4.4: Standard Deviations (SD) and Correlation Matrix

	S.D	China Final Price	Mexico Final Price	China Pre-tariff Price	Mexico Pre-tariff Price	China Tariff	Mexico Tariff	China Shares	Interaction
		Correlations							
China Final Price	0.82	1							
Mexico Final Price	0.87	0.51	1						
China Pre-tariff Price	0.82	1.00	0.51	1					
Mexico Pre-tariff Price	0.87	0.51	1.00	0.51	1				
China Tariff	0.01	-0.03	-0.07	-0.05	-0.08	1			
Mexico Tariff	0.02	0.04	0.04	0.04	0.01	0.38	1		
China Shares	0.10	0.04	0.07	0.04	0.08	-0.21	-0.17	1	
Interaction	0.30	0.25	0.18	0.25	0.19	-0.14	-0.12	0.73	1

* Data is in logarithms and in demeaned form
* Tariffs are calculated using (ln(1+t))
*Interaction = (Price*Shares)

4.4 Estimation and Results

4.4.1 Results (Fixed Effects Regression)

The results for the fixed effects regression are shown in Table 4.5, where we report these OLS panel regressions with fixed-year and product-specific effects. All three regressions are run using the mixed sample, where all variables are in natural logarithms. Column (1) shows the regression results on final prices for both Mexico and China. The final price product price comprises of the pre-tariff price and the tariff imposed on each product, which can be referred to in Equation (4.18) and (4.19).

Table 4.5: Product Level Regression (Fixed Effects-OLS)

	(1)	(2)	(3)
	Mex. Final Price	Mex. Pre-tariff Price	Mex. Final Price
China Final Price	0.53***		0.52***
	(0.005)		(0.005)
China Pre-tariff Price		0.53***	
		(0.005)	
China Tariff		-1.87***	
		(0.36)	
Mex. Tariff		1.72***	
		(0.22)	
Interaction (final price*share)			0.13***
			(0.02)
China share			-0.27***
			(0.062)
R^2 (Within)	0.267	0.27	0.268
R^2 (W'in excl time FEs)	0.256	0.259	0.259
R^2 (Between)	0.798	0.803	0.795
R^2 (Overall)	0.721	0.719	0.719
N	41707	41707	41707
Year Fixed Effect	Yes	Yes	Yes
Product Fixed Effect	Yes	Yes	Yes

Stars denote significance at 1% (***), 5% (**) and 10% (*)
Numbers in parenthesis () represent the standard errors

Our results show that if the Chinese price falls by 1%, Mexico will on average respond by dropping its price by 0.53%, which we term the Chinese price effect. That means that as the Chinese prices of exports to the USA have fallen, Mexico has gradually lost competitiveness, partly by not matching fully the cuts through time. Our main statement, however, is that Mexico has also lowered its price if China's products become cheaper. This can be represented graphically in Figure 4.4, where the relative China to Mexico price ratio has dropped since 1997. The R^2 within shows that China's final prices alone accounted for around 25.6% of the variation in Mexico's price, and it plus the year fixed effects accounted for 26.7%. The year effects (not reported) show an increasing trend, ranging from 0 in 1992 (omitted category) to 0.22 in 2007.

Column 2 in Table 4.5 breaks up the final prices into their pre-tariff and tariff components. The Chinese price effect itself is still 0.53, but the coefficients on tariffs for both countries are implausibly large and perverse. This would suggest at first glance that Mexico's prices tend to be affected more by tariff changes than by changes in Chinese prices, which is our main subject of interest. Taken at face value, they imply that an increase in the tariff on Chinese goods would drive down the Mexican price and an increase in the Mexican tariff drive it up. However, there are two factors that suggest this is not the right interpretation, namely the endogeneity in tariffs and the very slight variance in tariffs. There is a potential endogeneity issue whereby goods in which China becomes very competitive will tend to have slower and smaller declines in tariffs – again, see Table 4.4 above, where Chinese tariffs are negatively correlated with prices. Lardy (1995) commented on the increased level of protectionism in developed countries like the United States and the EU, imposing relatively higher tariffs on China's products as Chinese import penetration increased rapidly in their market. The sort of goods that are particularly subject to higher tariffs are light manufactures like textiles, toys and clothing. However, we do not believe that the result regarding tariffs should be taken too seriously.

Secondly, because we have product fixed effects, the coefficients are determined solely by inter-temporal variability, which is very small for the tariff series ─ Table 4.6 implies that if we decompose the variance of final prices into pre-tariff price and a tariff component, as in Equation (4.27), the latter accounts for substantially less than 1% of the variation in final prices for Mexico; similarly for China. Because of the small variation in tariffs, the coefficients on tariffs should be interpreted with caution, although it is still useful to work out what is happening with them.

$$\ln P^{Final} = \ln P^{PreTariff} + \ln(1 + tariff)$$
$$Var(\ln P^{Final}) = Var(\ln P^{PreTariff}) + Var(\ln(1 + tariff)) + 2\operatorname{cov}(\ln P^{PreTariff}, \ln(1 + tariff)) \quad (4.27)$$

	Var (Final Price)	Var (Pre-tariff Price)	Var (ln(1+tariff))
Mexico	6.02	6.02	0.00
China	4.62	4.62	0.00

Our explanatory variables have a wide range of means and variances and hence it is not appropriate to compare coefficients directly. We need to standardise the demeaned variables to compare the relative importance of each explanatory variable. In Table 4.6, we show the regression results with standardised variables. The results show that Chinese price is the most important variable, with a standardised coefficient of 0.50, while tariffs carry little weight with a very low coefficient. We conclude that tariffs are a weak and potentially misleading determinant of the final price in our sample. Overall, therefore, while these results are a disappointment, we feel justified in setting them aside and proceeding with the analysis of final, tariff-inclusive prices. We thus dropped the tariff variable from the regression and instead focused on only the final prices.

Table 4.6: Standardised Coefficients with Product Fixed Effects

	(1)
	Mex. Pre-tariff Price
China Pre-tariff Price	0.50***
	(0.0042)
China Tariff	-0.06***
	(0.0057)
Mex. Tariff	0.02***
	(0.0023)

Asterisks denote significance at 1% (***), 5% (**) and 10% (*)

Going back to our main regression results in Table 4.5, we inserted China shares in the USA ($s^C_{i,t}$) and also the interaction term ($ln\ P^C_{i,t} * s^C_{i,t}$) as additional controls in Column 3. Our model assumes a duopoly in the US market, but in reality there will be other big players exporting there. We accounted for the Chinese influence by controlling for Chinese import shares (S^c_{it}) in the US market. China's price influence might presumably be greater for products with a greater share in the US market; we call this the interaction term. This is represented in Equation (4.28) by the interaction of the Chinese import share with Chinese prices $(lnP_{it}^{c} * S_{it}^{c})$, where the coefficient β_2 measures the marginal effect of trade shares on the Chinese price effect (interaction term).

$$lnP_{it}^{M} = A + \beta_1 lnP_{it}^{C} + \beta_2 (P_{i,t}^{C} * s_{i,t}^{C}) + \beta_3 S_{it}^{C} + u_i + \lambda_t + \varepsilon_{it} \qquad (4.28)$$

$$lnP_{it}^{M} = A + lnP_{it}^{C}\left(\beta_1 + \beta_2 S_{it}^{C}\right) + \beta_3 S_{it}^{C} + u_i + \lambda_t + \varepsilon_{it} \qquad (4.29)$$

In Equation (4.30), the Chinese price effect on Mexico's price as represented is β_1 plus the size of its trade shares. If $\beta_2 > 0$ and is statistically significant, this implies a stronger Chinese price effect as China's export share increases.

$$dP_{it}^{m} \big/ dP_{it}^{C} = \beta_1 + \beta_2 \mathrm{S}_{\mathrm{i,t}}^{\mathrm{C}} \qquad \text{(where } 0 < S < 1\text{)} \qquad (4.30)$$

The (partial) coefficient on the trade share, β_3, is negative and significant at -0.27, suggesting a modest share effect that, in fact, has eluded many previous commentators (see the literature survey above) – where China has a 50% market share, Mexican prices are, *ceteris paribus*, 13.5% lower than when the Chinese share is 1%. More interestingly, the coefficient on the interaction term is positive and statistically significant at 0.13. Thus, if $S_{i,t}^{C} = 0$, the Chinese price effect is just 0.52, whereas if $S_{i,t}^{C} = 0.5$, it increases to 0.59. This is not a large increase, although it is in the expected direction. This would suggest that China's price effect will be stronger in the electronics/machinery sector and miscellaneous manufactures, as these are the main export sector for China. Considering the relative sizes of the main Chinese price effect and the interaction, this suggests that competition from China is not merely a matter of market penetration, but also has a large existential component – as soon as China appears in the market, Mexican producers find their pricing discretion curtailed.

4.4.2 Endogeneity: Instrumental Variables (IV)

The Bertrand model indicates that there might be some kind of reverse causation in our model specification, where P^C equally depends on P^M. Moreover, China, being a relatively new player, might take into account its competitor's existing product price before it priced its own product. There exists endogeneity in Chinese prices and the use of IV provides a tool to extract the variation in the endogenous variables. The IV must have the properties of both relevance and exogeneity. It has to be an important determinant of Chinese price (relevance) and can have an effect on Mexico's price only through its effect on China's price.

4.4.2.1 Choice of Instrumental Variables (IV)

As we mentioned in the previous chapter, China's output growth is due to increases in productivity, capital accumulation, increase in FDI and the reallocation of labour to manufacturing industries. China is not at the frontier of technology innovation during the early stages of growth, and even now is depending on the transfer of technology from more developed countries. The basic story of China's growth is that via technological catch-up, capital investment and the absorption of surplus labour, the country's capacity to produce has increased immensely, faster than for any other country over our sample period; indeed, this is the big shock in the context of competition for export markets. Moreover, we argue that China's growth is quite independent of anything Mexico might have done or not done and of issues pertaining to individual markets. Thus, the most natural instruments for Chinese export prices would be factors causing output shocks at home; that is, productivity, capital investment and perhaps even employment. However, the data are not available at anything resembling the level of disaggregation that we have in trade data and so we also need to consider a series of instruments based on trade data.

Productivity

China's productivity level can be used as an IV for the unit price of its exports. As seen in a study by the Asian Productivity Organization (2001), China's productivity performance (TFP) was increasing at a rate of 3.1% per year during 1970–2006. This is outstanding considering that the growth rate for Taiwan (ROC) and South Korea is estimated at around 1.6% and 0.5% respectively during the same period. Productivity is a measure of the amount of output we get for each unit of input. Theoretically, the productivity level is assumed to be negatively correlated with unit price in China. In terms of the exogeneity issue, we assume that Chinese productivity will have an effect on Mexican prices only through its influence on Chinese prices. There is an argument that there may be common productivity shocks where the advancement in technology influences prices in both China and Mexico, but we do not find it persuasive. First, any year-specific but cross-product shock will be picked up by the year's fixed effects. Second, for developing countries technological improvement comes mainly from catch-up, not from the development of new technologies, and thus is much more likely to be determined by local rather than global factors. Third, the factors behind China's increasing productivity are widely believed to be internal, such as high investment rates (including FDI), privatisation and a shift of labour out of agricultural work.

(Holz, 2006) found the total factor productivity level for 39 different sectors of the Chinese economy from 1994 until 2002. The productivity data as provided by Holz (2006) do not contain all the individual industrial sectors, but only Directly Reporting Industrial Enterprises (DRIEs). The productivity levels for the 39 DRIEs are then matched according to the International Standard Industrial Classification (ISIC) of Economic Activities, Revised Version 3.1, based on the closest similarity by description of the sectors involved. After obtaining the Chinese productivity level at the sectoral level, we need to convert the industry code to the HS92 6 digit level using the concordance table of trade data provided by UN Comtrade. This process is noisy and we lost quite a number of observations during the conversion process, as the DRIEs for China do not cover all the products in ISIC, and also because limited data is available in terms of productivity-level data from 1994 until 2002. For all these reasons, productivity is not such a good instrument in practice as it is in theory.

Sectoral Mean Prices as IV

We use Chinese sectoral mean unit prices to represent sectoral productivity, on the assumption that products in a sector share some productivity shocks and that individual product shocks are netted out by aggregation. This is an alternative to sectoral productivity, but generates far more observations. Bekker and Ploeg (2005) mention that grouping with the aim of generating instruments has also been used in models with panel data. Suppose that there are 100 products in Sector 1 with their own individual unit price, $P_1, P_2 \sim P_{100}$, then our instrument for each product can be defined as $P_i = \frac{1}{99}\sum_{j \neq i} P_j$, which is the average unit price of the 99 remaining products in that particular sector. Using the HS2 classification, we categorise our products into 97 different categories identified by their first two digit HS coding and calculate the average unit price for all products in that particular sector.

Chinese Import Price to Other Destinations as IV

Other IVs that we will be using are the Chinese price to other markets where Mexico has little trade. Chinese export prices differ across individual country markets, but can be assumed to be correlated with each other through their underlying production and productivity shocks. To avoid the concern that China’s influence in country A affects Mexico’s price in the US market via Mexico’s exports to country A, we chose markets in which Mexico is a small player. Japan and Korea have this feature; that is, where on average about 1.5% and 0.3% of Mexico’s exports go to Japan and Korea respectively. There is also very little export overlap between China and Mexico in these two external markets. Japan imported more than 60,000 product-years from China over the period and Mexico participated in only about 23% of these. Korea imported more than 58,000 product-years from China over the same period, whereas Mexico only participated in about 10% of these exports to the Korean market. Also, as these two markets are also major export markets for China, we will be able to obtain more observations to instrument for Chinese prices in the USA. There will be some cases where the units of measurement used on each product differ between reporting countries. However, since we are using natural logarithms and fixed effects, there is no problem in comparing products that are measured with different units. These countries are considered developed and rich, so product quality differences are less likely to contaminate the data as applied to the USA.

Overall, we believe that we can reasonably claim that Japanese and Korean import prices from China have the properties of both relevance and exogeneity necessary to be effective instruments. However, there will still exist outliers for the unit price as reported by Japan and Korea, which we identify by using the same method we used for detecting outliers for the case of China and Mexico.

China's Export Price to the USA

China's exports to the USA are also recorded bilaterally by the Chinese and US authorities and these sources do not completely match (Rozanski and Yeats, 1994; Ferrantino et al., 2012). We will also use the unit price of exports to the USA as reported by China to instrument for Chinese prices reported by the USA. Although informative, the unit price data at the HS6 level as reported by the USA are noisy ─ subject to many measurement errors. As mentioned in the previous chapter, China's reduction in the VAT rebate on exports increases the incentive to under-report at the Chinese border to avoid paying VAT. There is concern of over-reporting at the US border as multinationals try to avoid paying higher corporate income tax. The objective in this case is to reduce the effect of measurement errors in the data series. Nonetheless, as long as the errors in the two series are not perfectly correlated, we can expect to gain some benefit by using the Chinese data as an instrument. Again, we have to eliminate some outliers.

Endogeneity of China's Market Share

A second potential source of endogeneity is China's share of imports into the USA, which might be affected by the price of Chinese exports relative to other exports, including those from Mexico. A natural instrument for this would be China's share to other markets. As before, it is desirable that there be no risk that the price of Mexico's exports to the USA be affected directly by this share, but the possible causal link seems less direct than for prices *per se* – from China's share to Mexico's share to Mexico's price in that market to Mexico's price to the USA. In this case, therefore, given that market shares may well be influenced by distance, we have opted to use China's share of EU imports as the instrument rather than its share of Korean or Japanese imports. The share of Mexico's exports to the EU25 averaged just around 4.5% over the period 1992-2008.

4.4.3 Fixed Effect Regression – with Instrumental Variables (IV)

Our regression thus consists of up to three endogenous independent variables, namely Chinese prices (lnP_{it}^{c}), the Chinese share (S_{it}^{C}) and the interaction of Chinese prices with its import shares ($\ln P_{it}^{c} * S_{it}^{C}$). We experimented with five different instruments for lnP_{it}^{c}, a single instrument for share S_{it}^{C} and for ($lnP_{it}^{c} * S_{it}^{C}$) using the products of the chosen instruments. The instruments for each of the endogenous variables are shown in Table 4.7.

Table 4.7: Endogenous Variables and Its Possible IVs

Endogenous Variables	Possible IVs
China Price	China Productivity, Sectoral Price, Japan Price, Korea Price, China Reported Price to USA (up to 5 instruments)
ChinaPrice*ChinaShares	5 instruments if we cross multiply (price instrument and share instruments)
China Shares	EU25 (1 instrument)

The estimation results in Table 4.8 are done using 2 Stage Least Squares (2SLS), whereby each endogenous regressor is related to all three instrumental variables and the exogenous variables in the second-stage equation, namely the year dummies and fixed effects. The results for the simple bivariate regression with different instruments for Chinese prices are summarised in Table 4.8. The Chinese price effect is significant and exceeds the OLS estimate for every scenario when using Instrumental Variables. However, using Chinese industrial productivity from Holz (2006), theoretically the best instrument, has a very weak first-stage estimate with an F-statistic (7.55), with an R^2 of 0.004. Moreover, the Hausman endogeneity test has a p-value of 0.29, which suggests that we might be better off with OLS estimates rather than IV estimates. The reason is very probably the limited coverage of the productivity data – only 39 industries over 11 years, which not only gives us limited variation across products, but a huge loss in the number of observations, which falls from around 42,000 to about 19,000.

All the remaining instruments, which are based on trade data, have the property of relevance, as indicated by their high first-stage F statistics, suggesting that weak instruments are not a problem, with one exception – Korea reported prices have a strongly significant Hausman statistic. The results obtained motivated the use of IV. Using the sectoral mean prices as instruments is attractive in that we lose very few observations and the test statistics are strong. It gives a much larger estimate of the Chinese price effect of 0.76, but there may be residual doubts about the exogeneity of the instrument in this case.

Table 4.8: Instrumental Variables Estimates (Basic Equation)

Dependent Variable is Mexico's Price					
Price Instrument is:	Productivity	Sector Average Price	Japan Price	Korea Price	China Export Price
China Final Price	0.74***	0.76***	0.58***	0.54***	0.61***
	(0.22)	(0.02)	(0.05)	(0.06)	(0.04)
Hausman Test	0.2922	0	0.04	0.1646	0
R^2	0.2	0.22	0.24	0.21	0.22
Product Fixed Effect	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes
First-Stage Equations					
Instrumental Price	-0.37***	0.58***	0.17***	0.11***	0.21***
	(0.09)	(0.02)	(0.04)	(0.01)	(0.01)
F Statistic	F(9, 15894)= 7.55	F(17, 37355)= 231.69	F(17, 31532)= 88.09	F(17, 29541)= 68.75	F(17, 32420) =119.87
R^2	0.004	0.095	0.045	0.038	0.059
N	19069	41278	35087	33100	35966
Product Fixed Effect	Yes	Yes	Yes	Yes	Yes
Time Dummy	Yes	Yes	Yes	Yes	Yes

*standard errors in parenthesis are robust to heteroskedasticity ,
Asterisks denote significance at 1% (***), 5% (**) and 10% (*)

When we instrument with Japan, Korea or China reported prices, the sample sizes are reduced slightly because we can use only product-years that are not only sold by both Mexico and China in the USA, but also by China in the 'instrumental' country. Thus, for example, when using the prices of Chinese exports reported by Japan, there are only 34,986 out of the 41,707 product-year observations that Japan reported on imports from China. The estimates of the Chinese price effect in these equations are all positive and statistically significant at 0.58, 0.54 and 0.61 respectively, not too different from the OLS estimates, and for two of the three, the Hausman test suggests that endogeneity does indeed need to be addressed using IV regression. The OLS regression is more efficient than the IV estimator if endogeneity is not a problem. However, in the presence of endogeneity, OLS estimates are biased and not consistent, hence we need to correct for the bias using IV regression. Under the Hausman test, the null hypothesis is that OLS estimates are efficient; by rejecting the null hypothesis, the tests support the use of IV.

Table 4.9 reports the corresponding equations where China's share in the USA and the interaction terms are also taken as endogenous. This entails a further loss of observations, because now we need to take into account China's exports to the EU as an added necessary condition. The first-stage equations regress each potentially endogenous variable on all instruments relevant for the column, but for reasons of space we report only the coefficients for each variable on 'its' instrument; that is, the example given below for using Japan's reported price as the instrument for Chinese price (all prices are in natural logarithms):

$$P_{i,t}^{C} = \beta_1 P_{i,t}^{Japan} + \beta_2 (P_{i,t}^{Japan} * s_{i,t}^{EU}) + \beta_3 s_{i,t}^{EU} \qquad (4.31a)$$

$$P_{i,t}^{C} * s_{i,t}^{EU} = \gamma_1 P_{i,t}^{Japan} + \gamma_2 (P_{i,t}^{Japan} * s_{i,t}^{EU}) + \gamma_3 s_{i,t}^{EU} \qquad (4.31b)$$

$$s_{i,t}^{EU} = \rho_1 P_{i,t}^{Japan} + \rho_2 (P_{i,t}^{Japan} * s_{i,t}^{EU}) + \rho_3 s_{i,t}^{EU} \qquad (4.31c)$$

In the simplified table below, we report β_1 for (4.31a), γ_2 for (4.31b) and ρ_3 for (4.31c) for their first-stage regression.

The productivity instrument again is not statistically significant and hereafter we, regretfully, drop it from the analysis[9]. For the other instruments the estimate of the Chinese price effect declines slightly relative to the simple equation, except when using sectoral price; the share effects are negative, as expected in theory and similar to the OLS results; and the interactions are generally positive but insignificant. These results suggest that China's presence in the US market for the common set of products has a direct effect on the Mexican price, and that Mexican producers find their pricing

[9] Using productivity, the first stage are statistically significant, which might suggest that the fit is awful and the first stage wild.

discretion limited by the behaviour of Chinese prices. According to the results using the Japanese price as instrument and ignoring the (insignificant) interaction term, when China enters a market with, say, a 5% market share, Mexican producers reduce their prices by 3.3% (-0.67*5%) and then react to declines in Chinese prices with an elasticity of approximately half. If Chinese prices are falling by 3% per annum, it is the latter effect, which is based on the competitive threat posed by China more than its actual presence that comes to dominate. In this case, the Chinese price effect ranges from 0.54 when there is no Chinese presence to 0.61 when it has a 10% market share. This is not a large increase, but China's market shares do appear to have an impact on Mexico's prices.

Table 4.9: Instrumental Estimates – Full Equation

Price Instrument is:	Productivity	Sector Average Price	Japan Price	Korea Price	China Export Price
China Final Price	0.80	0.78***	0.54***	0.50***	0.61***
	(0.73)	(0.018)	(0.035)	(0.047)	(0.026)
Price*Share	11.7	-0.11	0.076	0.077	0.027
	(61.8)	(0.084)	(0.065)	(0.072)	(0.056)
China Share	-28.1	-0.16	-0.67***	-0.63**	-0.52***
	(144.9)	(0.26)	(0.22)	(0.25)	(0.19)
Hausman	0.01	0	0	0	0
R^2	-4.07	0.22	0.24	0.21	0.22
Product Fixed Effect	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes
First-Stage Regression					
Instrumental Price	-0.41***	0.61***	0.17***	0.11***	0.22***
	(0.092)	(0.011)	(0.006)	(0.005)	(0.006)
Instrumental Price*Share	0.12	0.73***	0.71***	0.63***	0.66***
	(0.12)	(0.019)	(0.013)	(0.012)	(0.012)
Instrumental Share	0.42***	0.62***	0.61***	0.59***	0.69***
	(0.015)	(0.16)	(0.014)	(0.013)	(0.012)
F Statistics					
Instrumental Price	6.92	1176.6	330.73	218.05	521.8
Instrumental Price*Share	163.44	2169.49	2476.97	2675.74	2509.65
Instrumental Share	310.52	2254.52	1892.43	1733.02	2081.98
R^2	0.005	0.101	0.046	0.038	0.061
N	18255	39777	34404	32467	35267
Product Fixed Effect	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes

The Chinese price effects are a little higher in the IV regressions than the OLS results. One possibility is that the IVs correct for errors in observation and hence remove some attenuation bias. Another, however, is that instrumenting reduced the sample sizes in a non-random way. Hence, in Table 4.10 we provide OLS estimates based on exactly the same samples as the corresponding IV equations in Table 4.9. The results are quite clear that the sample does not account for the differences in the estimated price effects – the OLS results on reduced samples are very similar to those in Table 4.9 (full sample) above. On the other hand, it is equally plain that the sample does explain a good deal of the difference in the estimated share and interaction effects. On the reduced samples, even the OLS estimates find negative share effects, albeit of smaller magnitudes than the IV results, and positive interaction effects.

Table 4.10: FE Regressions Using the Same Samples as Table 4.9

Dependent Variable is Mexico's Price					
Price Instrument is:	Productivity	Sector Average Price	Japan Price	Korea Price	China Export Price
China Final Price	0.51***	0.53***	0.51***	0.47***	0.51***
	(0.0080)	(0.0051)	(0.0059)	(0.0062)	(0.0059)
Price*Share	0.32***	0.12***	0.096***	0.17***	0.11***
	(0.044)	(0.020)	(0.022)	(0.023)	(0.021)
China Share	-0.46***	-0.23***	-0.12*	-0.22***	-0.21***
	(0.13)	(0.063)	(0.063)	(0.064)	(0.065)
R^2	0.26	0.27	0.24	0.22	0.23
N	18255	39777	34404	32467	35267
Product Fixed Effect	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes

The results discussed above use single instruments for each of the endogenous variables and hence preclude us from testing their exogeneity. To do this we combined instruments – at the cost of further reductions in sample size, again – and report the corresponding estimates in Table 4.11. The exogeneity condition implies that the instruments used are uncorrelated with the error term, an essential condition for the validity of the IVs. To do this test, we use the Sargan statistics, where the joint null hypothesis is that the instruments are valid. The test shows that the sector average price instrument does not meet the exogeneity requirements, but that the remaining three price instruments – prices reported by Japan, Korea and China and China's share in the

EU – apparently do. Eventually we get rid of the sector means as a possible IV as averaging across the very different products for each sector might seem inconsistent with the product level analysis. This is the set that we take as our definitive set of instruments for the rest of the analysis, although its results are not much different from those using the same instruments individually.

Table 4.11: Instrumental Estimates with Over-identification

Dependent variable is Mexico's price				
	Simple Bivariate Regression		Full Equation	
Instrument sets:	Sector average, Japan price, Korea price, China price, EU share	Japan price, Korea price, China price, EU share	Sector average, Japan price, Korea price, China price, EU share	Japan price, Korea price, China price, EU share,
China Final Price	0.68***	0.57***	0.68***	0.54***
	(0.015)	(0.024)	(0.018)	(0.027)
Price*Share			0.0086	0.080
			(0.051)	(0.054)
China Share			-0.26	-0.51***
			(0.19)	(0.20)
Sargan Test	0.00	0.66	0.00	0.58
Hausman	0	0	0	0
R^2	0.21	0.22	0.20	0.22
N	28362	28391	28122	28151
Product Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes

Our results show that the Chinese price effect is quite similar for the simple bivariate and full equation regression. Using combined instruments, our results are quite similar to that using separate individual IVs. Again, the interaction term is not significant and China's increased influence in the USA keeps Mexico's price down.

4.4.4 Technology Intensity Classification by OECD

We constrain all products to have the same slope (price effect) when we run a fixed effects regression on the whole product set. By categorising products, we postulate different price effects for each category as indicated by their technological intensity. The technological index developed by OECD classifies products according to their level of technology intensity: 'low technology', 'medium low technology', 'medium high technology' and 'high technology' (Hatzichronoglou, 1997). These sectors are classified accordingly by indicators based on the amount of RD expenditure as determined by the OECD, and we classify our products according to the different groups, as in Table 4.12. According to the OECD classification, most of the products (84%) at the HS6 level[10] are classified into the low technology and medium high technology sectors. Only 6% of products are classified into the high technology sector, while about 11% of products are classified as non-industrial.

Table 4.12: OECD Classification - Technological Classification

Description	Products	Percentage
Non-industrial	508	11
Low Technology	1,594	33
Medium Low Technology	802	17
Medium High Technology	1,602	34
High Technology	265	6
Total	4,771	

Source: (OECD, STAN Indicators Database)

We classify China and Mexico's common exports into five different sectors, characterised by their technology intensity, to find the total number of product-years for each group, as in Table 4.13. Most of the common exports between China and Mexico are classified in the low technology (35%), medium low technology (20%) and medium high technology (32%) sectors. To allow for different effects for each sector, we assign one dummy for each of the five OECD sectors, construct the interaction term of the sector dummy with each of the three explanatory variables and allow all coefficients to vary by group.

Table 4.13: Common Exports by OECD Classification (1992-2008)

	Product-Years	**Percentage**
Non-industrial	2808	7
Low Technology	14666	35
Medium Low Technology	8407	20
Medium High Technology	13381	32
High Technology	2409	6
Total	41671	100

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[10] HS92 system.

Equation (4.33) shows the full regression specification for incorporating time dummies and their interaction term, T_k, is a dummy variable that equals 1 for each OECD sector (k=1,..,5) and is coded 0 otherwise. The coefficient β_{1k} represents the Chinese price effect for the five different sectors. β_{2k} and β_{3k} are the interaction and share effect for each sector. Doing this, we come up with a total of fifteen endogeneous variables, five different classifications for each of the three explanatory variables.

$$lnP_{i,t}^{M} = \alpha + \sum_k \beta_{1k} \left(lnP_{i,t}^{C} * T_k\right) + \sum_k \beta_{2k} \left((lnP_{i,t}^{C} * lnS_{i,t}^{C}) * T_k\right) + \sum_k \beta_{3k} \left(lnS_{i,t}^{C} * T_k\right) + \lambda t_i + u_i + \varepsilon_{i,t}$$
(4.33)

The IV regression results for the simple bivariate and full regression are shown in Table 4.14. The instruments we will be using will be a combination of Chinese prices reported by China, Japan and Korea. For the simple bivariate regression, the Chinese price effect has a positive and significant effect on the Mexican price for all sectors, where the effect is strongest for the low technology (0.8) sector and is declining with the level of product sophistication. The low technology sectors are mainly labour intensive and China is still a labour abundant country.

The coefficients for medium low, medium high and high technology products are 0.53, 0.37 and 0.21 respectively. The smaller coverage of the common exports in the high technology sector at 6% of the total sample; according to the OECD technology classification, only 6.4% of total products are classified in this sector. The Chinese price effect is relatively smaller in the more sophisticated sector, which is to be expected, as China's advantage is still in labour-intensive industries. Another factor is that more sophisticated products are generally believed to have lower substitution between varieties. The Chow test (not reported) has a value of 136.9 and so indicates that the differences in the Chinese price effect are statistically significantly across groups. The weaker effect in the non-industrial sector is also expected, as China's exports are stronger in manufactured products.

It would seem that China has now ventured into higher end manufacturing however its role is mainly involved in the process of assembly due to its cheaper labour costs. Although the share of processing trade in total exports has declined for the low, medium low and medium high technology sector, its shares have risen in for the high technology sector, where its share has risen to above 85% since 2000 (Fu, 2011). Fu (2011) also found approximately 90% of China's exports in the technology intensive sector exports are in fact controlled by the MNEs instead of the local enterprises. The involvements of MNEs have led to positive FDI spillovers domestically but have discouraged export participation from local firms. In the processing trade system, productivity plays a lesser role as the MNEs are responsible for the marketing and sale in the destination market. Hence we would expect to see a lower Chinese price influence in the more sophisticated sectors.

Table 4.14: IV Regression by Technology Classification

Dependent variable is Mexico's price		(1) Simple Bivariate Regression	(2) Full Regression
OECD Sector		Combined Instruments	Combined Instruments
Non-industrial	China Price Effect	0.22*	0.16
		(0.13)	(0.16)
Low Technology	China Price Effect	0.86***	0.83***
		(0.028)	(0.035)
Medium Low Technology	China Price Effect	0.53***	0.49***
		(0.056)	(0.095)
Medium High Technology	China Price Effect	0.37***	0.35***
		(0.041)	(0.048)
High Technology	China Price Effect	0.21**	0.39***
		(0.089)	(0.11)
	Sargan Test	0.2	0.00046
	Hausman	0	0
	R^2	0.21	0.21
	Year Fixed Effect	similar for all sector	similar for all sector
	Product Fixed Effect	Yes	Yes
	N	28389	28149

*Combined instruments are Japan price, Korea price, China price.

For the full regression in Column (2), China's influence over Mexico's price is insignificant for the non-industrial sector; however, its effect is quite similar to the results obtained for the simple regression for the other manufacturing sector. The interaction term and Chinese shares (not reported) are mostly insignificant when using the full regression. The Sargan statistic does not satisfy the exogeneity condition, possibly because there might be too many endogenous variables: fifteen by categorising products according to OECD technology intensity, which might cast doubt on the validity of the Sargan test of exogeneity. A potential problem is that the bias of instrumental variable estimators increases with the number of instruments, irrespective of whether they are weak or strong instruments.

Another way to get different effects across sectors is to group products at the HS2 digit level, where we classify all the products into 15 different sectors. The regression results are shown in Appendix 4.2, where for the full regression we only allowed the Chinese price effect to have different slopes across sectors, but constrained the interaction and Chinese shares to be similar across all 15 sectors, otherwise we could end up with too many endogenous variables. The Chinese price influence is mostly in the right direction and significant for the manufacturing sectors. The effect for non-manufacturing sectors like animals and vegetables is insignificant; the transport sector also reported insignificant results for the Chinese price effect. Surprisingly, the IV regression shows an insignificant effect for the footwear sector and this might indicate completely different products between the two countries: China dominated the footwear market and had an average product share of 66% in 2008, whereas Mexico's average product share was less than 5% for the set of common products. The Chinese share and the interaction term, although not significant, show the expected influence in the right direction on Mexico.

4.4.5 Rauch Classification

Another way to seek heterogeneity is to categorise products according to the Rauch classification. The Rauch Classification maps the SITC4 digit level into three different groups of products, namely differentiated, homogeneous and referenced (Rauch, 1999). We need to convert the data to the HS 6 digit level following the concordance table as provided by Comtrade. Rauch defined homogeneous products as those with prices set on organised exchanges: sugar, oil and so on. Goods that do not have their prices set but are assigned a benchmark price are defined as referenced. Finally, products without a reference price and whose price is not set in the exchange market because of their immanent features are labelled differentiated. Rauch suggested two definitions, a conservative and a liberal one, in order to account for the difference in product classification. Liberal pricing maximises the number of products that are categorised as homogeneous, while conservative pricing minimises the number of products. There are relatively fewer products classified as homogeneous under the conservative system as compared to the liberal definition. Under the liberal regime, we found that about 70% of China's products in direct competition with Mexico are categorised as differentiated products while about 5% are categorised as homogeneous products. Kang (2008) found that China's export structure is mainly concentrated in differentiated products. If products are homogeneous, competition is based strongly on pricing and we would expect tougher competition between countries. Homogeneous products tend to have a larger elasticity of substitution as their prices are set at organised exchange market and hence exports tend to be weaker between distant countries. We report the regression results using for the liberal classification in Table 4.15.

Table 4.15: Rauch Classification: Liberal (Simple Specification Regression)

Dependent Variable is Mexico's Price			
	(1)	(2)	(3)
Instrument is	Japan Price	Korea Price	China Export Price
China's Price			
(Homogeneous)	0.87***	0.81***	0.92***
	(0.061)	(0.049)	(0.046)
(Referenced)	0.49***	0.40***	0.33***
	(0.082)	(0.080)	(0.062)
(Differentiated)	0.57***	0.54***	0.65***
	(0.036)	(0.049)	(0.031)
Hausman	0	0	0
R^2	0.23	0.21	0.22
N	33642	31743	34437
Product Fixed Effect	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes

Theory would suggest that the degree of substitution to be smaller between two countries for products which are differentiated (Dixit and Stiglitz, 1977). China's main export sector is in manufactures (differentiated products) and its market presence is considerably weaker for primary products (homogeneous). For differentiated products, we have argued that Chinese and Mexico's products are close substitutes as they are both middle income countries; both countries compete in terms of pricing in the US market. This is consistent with the results which show that the Chinese price effect is around 0.54 to 0.65 for differentiated products; which is smaller than the estimates for homogeneous products. For homogeneous products, China's price elasticity is around 0.9 i.e. when China's price drop by 10%, Mexico will retaliate by reducing its price by around 9%. The higher price elasticity for homogeneous products is as expected because of less scope for product differentiation i.e. we would expect commodities like sugar to have a higher degree of substitutability. China's export success are mostly in manufactures and our results show that the cheaper Chinese products have constrained the Mexico's pricing, supporting the hypothesis that products from these countries are seen as close substitutes. The Hausman test again supports the use of IV regression. The Chow test (not reported) shows that the Chinese price effect is statistically significantly different across groups.

4.4.6 Non-Tariff Barriers

China not only faced relatively higher tariffs than Mexico, but the USA also imposed other restrictions on imports from China, particularly through non-tariff barriers (NTB). The Multi-Fibre Arrangement (MFA) is one example of an NTB in which we are interested, under which developed countries like the USA set quotas on textile imports from developing countries like China. The impact of the MFA was seen as a way to raise the domestic price of clothing by limiting imports from cheaper developing countries. Another impact of MFA came from regional trade agreements like NAFTA, under which Mexico indirectly benefited from US quotas on its competitors. The quotas removed the competitive threat, because Chinese exports into the USA cannot increase beyond a certain amount. Under the Uruguay Round, the MFA was replaced by the Agreement on Textiles and Clothing (ATC) in 1995. This started the process of gradually removing the quotas on textiles and clothing products in four phases, as shown in Table 4.16.

Table 4.16: Phase-out Schedule

Phase	Starting Date	Share of Export Volume	Increase in Quota Growth Rate
1	January 1,	16	16
2	January 1,	17	25
3	January 1,	18	27
4	January 1,	49	n/a

Source: US Office of Textile and Apparel (OTEXA)

The abolition of quotas on textiles was completed in 2005. The importing country has the power to choose which set of products to include for each phase-out period, as long as it complies with the shares of its export volume integrated where generally the least sensitive products were integrated.

The product headings that were dropped off the quota list according to each phase were obtained from the US Office of Textiles and Apparel (OTEXA). Suppose that a product coded 420292 is in phase 3; we drop this product for all years prior to 2002, as the USA imposed a restriction on this product. Any quotas imposed on this product will be lifted starting in 2002. However, as China was not a member of the WTO until December 2001, it was not entitled to the first two phases of the schedule, but quotas were only lifted after 2002. The data for each phase-out are available from OTEXA at the HTS 10 digit level. By matching all products for the four phases to the HS6 digit level, we dropped over 5000 product-years. The non-tariff barrier might cause a bias in the Chinese price effect, as Mexico is protected by the MFA and hence its prices will not be very responsive to the predicted Chinese price in the textiles industry. The other NTB that we managed to find is that related to anti-dumping duties, and we dropped a further 200 product-years from our sample. After cleaning out the sample for products associated with NTB, we ran our IV regression and the results are shown in Table 4.17.

Table 4.17: IV Regression (Remove Non-Tariff Barriers)

Dependent Variable is Mexico’s Price		
	(1) Simple Regression	(2) Full Regression
	Combined Instruments	Combined Instruments
China Final Price	0.54***	0.53***
	(0.026)	(0.029)
Price*Share		0.009
		(0.056)
China Share		-0.15
		(0.21)
Sargan Test	0.58	0.78
Hausman Test	0.15	0.00
R^2	0.23	0.23
N	24173	23968
Year Fixed Effect	Yes	Yes
Product Fixed Effect	Yes	Yes

*Combined instruments are Japan price, Korea price, China price.

Our results for the Chinese price effect are the same as before. If on average China drops its price by 10%, Mexico will respond by dropping its price by around 5.3%. The partial effect of share has the expected negative sign, but is not significant and the interaction term is also statistically insignificant.

4.4.7 Established Products

Our sample is an unbalanced panel where products sometimes drop out and new products are introduced in some years. The Chinese price effect might be different for 'new' products and 'established' products. We consider a product to be more established if China exports it for a longer period of time; that is, when China exports to the US market consecutively for a period of five years. We expect that Mexico might react differently to China's prices on those established products from China as compared to products that China has just started exporting. The example in Table 4.18 provides a better explanation of how an established Chinese product is being selected.

Products X, Y and Z provide examples of products that China exported to the USA from 1992 until 1998. In this example, only product Y will be selected as an established product from 1994 to 2008, as China exported Y for five consecutive years, while both products X and Z showed some inconsistency where the product was not being exported in certain years. Product Y flips from an established product before 1994 to an established one after five years of trade. We did this for our sample and obtained a list of products where China has reported consecutive exports for five years or more; this is termed the set of established products. Those products that China exported for a sequence of less than five years, we termed unestablished products.

Table 4.18: Example of Established Products

Period (t)	Product	Product	Product
China Exports to US	X	Y	Z
1992	1	0	0
1993	0	0	1
1994	0	1	0
1995	1	1	1
1996	0	1	1
1997	1	1	0
1998	1	1	1

Although our sample started from 1992, this does not necessary mean that the first year of Chinese exports for a particular product was 1992. The product could have been exported in the previous year, which is not shown in our sample data set. To solve this problem, we used only those products where China did not report any exports to the

USA in 1992 for the unestablished products. This process will help identify that the year 1992 is not the first year of exports, which is particularly important for the identification of unestablished products. This identification problem is not important for the set of established products, as an established product is still considered established even if China exported that product before 1992, although we could have missed some observations for established products.

An example might make this clearer. Product X is not considered an established product because it was exported for only three years, namely 1992, 1993 and 1994. Although this product might be an established product if China could have exported product X before 1992 – that is, in 1990 and 1991 – the product will be dropped for our established product set. It will also not appear in our unestablished product set, as China exported product X in 1992.

We then divided Chinese exports into two samples, where Sample 1 consists of observations where a Chinese product existed in the US market for at least five years and Sample 2 consists of Chinese exports during its first four years of competition. After dropping observations for 1992 and using IVs, we are left with fewer observations for the two different groups; we have over 7000 observations[11] for the unestablished products and about 18,000 observations for the established products.

The regression results for the established and unestablished products are shown in Table 4.19. For established products, the Chinese price effect is statistically significant at 0.53, while it is relatively lower at 0.38 for unestablished products. The Sargan statistic indicates the exogeneity of our combined instruments, while the Hausman test supports the case for using IV regression for both groups. The Chinese price effect is stronger for established products, but our results show that shares are no longer significant. This would indicate that if China is established in that product, it represents a credible threat even if actual trade is not large.

[11] We lose quite a number of observations for unestablished products after dropping 1992 and those that China does not export to Japan, South Korea and the ROW.

For unestablished products, suppose that China enters the market with an insignificant share (0%), then its price effect will be 0.38, but if China enters the market with a 10% share, the Chinese price effect will increase to 0.44. This is quite a significant increase considering that many of China's products occupy more than 10% of market share. The effects of China's share are also considerably large in those products in which China has a 10% market share, where Mexico's price will be 13.7% lower. From our calculations, China has on average a 14% product share for unestablished products. Unestablished products are considered relatively new in the market and it is quite likely that China might be more dynamic in its pricing, although we are unable to tell as we take the Chinese price as given; Mexico's pricing might also react differently to the scale of these Chinese products, which are just trying to establish themselves in the market. If Chinese products enter on a larger scale, there might be more pressure on Mexico to respond compared to smaller-scale exports. A larger Chinese share shows a more credible threat for the future. The Hausman test does not support the use of IV for the unestablished set.

Table 4.19: IV Regression (Established Products)

Dependent Variable is Mexico's Price		
Instrumented Using	(1)	(2)
Japan, Korea, China, EU Shares	Established	Unestablished
	(>= 5 years)	(<5 years)
	IV	IV
China Final Price	0.53***	0.38***
	(0.033)	(0.11)
Price*Share	0.016	0.63***
	(0.062)	(0.23)
China Share	-0.39	-1.37*
	(0.25)	(0.71)
Sargan Test	0.35	0.12
Hausman Test (p-value)	0	0.53
R^2	0.21	0.12
N	17989	7229
Year Fixed Effect	Yes	Yes
Product Fixed Effect	Yes	Yes
Hausman Test (p-value)	0	0

4.4.8 Clean Products

To avoid the classification problems, we checked the regression results with the clean sample set. There have been three HS changes since 1992, namely the HS96, HS02 and

HS07 revisions. The HS is regularly updated to accommodate the emergence of new products and the disappearance of previously existing products. As a reminder, products that have not undergone any HS code changes during the conversion are considered clean products, while mixed products are those that have undergone HS changes. The data samples set that we have used for the above regressions is the combined set of clean and mixed products, which can be termed the ‘complete’ set of products.

In Table 4.20, the IV regression results for the clean products show that the Chinese price effect is 0.52 for the full regression and is slightly higher at 0.59 for the simple bivariate regression. The result shows that shares do matter: if China has a 10% share in the market, Mexico’s price will be 72% lower, which is a big influence considering China’s large share in the USA. The effect of shares on the Chinese price effect is also significant at 0.15. This means that the Chinese price effect will increase by 0.015 for every 10% increase in its shares. The Sargan and endogeneity test again support the IV regression.

Table 4.20: Clean Products

Dependent Variable is Mexico’s Price		
Intrumented Using	(1)	(2)
Japan, Korea, China, EU Shares	IV Regression	IV Regression
	simple	full
China Final Price	0.59***	0.52***
	(0.028)	(0.032)
Price*Share		0.15**
		(0.064)
China Share		-0.72***
		(0.21)
Sargan Test	0.25	0.070
Hausman Test	0.0	0.0
R^2	0.26	0.26
N	21499	21307
Year Fixed Effect	Yes	Yes
Product Fixed Effect	Yes	Yes

4.5 Robustness Tests

The above experiments make use of fixed effects IV regressions to solve for specific product effects and also the endogeneity issue for the Chinese price. In this section, we will examine various other specifications and estimate methods to see how our core specification estimates behave under different assumptions.

4.5.1 Taking out Global Price Trends in Product Prices (IV Estimates)

There is a danger that the connection between Mexican and Chinese prices reflects not a causal link but a common trend due to both being determined by world prices for the products concerned. In order to take these trends into account, we controlled for the variable$lnP_{it}^{globalP}$, which is the global export unit price at the product level. It included in our IV fixed effects regression. We obtained the global export price for each HS 6-digit product by calculating the unit price for each product. The products' unit price is obtained by dividing total world export value by the total quantity exported, having netted out China and Mexico's exports to the USA so as to avoid the problem of double counting. The specification with the global price index as shown in Equation (4.34) is also consistent with controlling for other competitor's price in the US market. The assumption is that the global export price is exogenous.

$$lnP_{it}^{M} = \beta_0 + \beta_1 lnP_{it}^{C} + \beta_2(\ln P_{it}^{c} * S_{it}^{C}) + \beta_3 S_{it}^{C} + \beta_4 lnP_{it}^{globalP} + u_i + \lambda_t + \varepsilon_{it} \qquad (4.34)$$

The results of this estimation, reported in Table 4.21 suggest that even allowing for any common price trends, China's presence in the US market for the common set of products has a direct effect on the Mexican price, and that Mexican producers find their pricing discretion limited by the behaviour of Chinese prices. The global export price has a positive effect on Mexico's price and has explained part of the variation in that price. The share effect is less consistent than the price effect. We found that the Chinese price effects are all still statistically significant (ranges from 0.3 to 0.47) after controlling for the global price trend and China's market share. This is perhaps the most convincing result as it is consistent controlling for other competitors.

Table 4.21: Instrumental Estimates – Full Equation

Dependent variable is Mexico's price			
	(1)	(2)	(3)
Instrument is	Japan Price	Korea Price	China Export Price
China Final Price	0.38***	0.30***	0.47***
	(0.068)	(0.100)	(0.051)
Price*Share	0.056	0.033	0.13**
	(0.072)	(0.085)	(0.063)
China Share	-0.18	-0.030	-0.42**
	(0.22)	(0.24)	(0.19)
Global Export Price	0.34***	0.38***	0.27***
	(0.042)	(0.061)	(0.029)
Hausman	0.2	0	0
R^2	0.28	0.26	0.25
Product Fixed Effect	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes
Wald F Test	71.3	34.4	125.5
First-Stage Regression			
Instrumental Price	0.12***	0.075***	0.16***
	(0.0084)	(0.0072)	(0.0088)
Instrumental Price*Share	0.71***	0.63***	0.70***
	(0.030)	(0.028)	(0.031)
Instrumental Share	0.61***	0.59***	0.70***
	(0.022)	(0.021)	(0.018)
N	34248	34248	34970
Product Fixed Effect	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes

*standard errors in parenthesis are robust to heteroskedasticity

That the Chinese price effect remains so well defined and strong after the allowance for global price trends is a powerful result. It insulates our conclusions from the fear that all we are picking up is a general model of price setting between multiple competitors and validates our identifying assumption that Chinese productivity growth and its corresponding reduction in prices is the major shock to the US import market over the 1990s and 2000s. Some scholars have argued that indeed this should be our main specification of the pricing equation. We have some sympathy with this view but have persisted with our simple bi-lateral model because it is cleaner as Mexico and China are so clearly competing against each other in the USA. It is a great comfort, however, that this issue of specification has so little effect on our basic conclusion.

4.5.1 First Difference

There is also the worry that there exists a common trend causing both P_{it}^{M} and P_{it}^{C} to be moving in the same direction over time, thus we need to control for time trend. Although our assumption is that China provides the largest shock since the early 1990s, a potential problem that can occur is when P_{it}^{M} and P_{it}^{C} both follow a deterministic common trend where each might actually be independent of each other. If this is the case, first differencing provides a way to get rid of the trend and will give unbiased results. The first difference method is another way to get rid of the time-invariant unobserved effect. The fixed effects method is more efficient when the error term u_{it} is serially uncorrelated (Wooldridge, 2009). However, if the error term follows a trend (serial correlation) the first difference method is better, as the Δu_{it} will be serially uncorrelated. Thus using first difference will detrend the variable to make it stationary. The first difference model can be represented by the following equations:

$$P_{it}^{M} = \alpha_i + \gamma_i t + \beta P_{it}^{C} + \mathrm{u_{it}} \qquad (4.35a)$$

$$P_{it-1}^{M} = \alpha_i + \gamma_i t + \beta P_{it-1}^{C} + \mathrm{u_{it-1}} \qquad (4.35b)$$

$$\Delta P_{it}^{M} = \mathrm{\gamma_i} + \beta \Delta P_{it}^{C} + \Delta \mathrm{u_{it}} \qquad (4.35c)$$

First differencing will get rid of the unobserved time invariant factors α_i and get rid of the linear time trend (t) for both China’s and Mexico's prices in Equations (4.35). If we assume the trend to be product specific, then we are still left with the time-invariant product-specific effect $\mathrm{\gamma_i}$ in Equation (4.35c). In this case, first difference fixed effects estimation will get rid of the product-specific trend. To correct for endogeneity issues, we use IV fixed effects regression for the first difference. The regression results for the first difference method are shown in Table 4.22.

Using the first difference method, the Chinese price effect is significant at 0.32 under the OLS estimates. The first difference method in Column (1) has a single constant trend effect. The interaction term and the shares are all significant and have the expected signs. However, to get rid of the product-specific time trend – that is, common productivity shocks for the different products – we take the fixed effects of the first difference. We get similar results for the Chinese price effect; the interaction and shares are also very similar. This suggests that the Chinese price effect is genuine and that this effect is not a result of a product-specific time trend causing both China's and Mexico's prices to move together.

We use IV to solve for the possible endogeneity in Chinese prices. The Chinese price effect weakens slightly to 0.29 and is expected to increase by 0.06 for every 10% increase in shares. The partial effect of shares is not significant using this method. However, all three regressions show that the Chinese price effect is significant and has a positive influence on Mexico's price.

Table 4.22: First Difference and Fixed Effects of First Difference

Dependent Variable is the first difference of Mexico's Price			
	(1) OLS	(2) OLS	(3) IV
	First Difference	First Difference Fixed Effects	First Difference Fixed Effects
d.china_FinalPrice	0.32***	0.32***	0.29***
	(0.0062)	(0.0067)	(0.10)
d.interaction	0.41***	0.46***	0.56*
	(0.029)	(0.032)	(0.29)
d.China share	-0.74***	-0.81***	-0.13
	(0.090)	(0.097)	(1.03)
constant	0.019***		
	(0.0045)		
Sargan			0.038
R^2	0.10	0.099	0.034
N	33666	33666	21875

4.5.2 Long Difference

China's rapid growth over the past few decades is impressive and as long as China can maintain its productivity, Chinese competition is here to stay and is a long-run issue Griliches and Hausman (1986). The long difference method is another way to get rid of a product-specific effect by differencing observations that are more than one period apart (Griliches and Hausman, 1986). Observations are taken to be less correlated with each other in longer-run phenomena as compared to one year apart. However, we suffer from a further loss of observations when using long difference. We ran a regression using long difference by differencing each product for every eight years. Each product had a maximum of two observations for our 17-year sample period (1992-2008). The first observation for a product is the difference between the 9th year and the 1st year of Chinese exports; if China exports this product in the 17th year, the 2nd observation will be recorded. As shown in Table 4.23, the Chinese price effect is still significant and ranges from 0.63 to 0.72 depending on the number lags we use. Using lags of 16 where we take the difference in the unit price between 2008 and 1992 ($P_{2008} - P_{1992}$), we obtained a coefficient of 0.72. The coefficients of the trade shares for both Mexico and China are not very significant for predicting changes in Mexico's price.

Table 4.23: Long Difference

	Long Difference (OLS)	
	lag 8	lag 16
China price	0.63***	0.72***
	(0.015)	(0.029)
Price*Share	0.071	-0.11
	(0.061)	(0.090)
China share	0.031	-0.38
	(0.19)	(0.30)
constant	0.14***	0.22***
	(0.025)	(0.062)
R^2	0.35	0.46
N	3578	801

4.5.3 Regressing Mexican Price on EU price in the USA

Our assumption is that China is the shock that is exerting competitive pressure on the other countries, especially developing countries like Mexico. However, in the interest of completeness, we wanted to check if Mexico’s prices are affected by the EU countries’ prices in the USA. In Equation (4.36), our results show that the EU price is insignificant in the IV regression, but is positive and significant in Equation (4.37) after taking into account global trends. We use EU prices to Japan to instrument for EU prices in the USA.

$$lnP_{it}^{M} = A + \beta_1 lnP_{it}^{EU} + u_i + \lambda_t + \varepsilon_{it} \quad (4.36)$$

$$lnP_{it}^{M} = A + \beta_1 lnP_{it}^{EU} + B_4 lnP_{it}^{globalP} + u_i + \lambda_t + \varepsilon_{it} \quad (4.37)$$

Using OLS fixed effects that are not reported, we found that Mexico will reduce its price by 5.5% if the EU drops its price by 10% in the US market. In OLS, prices are all linked, but when we get to IV we expect to see weaker results. The IV regression results are shown in Table 4.24; the EU price effect on Mexico is not significant, as shown in Column (1), and the Hausman test does not support the use of IV regression. The regression seems implausible with a negative R^2; we then decided to take out the trends in product prices by controlling for global export prices (excluding Mexico and EU exports to the USA). After controlling for global price trends, the EU price effect is now positive but very large at 1.17, although we still get a very low R^2; the results also show that the global price does not affect Mexico's price in the USA.

Table 4.24: Regressing Mexico on EU price

Dependent Variable is Mexico's Price		
	(1)	(2)
Instrument is	EU price in Japan	EU price in Japan
EU Price	1.44	1.17***
	(1.13)	(0.34)
Global Export Price		-0.078
		(0.20)
Hausman Test	0.35	0
R^2	-0.19	0.031
N	37607	37597
Product Fixed Effect	Yes	Yes
Time Fixed Effect	Yes	Yes

4.5.4 Regressing China on Mexico's Price (Mexico's Price Effect)

In the Bertrand model, there exists the problem of endogeneity in product price and hence the estimates will be biased. In looking at the Chinese price effect, we identified that the increasing Chinese productivity as the exogenous shock on Mexico's price. However when looking at Mexico's price effect, it is quite hard to find a suitable instrument for Mexico's price in the USA, as China is a major exporter to many countries (China has a 10% share in Canada for 2008) while Mexico's main export market is the USA. Although not a suitable instrument, we chose Mexico's price to Canada to instrument for its price in the USA. We note that the estimate will be biased if because of endogeneity in product prices especially when there are no suitable instruments available. In the interest of completeness, we also regressed Chinese prices on Mexico in the USA following Equation (4.38) and the results are shown in Table 4.25.

$$lnP_{it}^{C} = A + \beta_1 lnP_{it}^{M} + \beta_3 lnP_{it}^{GlobalP} u_i + \lambda_t + \varepsilon_{it} \quad (4.38)$$

Mexico's price effect on China is positive and significant, as shown in Table 4.25 when we control for the global price trend. However, the instrumenting problem above and our arguments thus far about the dynamism of Chinese exports, which is widely seen as a causal shock, lead us to expect the correlations.

Table 4.25: Regressing China on Mexico's Price

Dependent Variable is Mexico's Price	(1)
Instrument is	Canada price
Mexico Price	0.43***
	(0.062)
Global Export Price	0.31***
	(0.033)
Hausman	0.02
R^2	0.28
N	24477
Product Fixed Effect	Yes
Time Dummies	Yes

4.5.5 Using Lagged Japan, Korea Price and China price as IV

Given the price interactions between products that are possible substitutes and the increasing globalisation and transparency in trade price data, we use one year lag of Japan. Korea and China prices as possible IV as a robustness test. We loose some observations when using one year lag of the selected instruments as compared to using current spontaneous prices. The Chinese price effect is still statistically significant and is in the range from 0.38 to 0.54 as shown in Table 4.26. Overall the test result show that the Chinese price effect is present while the share effects are less well defined and less robust.

Table 4.26: Using Lag (1) for Japan, Korea and China's Price as IV

Dependent Variable is Mexico's Price			
	(1)	(2)	(3)
Instruments are	Lag Japan Price	Lag Korea Price	Lag China Export Price
China Final Price	0.38***	0.54***	0.53***
	(0.060)	(0.14)	(0.058)
Price*Share	-0.058	-0.089	0.047
	(0.068)	(0.077)	(0.060)
China Share	0.094	0.14	-0.27
	(0.22)	(0.23)	(0.21)
Global Price	0.34***	0.24***	0.22***
	(0.036)	(0.083)	(0.034)
Hausman	0	0	0
R^2	0.29	0.27	0.26
N	29153	27386	29785
Wald F Test	115.9	22.6	121.9
Product Fixed Effect	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes

4.5.6 Distribution of Coefficients by Product

Our sample consists of more than 4000 products. We ran separate regressions by product to obtain their individual coefficients; each product now has its own slope. The regressions were done for products that are in the common exports for both China and Mexico and that are present for at least eight years. We ran the simple OLS regression and also the simple bivariate equation by product, controlling for the endogeneity in Chinese price using the combined IVs. This regression was run using Equation (4.39) and the results are shown in Table 4.27.

$$P_i^M = \gamma_i + \beta_i P_i^C + e_{i,t} \quad (4.39)$$

For the OLS regression, we are left with 1256 products and the average price effect at 0.72.We get slightly fewer observations when using IV regression; at the individual level the average Chinese price effect is similar at around 0.74.. On average the Chinese price effect is around 0.74, which is still about what we obtained with the IV estimates, it is nonetheless positive and consistent with the overall story.

Table 4.27: Summary Statistics of Chinese Price Coefficients

	Variable	Products	Mean of Parameter Estimate –Chinese Price Effect	SE of Mean
OLS Estimates	For Exports ≥ 8 years	1256	0.72	0.02
IV Estimates	For Exports ≥ 8 years	1101	0.74	0.05

*all estimates are significant at 10%

Figure 4.9 (OLS) and Figure 4.10 (IV) shows the Kernel density function and also the normal distribution function for β_i, where i represents each product heading. Kernel density plots are usually a much more effective way to view the distribution of a variable, which in our case is the coefficient of Chinese price. Most of the estimates are concentrated around the mean and have higher peaks around the mean compared to the normal distribution. However, we feel reasonably assured that on average the Chinese price effect has the correct positive sign and is consistent with the overall story.

Figure 4.10: Distribution of Coefficients (OLS)

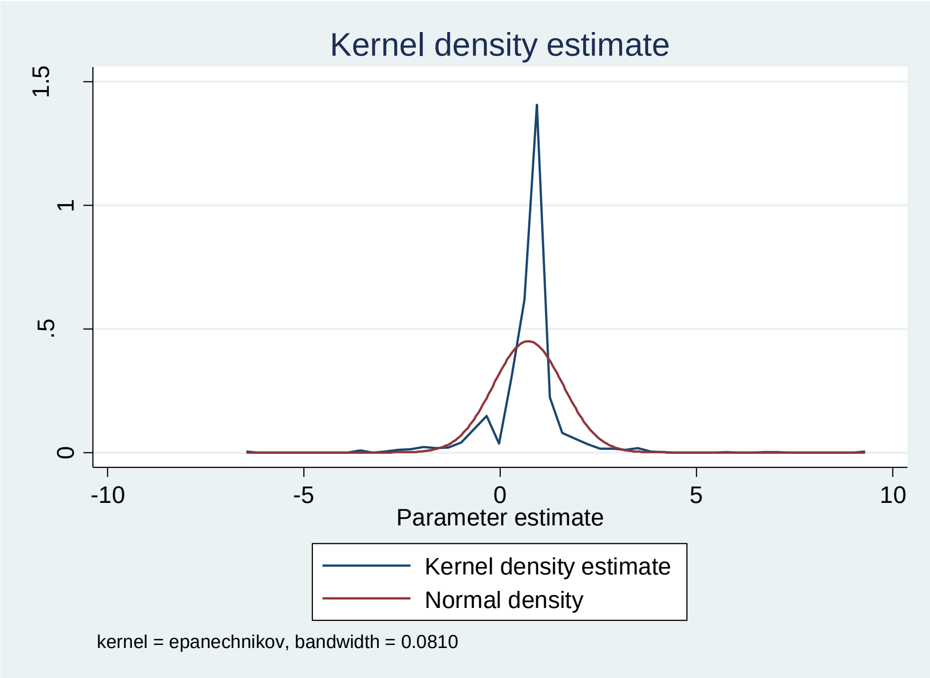
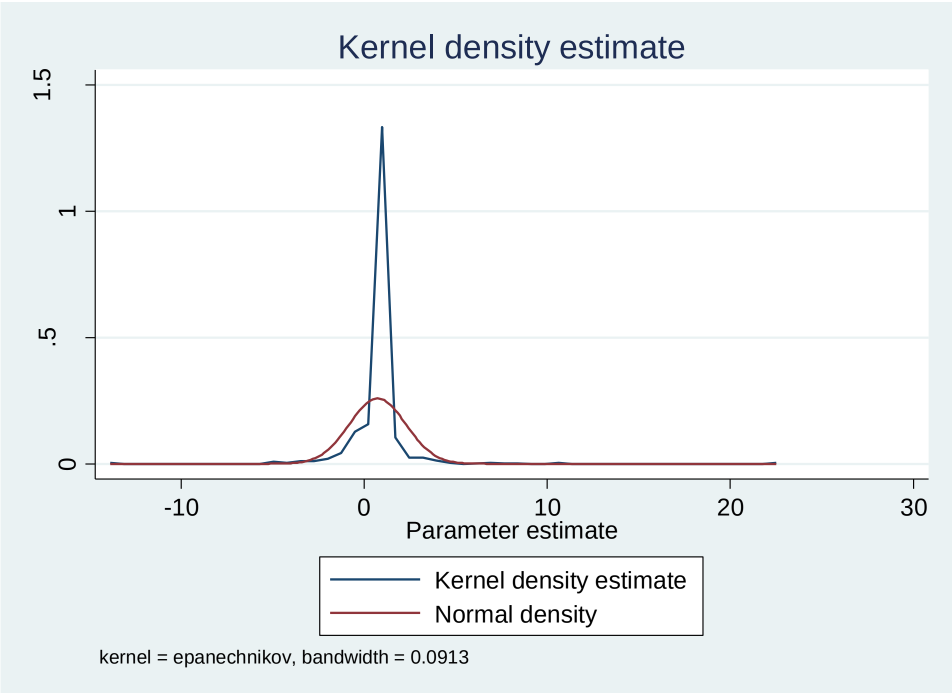


Figure 4.11: Distribution of Coefficients (IV)



4.6 Conclusion

The regressions carried out at the product level comprise around 42,000 observations when working with the common set of exports. Because of the noise surrounding the unit price, we removed outliers that could lead to a bias in our estimates. We need to solve for endogeneity in the Bertrand model by choosing suitable instruments for the Chinese price i.e. Japan price, Korea price and China's reported price. Our main finding is that the Chinese price effect is significant and positive after subjecting it to several robustness tests. Although the effect of shares and the interaction term do have the expected signs, they sometimes fail to provide significant effects. Overall, our results suggest that a 1% fall in Chinese price will cause Mexico to lower its price by 0.5%; the Chinese price effect, however, ranges from 0.3 to 0.68 when using the combined set of instruments (Japan, Korea and Chinese reported price). The Hausman identification test has helped to support the case for IV regression on which most of our latter regression results are based. In order to take into account for the other competitors' effect on Mexico's price, we run the main specification using the global price. The Chinese price effect dropped slightly to around 0.3 to 0.47 (not including sector average) as the global price has perhaps explained part of the variation in Mexico's price. This is perhaps the most convincing result as it is consistent controlling for other competitors. We got rid of the trend by using the fixed effects of the first difference; the price effect falls to around 0.29 to 0.32. We also got rid of those observations where NTB have been imposed; the Chinese price effect is still around 0.5.

By classifying products accordingly to the Rauch classification, we found the Chinese price effect to be greater for homogenous products; this is expected as there is a lesser degree of differentiation and greater degree of price competition in this category. For differentiated products the Chinese price effect is around 0.51 to 0.75 and is statistically significant. For manufactured products (differentiated), there will be price competition between China and Mexico as their products are seen as closer substitutes.

We also found the Chinese price effect to be stronger for the low technology and medium low technology sector. We postulate that Chinese competition is largely in terms of prices, driven by rapidly increasing productivity and scale in Chinese industry. However for sophisticated products which usually involves processing trade, productivity plays a lesser role as the MNEs are responsible for the marketing and sale in the destination market. Hence inferences on the Chinese price effect in the more sophisticated need to be taken with caution.

The study also showed that the changes brought about by the HS revisions do not seem to have much influence on the Chinese price effect, as shown in our clean and complete set of products. The definition of an ‘established’ product is subjective; in our study we define established products as those that have been on the market for five years or more. China’s price effect is slightly smaller for the unestablished set of products, but one interesting finding is that China's import share for newer products in the market matters to Mexico, while only price matters for the set of established products.

We conclude that the Chinese price effect is significant and positive after subjecting it to several robustness tests. The share effects are less well defined and smaller than the price effect. The China effect is existential. We do acknowledge that the Chinese price effect is not based only on the common basket of exports, but China also has a price influence on products that it has the potential to export in future. The study of potential competition will be our main objective in the next chapter.

Appendices for Chapter 4

Appendix 4.1: Balanced and Unbalanced Set

	Balanced Set		Unbalanced Set		Share of Trade
Sector	Product Headings	Billions USD	Product Headings	Billions USD	(Balanced/Unbalanced)
Animals (0)	272	12.90	707	14.00	0.92
Vegetables (1)	510	3.89	1809	6.38	0.61
Foodstuffs (2)	544	8.62	1346	13.30	0.65
Minerals (3)	119	11.20	778	14.80	0.76
Chemicals (4)	884	10.90	5010	33.30	0.33
Plastics (5)	476	23.30	2112	73.20	0.32
LF (6)	136	20.30	601	69.60	0.29
Wood (7)	595	22.80	1911	47.70	0.48
Textiles (8)	2992	176.00	8228	223.00	0.79
Footwear (9)	306	29.50	697	181.00	0.16
Stone (10)	391	8.10	1567	43.10	0.19
Metals (11)	1411	41.40	5324	125.00	0.33
Machinery (12)	2091	471.00	7507	821.00	0.57
Transport (13)	102	12.20	897	40.30	0.30
Misc (14)	765	100.00	3213	416.00	0.24
Total	11594	952.11	41707	2121.68	

*Data obtained from Comtrade and derived using own calculations
*There are 682 products for each of the 17 years (1992-2008) for the balanced set

Appendix 4.2: Sectoral Classification

	(1)	(2)
	IV Simple regression	IV Full regression
Animals (0)	-0.11	-0.097
	(0.29)	(0.28)
Vegetables (1)	0.25	0.25
	(0.18)	(0.18)
Foodstuffs (2)	0.82***	0.72***
	(0.073)	(0.082)
Minerals (3)	0.60***	0.51***
	(0.17)	(0.18)
Chemicals (4)	0.17***	0.17**
	(0.065)	(0.066)
Plastics (5)	0.58***	0.57***
	(0.093)	(0.092)
LF (6)	0.64***	0.65***
	(0.11)	(0.11)
Wood (7)	0.98***	0.98***
	(0.039)	(0.039)
Textiles (8)	0.84***	0.83***
	(0.041)	(0.044)
Footwear (9)	0.29	0.27
	(0.31)	(0.31)
Stone (10)	0.73***	0.70***
	(0.26)	(0.25)
Metals(11)	0.50***	0.50***
	(0.059)	(0.059)
Machinery (12)	0.45***	0.44***
	(0.049)	(0.052)
Transport (13)	-0.11	-0.14
	(0.22)	(0.22)
Misc (14)	0.51***	0.49***
	(0.065)	(0.069)
Price*Share		0.020
		(0.057)
China share		-0.11
		(0.21)
R^2	0.21	0.21
N	28391	28151
Sargan	0.00080	0.0012

5. Potential Competition

5.1 Introduction

China is an important player in the world and is considered a price setter in many products. As emphasised in the chapter on actual competition, a product is categorised at the HS 6 digit level. In 1992, China's direct influence covered just about 65% of Mexico's products exported to the USA and this grew to 92% in 2008. Although China exports most of the products that Mexico exports to the USA, there are still some products in which Mexico does not face direct competition. Our study here is an extension of actual competition in several ways. In actual competition, we are using the sample that covers 83% of Mexico's total product-years to the US market for the period from 1992-2008. This chapter will look at the remaining 17% of Mexico's product-years in which there is no Chinese presence in the US market. The products that China has not yet exported to the US market are termed 'potential products' and the main objective of this chapter is to find Mexico's price reaction to China's price for this particular set of products. The threat of China entering the market might act as a reminder constraining Mexico from charging a higher price, deterring China from entering or returning to the market.

We identify China's threat of entry by identifying products where China exports to other markets, arguing that it will easier for China to shift its supply to the USA as the productive capacities are already in place. Andrews (1949), one of the pioneers of 'potential competition', emphasised the concept of 'cross-entry competition', where firms that are already established in other closely related products can diversify and move into the market if conditions are right. In the context of international trade, the work by Schiff and Chang (2003) is to our knowledge the only literature related to potential competition. Although there has not been much study done on potential competition in international trade, this concept is popular in studies of airline and retail markets. In the context of potential competition, the Chinese competitive effect on Mexico is not constrained to products in which China is present in the market, but extends to the set of products that China has the potential to export.

We assume that the Chinese competitive effect occurs even before actual competition takes place. One of the problems arising when doing this exercise is to find the estimated Chinese prices in the US market for the set of products in potential competition, as there is no trade on these products reported by the USA. This thesis will use China's exports as reported by Japan and Korea, for reasons explained in the actual competition chapter, in order to predict Chinese prices on the set of potential products to the US market. We will also use China's reported price to the ROW other than the USA to predict China's price for potential products in the US market. All regressions will be done using fixed effects to eliminate constant but unobservable differences across products. The model is very loosely related to Bertrand price competition, but behaves more like limit pricing, with two firms exporting to a third market, where the incumbent firm will respond to the likely prices of the entrants. This chapter aims to investigate the effect of changes in China's predicted export prices on Mexico's export prices in the US market for the set of potential products. The unit price for a potential product is the predicted price based on China's prices to other markets.

Another way to identify potential competition is to look at Mexico's price pattern before and after China's first entry, which we term the temporal dimension of Chinese competition. If China threatens to enter the market, Mexico will be constrained to charge a lower price to keep China out of the market in order to gain a bigger share of it. However, actual Chinese prices in the US market can only be observed when Mexico has failed, which leads to China's first entry or return to the US market. To isolate this shock, we will use the logit model to find the propensity of China to enter the US market, which is independent of Mexican firms' pricing decisions. China's probability of exporting a potential product depends on its establishment of other closely related products where resources are assumed to shift easily between products. Chinese competitiveness to the ROW in a particular product is a vital factor that can assist China's first batch of exports into the US market in period t as well. We calculate the Revealed Comparative Advantage (RCA) index at the product level and use it as an indicator to measure China's competitiveness in potential products. Our assumptions are that China's entry into the US market is a consequence of the increased level of competitiveness brought about by its increased productivity, and that China's entry is independent of Mexico's pricing strategy.

This chapter is organised as follows. The next section will provide discussion of some of the literature on potential competition. We then proceed to give an overview of the potential competition model and also some stylised facts on the potential products. We will explain our model specification and discuss the data and sample selection, which will be followed by the regression results. Another method of looking at potential competition is by considering the temporal price effect, which will then be discussed and examined.

5.2 Literature Review

Among the early pioneers of price competition, Hall and Hitch (1939) conducted questionnaire interviews and found that most firms do not behave according to the marginal cost pricing rule principle, but instead price their products based on the ‘full cost’ or average cost of production. Firms usually do not charge above their full costs, fearing that higher profits might encourage potential entrants to the market. Oligopoly is a common feature for manufactured products and firms’ pricing decisions depend not only on the reaction of actual competitors but also of potential competitors. (Bain, 1949) later further developed this concept and also stated that the established firm might forgo current profit by limiting price to prevent potential entry. P.W.S Andrews (1949) extended potential competition by introducing the concept of 'potential cross-entry', where the incumbent firm faces competition not only from direct competition but also from potential firms producing closely related products, whose resources could be quickly diverted to producing these products if profits get high. We can relate these findings to competition between Mexico and China; as China produces many of the product headings in which Mexico is also exporting to the USA, it will be easier to divert its resources to produce these products if profits become attractive.

Baumol (1982) argued that countries will not be able to exploit their monopoly power when the market itself is contestable, as there are other potential entrants waiting to enter the market. In potential competition, pricing is based not only on taking share away from your competitors, but also on pricing accordingly in order to offset potential entrants. A contestable market is an extreme case of potential competition where the assumptions are that there is no cost of entry and exit, so potential firms can just enter the industry if there are profits to be made and exit when prices are pushed down by increases in supply, leading to normal profits. Accordingly, the absence of sunk costs and no barriers to exit play a crucial role in contestable markets, where the threat posed by the possibility of new firms entering the market is taken to be a key determinant of the behaviour of existing firms. Potential competition is a result of the extent to which a market is open to new entry. This means that based on the potential competition model, the incumbent firm will behave as if it were in a perfectly competitive market and charge a price based on minimum average costs in the long run. As a result, consumers can continue to enjoy lower prices from competition. A contestable market has all of the characteristics of a perfectly competitive market, but is characterised by few firms in the market. Hence, the price charged by the incumbent firm will be the main factor determining potential new entrants to the market. There exist three conditions in contestable markets, as described by Helpman and Krugman (1989), where the first equilibrium condition is that the market must clear; that is, demand must equal supply. The second equilibrium condition is that the market price should be at least able to cover the costs of production. The third condition is that in the long run, market equilibrium should be sustainable, which implies that no firm can undercut the market price, supposing that the cost function is the same for all firms.

Potential competition is often seen in the airline, mobile telecommunications and banking and electricity markets. Baumol (1982) emphasised the airline industry as the perfect example of a contestable market during the early 1980s, as there was much 'hit and run entry' by low-cost airlines during that period. Since 1993, the industry has become more liberalised and competition has increased. Some of the literature on airline pricing includes (Borenstein, 1992; Reiss and Spiller, 1989; Brueckner et al., 1992; Mayer and Sinai, 2003). However, most of these studies looked at pricing only after entry occurs. For potential competition, Goolsbee and Syverson (2008) found that the incumbent airline companies, having identified South West Airlines (SWA) as a threat, lowered their fares on specific routes even before SWA entered; the potential threat of entry started when SWA began to announce that it was entering a specific route. Their study found that incumbents' fares were relatively lower for routes where SWA threatened to enter, as compared to their other routes from the same airport. They concluded that price competition occurs before competition actually occurs, when the incumbents identify the threat of potential entrants.

Ghosal (2002) stated that more liberalised international markets may not only lead to greater actual foreign competition, but also greater potential foreign competition. By focusing on the US market, these results showed that an increase in profit in the previous period (π_{t-1}) will lead to an increase in import shares (IMS) in the current period t. This is what is termed inter-temporal potential competition: as the market becomes too lucrative it will attract potential entrants in the next period. Ghosal measured potential foreign competition by estimating the response of a country's Industry Import Share (IMS) in period t to profit margins (π) in the current period (t) and the lagged period (t-1). Using annual data covering the 332 4-digit US manufacturing industries over the period 1969–1994, the import share (potential foreign competition) is measured as the ratio of imports to the sum of imports plus domestic sales. The model specification is constructed using the first differences method, as shown in Equation (5.1):

$$\Delta IMS_{i,t} = \alpha_i + \beta_1 \Delta\pi_{i,t} + \beta_2 \Delta\pi_{i,t-1} + other\ controls \qquad (5.1)$$

The results show no significant effect of the current profit level (π) on import shares ($IMS_{i,t}$).

In Ghosal's study, the domestic price setting is the driver for import penetration, while we hypothesise the increased Chinese productivity as the driver for lower Chinese prices; assuming few barriers to entry, China will be able to sell and gain shares in the market if it can produce cheaply. As in actual competition, theoretically speaking we believe that China's entry into the US market is the main exogenous shock, which is independent of Mexico. Our study here is focused on the competitive effects on Mexico for the set of products that China does not currently export to the USA. We identify potential Chinese entry into the USA by China's ability to export to other countries. If China can export to other markets, it will be easier to shift exports to the USA, assuming no barriers to entry. In the potential competition model, China will still exert competitive pressure in the USA even if there is no actual Chinese presence. There have not been many studies conducted on potential price competition in international trade, and nothing on China that we know of. A study done by Schiff and Chang (2003), which is an extension of the work done by Chang and Winters (2002), examines the impact of market presence and contestability on the price reaction of US exporters (non-members) to Argentinian exporters (members) in Brazil's market when MERCOSUR was formed. Schiff and Chang chose the USA and Argentina as these countries represent two of the biggest suppliers to Brazil. In their paper, they used preferential tariff changes given to member countries as the driver to gauge the competitive pressure on non-member countries for the set of products without Chinese presence, which we term 'potential products'.

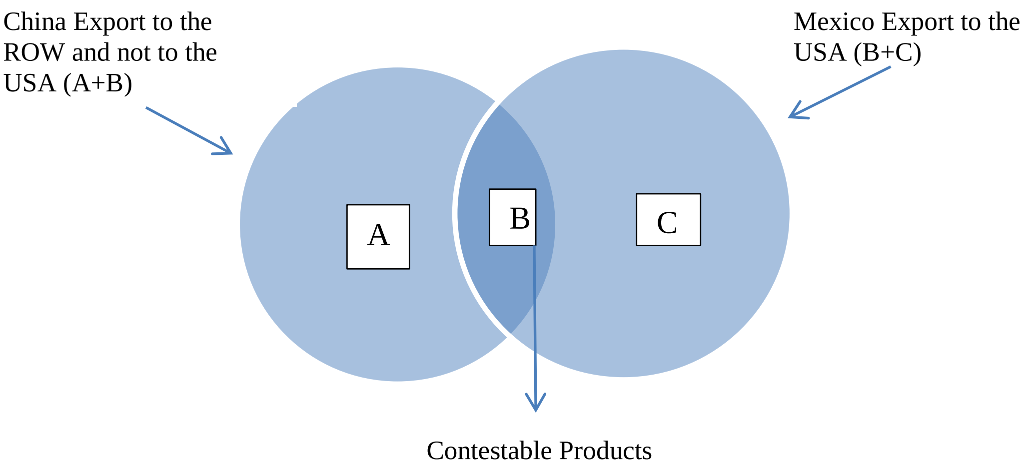
Even for those products without any Argentinian presence in the market, there might still be competitive pressure on the USA. It is noted that tariff schedules exist even for products that Argentina does not export to Brazil. Schiff and Chang's study emphasised the competitive effects on the USA for products without Argentina's presence, and further refined contestability as products that Argentina export to the ROW but not to Brazil. Their results show that Argentina's threat of entry increased the US price reaction to preferential trade liberalisation. They did not find any statistically significant effect on US price behaviour for products in which Argentina is absent in Brazil's market and does not export to the ROW. They then concluded that under the context of 'contestability', the non-member country (USA) will tend to constrain its pricing to deter entry.

The method proposed by Schiff and Chang (2003) is used to measure the one-time shock in tariff changes and the price response of the incumbent country. This one-time shock in tariff changes is quite difficult to observe in the case of China, as the country received Most Favoured Nation (MFN) status from the USA even before its entry to the WTO. China has been granted MFN status by the USA since 1980, and the contract has been renewed since 1989 (the year of the Tiananmen incident), but strenuous discussion usually occurs between the two countries and it was only after its WTO accession that China was been granted MFN rights in the US market. Similar to actual competition, we seek to identify the price effect directly, as we find little variation in the tariff schedules for both China and Mexico.

5.3 Definition of a Potential Product

It should be emphasised that a product is treated as a potential product if Mexico exports to the USA and China does not in a particular year. So we first need to identify all those products where Mexico exports to the USA without any Chinese competition, which we term the potential set of products. For this set of potential products, there is a probable threat of entry for Chinese products into the USA if China has the capability to produce this product. However, it is not possible to know whether China actually produces at the HS6 digit level, so we identify the threat of entry by looking at China's exports to the ROW (but not to the USA) for the set of potential products.

Figure 5.1: **Potential Products and Threat of Entry (Contestable Products)**



A+B are China's export headings to the ROW but not to the USA for the sample period
B+C are the export headings of Mexico to the USA for the sample period
B is the set of potential products, where China exported to the ROW (but not to the USA) that overlap with Mexico's exports to the USA

The data obtained are derived from the UN Comtrade statistics at the HS6 level (HS92), similar to that defined in actual competition. In Figure 5.1, the set 'A+B' is the set of product headings that China exports to the ROW but not to the USA, while Set 'B+C' is the set of product headings from Mexico to the USA. Set B is the common set of products that China exports to the ROW (but not to the USA) and Mexico exports to the USA; these are termed 'contestable products'. An example of a potential product is illustrated by product 251311 in Table 5.1, where it is assumed that China and Mexico are the only two countries exporting product code 251311 to the USA.

Product 251311 can be considered a potential competition product for all years where Mexico is the only exporter to the US market; however, the threat of entry can be identified if China exports to the ROW. We can see that China exported this product to the USA in certain periods, but dropped out of the export basket in most periods. It seems that China started to export pumice stones more consistently after 2000. There is concern about the appropriateness of allocating the product to the potential basket for the period 2000 to 2006, as it is absent from China's exports for only a year since 1999, which might be attributed to a data entry error. However, as there are relatively few observations for potential products, in general we take all product-years in which Mexico exports without actual Chinese competition to be a potential product. In the section on temporal potential competition, we addressed this issue by using a slightly different definition of a potential product.

Table 5.1: Example of a Potential Product

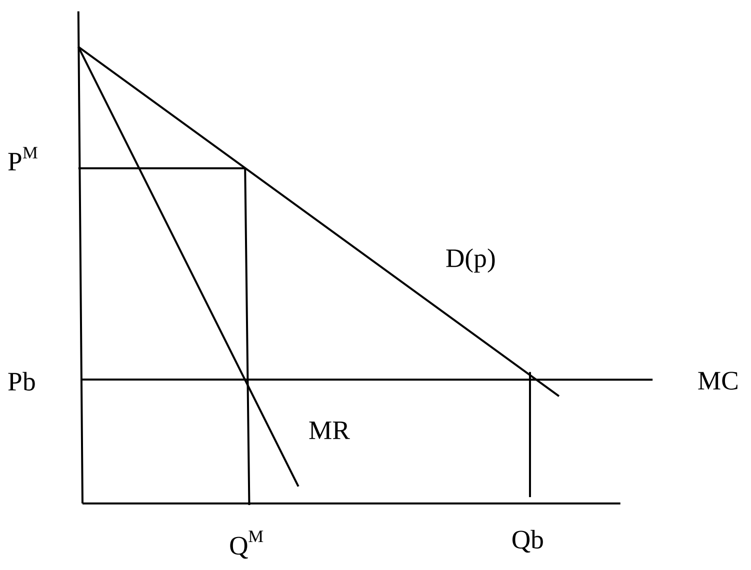
Year	Product Code	Exporting Countries	Competition
1992	251311	Mexico	Potential
1993	251311	Mexico	Potential
1994	251311	Mexico and China	Actual
1995	251311	Mexico	Potential
1996	251311	Mexico	Potential
1997	251311	Mexico	Potential
1998	251311	Mexico	Potential
1999	251311	Mexico and China	Actual
2000	251311	Mexico	Potential
2001	251311	Mexico and China	Actual
2002	251311	Mexico and China	Actual
2003	251311	China	
2004	251311	Mexico and China	Actual
2005	251311	Mexico and China	Actual
2006	251311	Mexico	Potential
2007	251311	None	
2008	251311	None	

***** 251311 – (Pumice Stones)

5.4 The Model for Potential Competition

Our model is related to the limit pricing theory, where the established firm (Mexico) will constrain its price due to the potential entry of its rival (China). Thus, Mexico will charge a price that is lower than its monopolist price today even though competition has yet to occur. Potential competition can be seen as a way to discipline the monopolist price. For the simple model, we will first consider the market for a single homogeneous product where Mexico is the only exporter to the USA. In Figure 5.2, the linear demand curve D (p) represents US demand for import of the product. The downward-sloping demand curve D (p) indicates a fall in the quantity demanded when price increases and vice versa. The marginal revenue curve (MR) is derived from the downward-sloping demand curve. There are assumed to be constant marginal costs, meaning that different export markets are independent of each other. The marginal cost for Mexico is represented by the horizontal line MC. Suppose that Mexico is the incumbent exporter of a particular good in the US market, its profit-maximising price will be at P^M and the quantity supplied will be at Q^M. There are positive profits to be made if Mexico is acting as a monopolist in the US market. The price charged by a monopolist will be higher compared to perfect competition; however, this does not mean that Mexico will charge the monopolist price at Pm, as there is the threat of China entering the market.

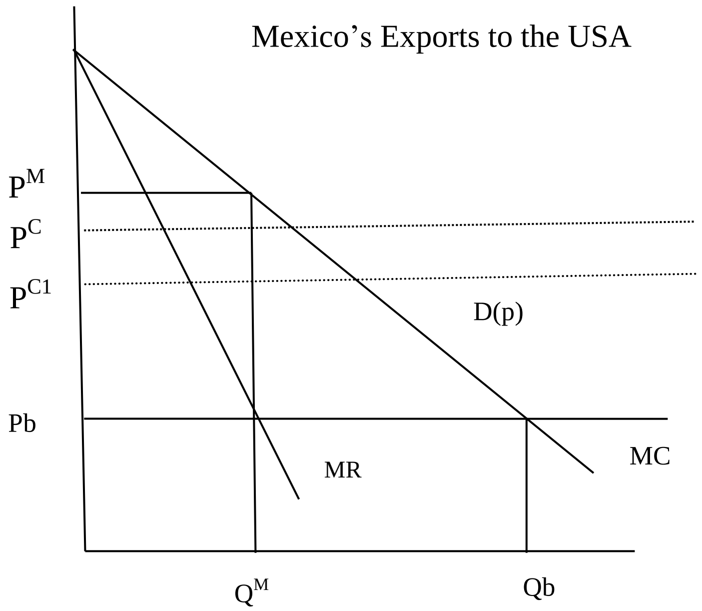
Figure 5.2: Monopolist Pricing (Mexico's Exports to the USA)



As emphasised by Andrews (1949), the potential competitors are those that are already established in closely related products, making it easier to shift resources between production sites. The potential of China entering will constrain Mexico from charging the monopolist price. Here, we are assuming that the average costs function differs between Chinese and Mexican firms.

Now suppose that China's predicted price is as represented by P^C in Figure 5.3; this is the assumed price at which China enters the market. In potential competition, Mexico's strategy is to prevent China from entering the US market and thus will be constrained from charging a price slightly below P^C. For homogeneous products, we assume that as long as Mexico is disciplined enough not to charge a price above P^C, China will not be able to enter the US market.

Figure 5.3: Potential Competition Pricing (Homogeneous Goods)



However, over time the increased level of Chinese productivity might lead to a fall in Chinese prices from P^C to P^{C1}. Suppose that initially Mexico charges a price of P^C to prevent China from entering the US market. However, the increased level of Chinese productivity has now pushed prices down from P^C to P^{C1}. Mexico will try to respond to China's lower prices by reducing its prices to just below P^{C1}. Thus, Mexico will respond to changes in the predicted Chinese price by trying to deter Chinese entry. We mentioned in the previous chapter that China has had the highest productivity growth over the past few decades; this has led to the reducing cost of production being passed on to its exports and is termed the ‘China price factor’. Theoretically, in Figure 5.3, if China managed to get its price down below Pb, Mexico would be forced out of the US market. However, in the real world, products are not completely homogeneous and products at the HS6 level exported by China and Mexico might be slightly different. The price charged by both countries need not be exactly the same for differentiated products, but China's price does influence Mexico's price, as they are considered close substitutes.

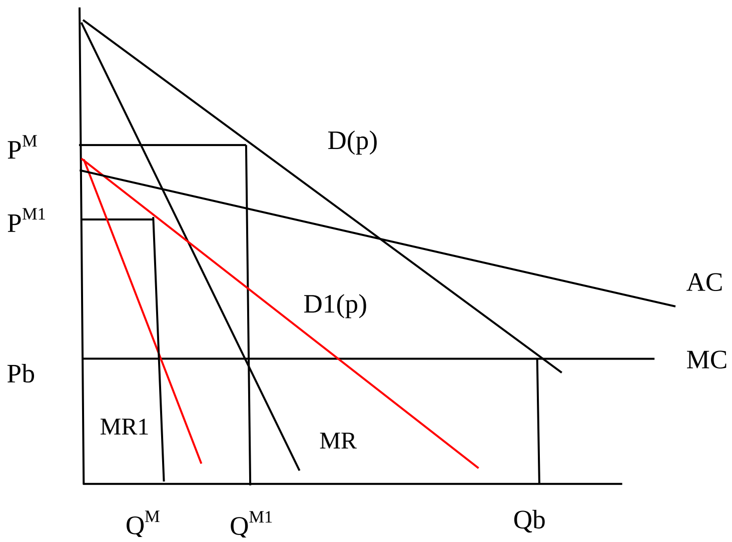
5.4.1 Differentiated Products

For differentiated products, Mexico will still be able to sell its products even if its prices are not identical to China’s. However, if products are considered to be close substitutes, their demand will be closely linked. Consider the Mexican firm’s problem of keeping the Chinese firm out. The Chinese side of it is illustrated in figure 5.4 below. Suppose that if the Mexican firm charges a price P^{Mex}, the demand for the Chinese product will be given by demand curve D(p). The Chinese firm is a monopolist in its own market and so with marginal cost curve (MC) and the marginal revenue curve MR it will choose to sell Q^M at price P^M. This is its profit maximising sales level, but it still needs to choose whether to enter or not. If, after allowing for some fixed costs, its average costs are given by average costs AC, $P^M > AC$, so profits are positive and entry will occur.

Now, however, suppose that the Mexican firm lowers its price. With their interdependent demands, the demand curve faced by the Chinese firm will contract to D1(p), with corresponding marginal revenue of MR1. Assuming the same cost curves, the new profit-maximising output is Q^{M1} with price P^{M1} and at this point prices do not cover average costs and so the firm will choose not to incur the fixed costs and enter the market.

Finally assume that Chinese costs fall because of its improving productivity. Although we have not drawn it into the figure, it is plain that AC could fall far enough that the point (Q^{M1}, P^{M1}) could generate positive profits, at which time in this simple model entry will occur. The Mexican firm might be able to block it but only by reducing its own price even further so that the residual demand curve facing the Chinese firm contracted further. That is, improving Chinese productivity would have forced the Mexican firm to reduce its price even though the Chinese firm did not sell a thing in that particular market.

Figure 5.4: Differentiated Products



5.5 Stylised Facts

5.5.1 Coverage

For potential competition, our main emphasis will be on the sample of 9622 product-years that Mexico exports to the USA without any actual Chinese competition, shown in Table 5.2. We use US reported data for similar reasons as described in actual competition. Over the period from 1992-2008, there are 9622 out of a total of 57,460 product-years that Mexico exported to the USA without Chinese competition. In this chapter, our main objective is to look at the potential price competition of Chinese products.

There is a decline in the number of products that Mexico exports to the US market without Chinese competition over the years, as shown in the 'potential' column in Table 5.2. In 1992, there were a total of 872 products that Mexico exported to the USA without Chinese competition. The products under potential competition declined gradually every year, so that in 2008, there were just over 200 products under potential competition. We looked at 83% of Mexico's exports that were in actual competition for the period 1992-2008, but here we will be considering the remaining 17% of those products that were in potential competition.

Table 5.2: USA Imports from Mexico by Product Headings at HS6

Year	Actual (Competition from China)	Potential (No China Presence)	Total Exports
1992	2,017	872	2,889
1993	2,146	845	2,991
1994	2,300	813	3,113
1995	2,528	867	3,395
1996	2,589	891	3,480
1997	2,729	794	3,523
1998	2,781	739	3,520
1999	2,893	660	3,553
2000	2,992	547	3,539
2001	2,960	516	3,476
2002	3,039	414	3,453
2003	3,066	362	3,428
2004	3,124	333	3,457
2005	3,203	282	3,485
2006	3,232	238	3,470
2007	3,132	215	3,347
2008	3,107	234	3,341
Total	47,838 (83%)	9,622 (17%)	57,460 (100%)

*****Data obtained from Comtrade and tabulated using own calculations

In order to get a better understanding of the dispersion of products that China does not export to the USA, we provided a summary description of the 9622 potential products by categorising them into 15 different sectors, as shown in Table 5.3. In 1992, most of the products that China did not export to the USA are in Sectors 1 (Vegetable Products), 4 (Chemical Industry), 8 (Textiles), 11 (Metals) and 12 (Machinery). The table also shows that most of the potential competition occurred during the earlier period, but that China exported almost everything that Mexico exports by 2008. There does not seem to be any potential competition involved in Sector 9 (Footwear) or Sector 14 (Miscellaneous), as China exports almost all of these products to the USA, which Mexico also does for the whole period.

Table 5.3: Coverage by Sector (Product Headings)

Sector	1992	2000	2008
Animals (0)	28	40	38
Vegetables (1)	75	63	50
Foodstuffs (2)	29	33	26
Minerals (3)	58	27	20
Chemicals (4)	178	97	25
Plastics (5)	55	15	0
LF (6)	11	7	1
Wood (7)	42	24	11
Textiles (8)	94	81	14
Footwear (9)	0	0	0
Stone (10)	30	16	5
Metals (11)	116	60	20
Machinery (12)	102	54	11
Transport (13)	25	19	12
Misc (14)	29	11	1
Total	872	547	234

***** Data obtained from Comtrade and tabulated using own calculations

There is a slight worry over whether these potential products are not being recorded in China's export basket due to the HS revisions, as already discussed in Chapter 3.4. After further examination, it was found that 7006 out of the 9622 products are in the clean product sample, which means that 76% of the potential products are completely free from the HS revision problem.

5.5.2 Stylised Facts by Trade Value

We tabulated the total trade value of Mexico's exports for both actual and potential competition (Table 5.4). The accumulated total trade value for the potential products from the period 1992-2008 is reported at USD 119.35 billion, which is only about 5.78% of Mexico's total exports to the US market over the entire period. This 5.78% of value is covered by 17% of Mexico's headings. It is noted that on average the potential products are relatively small compared to actual products. The percentage of potential to total exports remained quite low after 1998.

Table 5.4: USA Imports from Mexico by Trade Value at HS6 (Reporter US)

Year	Actual Competition (USD Billions)	%(Actual/Total)	Potential Competition (USD Billions)	%(Potential/Total)	Total Exports to USA (USD Billions)
1992	28.2	78.7	7.63	21.3	35.83
1993	32.8	80.57	7.91	19.43	40.71
1994	45.7	90.78	4.64	9.22	50.34
1995	57.3	91.26	5.49	8.74	62.79
1996	58.5	78.95	15.6	21.05	74.10
1997	80.4	92.24	6.76	7.76	87.16
1998	85.2	88.75	10.8	11.25	96.0
1999	105	94.4	6.23	5.6	111.23
2000	133	96.69	4.55	3.31	137.55
2001	128	96.63	4.47	3.37	132.47
2002	132	97.08	3.97	2.92	135.97
2003	129	92.27	10.8	7.73	139.80
2004	152	96.56	5.41	3.44	157.41
2005	166	96.19	6.57	3.81	172.57
2006	196	97.72	4.57	2.28	200.57
2007	207	97.27	5.8	2.73	212.80
2008	210	96.26	8.15	3.74	218.15
Total	1946.1	94.22	119.35	5.78	2065.45

***** Data obtained from Comtrade and tabulated using own calculations

As Mexico's total exports to the US market increased steadily but slowly over the years, the products in potential competition accounted for about 2% of Mexico's total exports in 2006. The percentage of potential to total exports at 21% seemed to be particularly high for 1996, 1998 and 2003. It is quite a surprise to find the sudden hike in potential trade volumes for these periods and we investigated it further. The breakdown for the potential products by sector for these three years is shown in Appendix 5.1. On closer inspection, we found an exceptionally high value of trade in Sector 13 (Transport) for those periods compared to the other periods. The products in the transport sector usually consist of heavy-duty vehicles and parts; that is, trucks, motorcycles, buses and so on. There are only 33 product headings in the transport sector and this made up 59% of the value of potential products for 1996. An example can be provided for product 870421 (diesel-powered trucks), which Mexico exports to the USA while China does not. Mexico exported around USD 836 million of this product heading alone in 1996; this is around 5.5% of the total value of potential products in 1996. The other products in the transport vehicle sector consist of heavy-duty products such as automobiles (engines>3000cc), road tractors and so on. On average, we found that the transport sector made up 42% of the total value for potential products. The vegetable products sector is the second largest sector of potential products, making up 24% of potential products for the sample period.

5.5.3 Classification of Potential Products by Different Case Scenarios

We wanted to find out whether the sudden hike in potential products is actually due to China's exit or whether China just does not export the product. A product can be termed a potential product if Mexico exports to the US market without any Chinese competition in a particular period (T). We have argued that China could still be a huge threat even if in that year it did not export, as theoretically speaking there could be less competitive pressure on Mexico's firms if China exited instead of trying to get in. Potential competition in period T can occur if Mexico starts to or continues to export the product in period T while China does not. There are four possible scenarios that make a product eligible to be classified as a potential product in period T, as shown in Table 5.5.

In Case 1, both countries exported the particular product in period T-1, but China exited while Mexico continued to export in Period T. In Case 2, China did not export in either period while Mexico exported in both periods. In these two cases, this potential product is considered an existing export of Mexico's. In Case 3, if both countries did not export that product to the market in the previous period (T-1), that product would become a potential product if Mexico started to export in period (T) and China did not. In Case 4, China exported the product but Mexico did not in period T-1, but for some reason, Mexico started exporting the product in period T while China exited. In both these cases, this product would be considered a new export for Mexico. The products in Cases 1 and 4 are potential because of China's exiting the market in the current period. A product becomes a potential product if Mexico starts to or continues to export while China does not in period T.

Table 5.5: Different Scenarios of How a Potential Product Can Occur

	Period T-1	Period T	Potential Competition by Cases
Case 1	China Export	China does not export	China Exit
	Mexico Export	Mexico Export	Mexico Existing Products
Case 2	China does not export	China does not export	China does not export
	Mexico Export	Mexico Export	Mexico Existing Products
Case 3	China does not export	China does not export	China does not export
	Mexico does not export	Mexico Export	Mexico New Products
Case 4	China Export	China does not export	China Exit
	Mexico does not export	Mexico Export	Mexico New Products

5.5.4 Classification by Coverage (Product Headings)

The numbers of product headings that are in potential competition classified according to the four different case scenarios for each period are shown in Table 5.6. Initially we are interested in finding out the unusual increase in potential products in 1996, as shown in Table 5.4. In 1996, there were 891 products that Mexico exported to the US market without any Chinese presence. Out of these 891 potential products, 18% (163 products) are in Case 1, 58% in Case 2 (518 products), 19% in Case3 (171 products) and only 4% in Case 4 (39 products). In 1996, there are 202 products (22%) that China exited the market (Case 1 + Case 4). Most of the potential products belong to Case 2, where Mexico exported for two consecutive years and China has yet to enter. We conclude that the majority of Mexico's potential products are in Case 2 and Case 3; on average we found that 79% of potential products fall into these two cases for the sample period. The lack of Chinese presence is not because China has exited the market, but because it has yet to penetrate it. Mexico might not be too worried about constraining its own price if China exited the market in the first place, as the logic behind potential pricing is to deter entry, although there is the worry that China might re-enter the market. It seems like Case 2 and Case 3 is a better description for potential competition; we will deal with the different classification in the regression analysis section. However for now, we provide some descriptive statistics of all products in potential competition.

Table 5.6: Potential Products by Product Heading

Year	Product Headings	Case 1	Case 2	Case 3	Case 4
1992	872	n.a	n.a	n.a	n.a
1993	845	126	482	201	36
1994	813	119	466	200	28
1995	867	133	465	231	38
1996	891	163	518	171	39
1997	794	128	507	140	19
1998	739	133	465	115	26
1999	660	128	403	102	27
2000	547	102	325	94	26
2001	516	120	292	79	25
2002	414	83	243	74	14
2003	362	75	214	52	21
2004	333	72	181	61	19
2005	282	57	169	38	18
2006	238	50	135	41	12
2007	215	49	130	23	13
2008	234	57	138	28	11
Total	9,622	1595 (17%)	5133 (53%)	2522 (26%)	372 (4%)

***** Data obtained from Comtrade and tabulated using own calculations

As shown in Table 5.7, the trade value of Mexico's new products (Case 3 + Case 4) totalled only around USD 56.5 million in 1996, compared to Mexico’s existing products at USD 15,500 million. As mentioned, the 1996 spike in potential products was mainly in the transport vehicle sector and we found that 99% (USD 15500 million) of potential products in this sector consists of Mexico’s existing products (Case 1 + Case 2). The results indicate that Mexico's increased trade in potential products in 1996 is not so much new products but more existing products. Our study found that potential competition is more likely to occur because China has not entered the market, not because China has exited the market, although 1996 is an exception, where we find that increased potential trade is due to China exiting the market. We need to investigate this further, as theoretically speaking limit pricing is a strategy used to prevent entry; once entry occurs, Mexico and China might play a Bertrand game. Thus if China exited the market, it might be due to the country losing its comparative advantage.

Table 5.7: Mexico's Trade Value by Cases

Year	(USD Millions)	Product Headings	(USD Millions)	Product Headings
	(Case 3 + Case 4)		(Case 1 + Case2)	
	(New Products)		(Existing Products)	
1993	67.4	237	7840	608
1994	121	228	4520	585
1995	155	269	5340	598
1996	56.5	210	15500	681
1997	20.1	159	6740	635
1998	185	141	10600	598
1999	20.3	129	6210	531
2000	40.8	120	4510	427
2001	32.1	104	4440	412
2002	35.6	88	3940	326
2003	37.2	73	10800	289
2004	27.8	80	5390	253
2005	11.1	56	6560	226
2006	23.9	53	4540	185
2007	16.3	36	5780	179
2008	5.76	39	8140	195

* Data obtained from Comtrade and tabulated using own calculations

5.5.5 Mexico's Influence in the USA

Although the trade value of potential exports constitutes just a small percentage of Mexico's total exports, this does not mean that these products are insignificant exports for Mexico. The small trade ratio of the potential products is most probably due to the small number of observations in potential competition (9622), as compared to those observations in actual competition (41,707). In order to get a better understanding of the significance of potential products for Mexico in the US market (for all cases), we computed each product's market share in the US market. We then found the simple average trade shares for all products, for both actual and potential competition in a given year (Table 5.8).

Table 5.8: **Average Trade Shares for Mexico's Exports**

Year	Actual Competition	Potential Competition (Case 1 to case 4)
1992	0.073	0.121
1993	0.075	0.115
1994	0.072	0.123
1995	0.076	0.132
1996	0.082	0.134
1997	0.089	0.132
1998	0.090	0.140
1999	0.091	0.146
2000	0.091	0.158
2001	0.092	0.169
2002	0.091	0.145
2003	0.089	0.156
2004	0.089	0.161
2005	0.089	0.176
2006	0.089	0.207
2007	0.088	0.205
2008	0.088	0.216

***** Data obtained from Comtrade and tabulated using own calculations

Mexico's mean product share in the US market for potential products was around 21.6% and only around 8.8% for products in actual competition with China in 2008. The average trade share for Mexico's product in potential competition has increased every year, from 12.1% in 1992 to around 21.6% in 2008. Mexico's average market share is higher for those products where there is no Chinese competition. This might be expected, as there is no Chinese presence to shift demand away suppliers like Mexico.

Although Mexico has a major market share in the USA for these products, it is not the only exporter to the US market. Our findings show that there are more than 100 countries exporting to the US market in every period for the set of potential products. However, many of the exporting countries have insignificant market shares and we will report only on the major suppliers in the US market for the potential products. We found that the major exporters in potential products were from developed countries, dominated by countries such as Canada, Germany and Japan during the 1990s and early 2000s. In 1992, these countries exported many of the potential product headings to the US market, with exports exceeding those of Mexico for these potential products. For the set of potential products, the mean import shares for Canada and Japan in the US market are estimated at 29% and 15% respectively in 1992. In 2008, Canada exported the majority of these potential products, with a mean market share of 33% in the US market. We also observed that there are more developing countries such as Chile, Brazil and Trinidad and Tobago exporting these potential products to the US market in recent years. However, competition from these countries is concentrated only in certain products, as they do not have many common exports with Mexico for these potential products.

In order to examine the absence of Chinese competition for Mexico's trade shares, we classify the potential products into different categories according to market share, as shown in Table 5.9. Our results show that there is an increase in the total number of product headings in which Mexico has a large share in the market over the years. In 1992, Mexico exported 872 products to the US market that were without Chinese competition, where 256 (29%) of these products had a market share of more than 10%. By 2008, 105 out of the possible 234 products (45%) had a market share of more than 10%. In 2008, 34% of Mexico's product headings in potential competition had more than 20% of US total market share and 17% of its products had more than 50% share.

By comparison, Mexico had only 26% of its products in actual competition with more than a 10% share in the US market in 2008. Also in 2008, Mexico had 14% of its products with more than a 20% market share and just 3% of its products with more than half of the US market. Mexico has on average a higher product share in potential products, compared to those where there is direct Chinese competition.

Table 5.9: Mexico's Trade Shares in the US market for Potential Products

	Total Product Headings	Product Headings		Product Headings		Product Headings	
Year	Potential Products	Trade Share>10%	Ratio	Trade Share>20%	Ratio	Trade Share>50%	Ratio
1992	872	256	0.29	161	0.18	68	0.08
1993	845	229	0.27	145	0.17	57	0.07
1994	813	231	0.28	154	0.19	67	0.08
1995	867	264	0.30	171	0.20	76	0.09
1996	891	267	0.30	185	0.21	79	0.09
1997	794	232	0.29	164	0.21	74	0.09
1998	739	226	0.31	165	0.22	70	0.09
1999	660	212	0.32	152	0.23	70	0.11
2000	547	201	0.37	141	0.26	63	0.12
2001	516	191	0.37	138	0.27	66	0.13
2002	414	129	0.31	90	0.22	45	0.11
2003	362	121	0.33	93	0.26	42	0.12
2004	333	116	0.35	82	0.25	42	0.13
2005	282	102	0.36	76	0.27	36	0.13
2006	238	98	0.41	70	0.29	41	0.17
2007	215	88	0.41	71	0.33	37	0.17
2008	234	105	0.45	79	0.34	39	0.17
Total	9622	3068		2137		972	

***** Data obtained from Comtrade and tabulated using own calculations

5.5.6 Importance of Potential Products in China Exports

Some of the possible reasons why China exported most of the potential products to other markets but not to the USA initially could be due to a failure to meet the required standards or quality issues. It might also be that these products make up a small percentage of total Chinese exports and are not considered as important exports for China. Another possible reason could be the high level of protection prohibiting China's entry, and possibly a ban on certain Chinese products. It might also be possible that a higher tariff was imposed on these potential products to prevent China from entering the market in the first place. However we have shown that there is little variation in tariffs and as it becomes more competitive in pricing brought about by an increase in productivity. We checked that most of these potential products with positive tariffs are from the period 1992- 1998; almost all the other potential products have zero tariff. It would not be accurate to measure the average tariff rate between actual and potential products due to their different sample size. There are about 2500 product years for potential products and more than 30,000 products in actual competition with positive tariffs imposed on them. However for reference purposes, simple tariff rates for potential products and actual products with positive bound tariffs are both around 6% for our sample. To investigate the size of China's exports of potential products, we sought to identify the importance of its exports of potential products to the ROW. China's total product headings and exports to the ROW, excluding the USA, are shown in Table 5.10.

Table 5.10: China's Export to ROW (Potential Products)

Period	China Exports in Potential Products to ROW (by Product Headings)	China Exports in Potential Products to ROW (USD Billions)	China Total Export to ROW Excluding USA (USD Billions)
1992	769	2.89	46.04
1993	783	3.02	107.33
1994	757	5.32	139.65
1995	813	5.53	171.49
1996	845	6.81	189.6
1997	754	5.94	209.19
1998	707	4.1	202.91
1999	634	3.73	226.22
2000	537	5.21	289.39
2001	509	3.8	300.62
2002	410	5.5	343.52
2003	360	3.83	433.75
2004	329	4.72	572.48
2005	280	8.47	712.17
2006	236	8.43	874.22
2007	213	10	1,089.89
2008	229	17.1	1,273.70
Total	9165		

***** Data obtained from Comtrade and tabulated using own calculations

China exported the majority of the potential products to the ROW, exporting 9165 out of a possible 9622 potential products for the period 1992-2008. In 1992, China's exports in potential products were only around USD 2.89 billion, which is about 6% of its total exports to the ROW at USD 46 billion. By 2008, China exported around USD 17.1 billion of potential products to the ROW; however, this was only around 1% of China's total exports to the ROW, which were worth more than USD 1200 billion. There are fewer product headings that China did not export to the US market over time, explaining the small amount of trade in these potential products.

To find Chinese influence for the potential products, we find China’s share of ROW imports by product heading, as represented in Equation (5.2):

$$s_t = \sum_{i=1}^{n} \left[x_{it}^{ROW\ Import\ China} \Big/ x_{it}^{ROW\ total\ Import)} \right] \qquad (5.2)$$

where i represents a product and t represents a year, $x_{it}^{ROW\ Import\ China}$ is ROW imports from China while $x_{it}^{ROW\ total\ Import)}$ is ROW total import.

The average product share is calculated by taking the simple product average for a given year, the results of which are shown in Table 5.11. China has an average market share of only around 2% in the ROW for the potential products in 1992, which increased slightly to 5% in 2008. As these are potential products, China's market share of the US market was zero. China’s average product share for potential products to the ROW was relatively small compared to its market share in actual competition to the ROW. For products in actual competition, China's market share to ROW increased from around 6% in 1992 and averaged around 17% in 2008. This suggests that China has a lower comparative advantage in potential products.

Table 5.11: China Market Share in ROW

Year	China Export Shares (Actual Products)	China Export Shares Potential Products
1992	0.06	0.02
1993	0.09	0.02
1994	0.09	0.02
1995	0.09	0.03
1996	0.09	0.02
1997	0.09	0.02
1998	0.09	0.02
1999	0.10	0.03
2000	0.11	0.03
2001	0.12	0.03
2002	0.12	0.03
2003	0.13	0.03
2004	0.13	0.04
2005	0.15	0.04
2006	0.15	0.05
2007	0.16	0.05
2008	0.17	0.05

* Data obtained from Comtrade and tabulated using own calculations

A breakdown of the average market by sector for three different periods, namely 1992, 2000 and 2008, is given in Table 5.12. It can be seen that China's market share for potential products in the ROW is small, especially for 1992. We noticed that the Chinese market share in the textiles industry had increased from 2% in 1992 to 20% in 2008. It was noted that China only started to enjoy the quota phase-out in 2002, after it joined the WTO. We also found that there are 1171 observations out of the total number of potential products (9622) that are subject to MFA quotas, all of which are in the textiles sector. We could say that the increase in China’s import shares of ROW market in the textiles sector is likely due to MFA.

In the machinery/electrical sector (12), China's share in the ROW had also increased to 8% in 2008, compared to just 1% in 1992. Although the figures are not shown here, we found that China's share of ROW imports in actual competition was higher than its share in potential competition. The US market is the main export destination for Chinese products and we can say that China is more competitive and captures a larger market share for those products that it does export to the US market. These findings suggest that China exports the ‘right’ products to the USA; that is, the USA is pretty open, so only the ‘best’ products will be viable there.

Table 5.12: China's Import Shares of ROW market for Potential Products (by Sector)

	China Import Share ROW		
Sector/Year	1992	2000	2008
Animals (0)	0.02	0.00	0.01
Vegetables (1)	0.03	0.04	0.04
Foodstuffs (2)	0.03	0.02	0.03
Minerals (3)	0.03	0.05	0.07
Chemicals (4)	0.02	0.02	0.03
Plastics (5)	0.00	0.01	0.00
LF (6)	0.01	0.02	0.01
Wood (7)	0.01	0.02	0.01
Textiles (8)	0.02	0.09	0.20
Stone (10)	0.01	0.02	0.06
Metals (11)	0.01	0.02	0.08
Machinery (12)	0.01	0.02	0.08
Transport (13)	0.00	0.00	0.03
Miscellaneous (14)	0.01	0.02	0.00

***** Data obtained from Comtrade and tabulated using own calculations

5.5.7 Revealed Comparative Advantage (RCA)

China might exhibit different levels of competitiveness for products in actual and potential competition. The Balassa Index or the Revealed Comparative Advantage (RCA) index measures the degree of specialisation in a country's comparative advantage (Balassa, 1965). The RCA index at the product level for China was constructed for the whole sample set, as we want to capture China's competitiveness between the two set of products. A country reveals comparative advantages in products for which this indicator is higher than 1, showing that its exports of those products are more than would be expected on the basis of its importance in total exports of the reference area.

The RCA Index is defined as in Equation (5.3):

$$RCA_{it} = \frac{x_{i,t}^{China}}{X_t^{China}} / \frac{x_{i,t}^{ROW}}{X_t^{ROW}} \qquad (5.3)$$

where $x_{i,t}^{China}$ measures China's exports to the ROW (excluding the USA) for each product i in period t, X_t^{China} is China's total exports in a given year, $x_{i,t}^{ROW}$ measures ROW total exports (excluding to the US market) for product i in period t and X_t^{ROW} measures ROW total exports in a given year. We take China's exports to the ROW, which excludes the US market, so that the results will not be biased when we are comparing products in actual and potential competition.

We constructed the simple average RCA index for all products in each year, as shown in Table 5.13. For the period 1992-2008, China's RCA to the ROW was about 1.84 for the common products in actual competition, while the RCA index was just 0.50 for the set of potential products, indicating that China did not on average have a comparative advantage in the set of potential products for all the years in our sample. This is not surprising, considering that the USA is one of the most important import markets worldwide and China exports its most competitive products to the US market.

Table 5.13: China's RCA Index to ROW (excluding the USA)

Period	Actual Products	Potential Products
	RCA Index	RCA Index
1992	2.40	0.62
1993	1.87	0.37
1994	1.91	0.52
1995	2.00	0.58
1996	2.03	0.54
1997	1.92	0.48
1998	1.92	0.48
1999	1.90	0.50
2000	1.88	0.54
2001	1.85	0.45
2002	1.74	0.46
2003	1.74	0.42
2004	1.70	0.46
2005	1.70	0.44
2006	1.70	0.50
2007	1.63	0.47
2008	1.71	0.50
Total	1.84	0.50

* Data obtained from Comtrade and tabulated using own calculations

The RCA index are product specific as in Equation (5.3) and we compute China's average RCA index to the ROW for each of the 15 different sectors and compare between potential and actual competition products (Table 5.14). The results indicate that China does not have a comparative advantage for the products in almost all the sectors that it does not export to the USA, except the textiles industry. As mentioned, the USA is a large market to which most of China's exports will be exported. China has a comparative advantage for most products that it exports to the US market (actual competition), as indicated by the RCA index that is greater than one, but in this chapter we are interested only in the set of products in potential competition; the RCA indexes for both sets are tabulated for comparison purposes only.

Table 5.14: China's RCA Index to the ROW by Sector (1992-2008)

	Actual Products		Potential Products	
Sector	Product Headings	RCA Index	Product Headings	RCA Index
Animals (0)	713	1.62	538	0.16
Vegetables (1)	1826	1.92	999	0.54
Foodstuffs (2)	1357	1.10	582	0.53
Minerals (3)	774	1.79	500	0.73
Chemicals (4)	5138	1.16	1645	0.32
Plastics (5)	2156	0.62	321	0.12
LF (6)	609	3.48	106	0.29
Wood (7)	1948	1.05	408	0.23
Textiles (8)	8303	3.40	1369	1.33
Footwear (9)	698	5.15	5	0.93
Stone (10)	1597	1.27	294	0.32
Metals (11)	5419	1.33	1102	0.34
Machinery (12)	7793	1.19	870	0.23
Transport (13)	906	0.82	290	0.13
Misc (14)	3294	2.59	136	0.31

* Data obtained from Comtrade and tabulated using own calculations

For potential products, one sector that particularly stands out is the textiles industry, which shows that China has a comparative advantage in the ROW markets, as indicated by its RCA index (excluding to the USA) of 1.33. There are more than 1300 observations for textile products in potential competition, and it is a surprise indeed to find China not exporting these products to the US market if it has a comparative advantage in these products in the ROW markets. One possible explanation is the trade policy that was implemented to restrict Chinese products into the USA, specifically the Multi-Fibre Arrangement (MFA). Another problem could be that China exports many of the lower-quality textiles to the lower-income developing countries. To check for this, we calculated China's RCA index to just the OECD high-income countries for textile products in potential competition. Our results show that China has an RCA index of around 0.8; that is, it does not have a comparative advantage for these products in the OECD region either. However, many of the OECD countries also imposed MFA quotas on Chinese products, hence we cannot be certain about the possible reasons for China not exporting these products to the USA in the first place.

Under the MFA, developed countries like the USA would set quotas on yarn, textiles and apparel from developing countries, which are seen as a way to raise the domestic price of clothing by limiting imports from the cheaper developing countries. Another impact of MFA is that Mexico indirectly benefited from the US quotas on its competitors. The set of products that are integrated into the WTO rules by the removal of quotas during each phase are import country specific.

Under the Uruguay Round, the developed countries started the process of gradually removing the quotas on textiles and clothing products over four phases, under which the quotas on textiles were totally abolished in 2005. China was ineligible for the first two phases, as it only joined the WTO in 2001; the USA lifted quotas on Chinese products for the first three phases, starting in 2002. Thus, although China has a comparative advantage in many of these products, there is a limit on the quantity entering the USA. The ATC started the process of gradually removing the quotas on textiles and clothing products over the four phases. Under the MFA, the USA is supposed to abolish quotas on all Chinese products (textiles and yarns) by 2005; however, the USA successfully implemented safeguards on 22 products under the MFA against Chinese products, effective until the end of 2008 (Brambilla et al., 2010). The importing country (USA) has the power to choose which set of products to include for each phase-out period as long as it complies with the shares of its integrated export volume. These researchers found that Chinese exports under the MFA are still relatively restricted to the US market, as China faced a stronger quota system compared to other countries. Brambilla et al. (2010) commented that a relatively high share of Chinese exports was covered by the quotas, which were binding. China also faced relatively lower quota growth rate and was very restricted in adjusting its quotas using flexibility. After the quotas were lifted in 2005, China's exports surged and these researchers also found that almost all regions, except South Asian countries, experienced a decline in exports (MFA products) to the US market. Their findings also show that China's unit values fell in the years in which its products were integrated. As Mexico is a member of NAFTA, the majority of its exports to the USA are not subject to quotas and hence the elimination of quotas could have posed a serious threat to Mexico's products.

A limit on the amount of China's exports would generally affect its competitive effects on products in actual competition. In potential competition, only zero quotas matter, as they restrict specific Chinese products completely. The non-tariff measures for the USA are obtained from the TRAINS database in WITS and the data is only available up to the year 2006. There are many different classifications of non-tariff barriers, but the USA only reported those related to anti-dumping regarding China, again only affecting products in actual competition. For potential competition, we need to identify those products that the USA has banned, usually for health or safety measures. In 2004 the USA stopped importing poultry products from China out of fear of bird flu. However, most of the NTBs from the USA are not a complete ban on Chinese imports; they restrict the amount of Chinese imports and are more relevant to actual competition. We identify and investigate the characteristics of the products that are affected by the MFA quotas in the section on temporal competition.

5.6 Deriving China's Probability of Exporting

Our assumption is that China's increased productivity is the exogenous shock, which is independent of Mexico's pricing decisions and also the tariffs imposed by the USA Furthermore as we are dealing with the final Chinese price, which has already taken into account of the tariffs. There is the worry that Chinese entry can occur due to the failure of Mexico's strategy to deter entry; that is, if entry is not exogenous we may get biases in estimating its effects. We need find a control variable that isolates the effect of Chinese entry. We thus propose a method to find the probability of China entering the market that is independent of Mexico's firms. This can be done using a binary response function: variables with only two categories. The main interest in a binary function lies in the response probability (y), which can be explained by a set of x explanatory variables $(x_1, x_2 \ldots x_k)$, as shown in Equation (5.4). In this exercise, $Y_{i,t}^{China}$ is China's export indicator, which has a value of 1 if China exports to the USA and 0 if not. We consider three explanatory variables: the lagged value of the dependent variable itself $Y_{i,t-1}^{China}$, the ratio of the HS6 (it is the total number of HS6 subheadings under each HS4 heading) and China's RCA to the ROW index (excluding the USA). The lagged dependent variable $Y_{i,t-1}^{China}$ is a dummy that takes on a value of 1 if China exported in the previous period (T-1) and 0 otherwise. We will provide an explanation to derive the ratio of HS6 following Equation (5.6)

$$P(y=1|x) = P(y=1|x_1, x_2, x_3) \qquad (5.4)$$

$$P(y=1|x_{i,t}) = \beta_1 Y_{i,t-1}^{China} + \beta_2 Ratio\ of HS6_{i,t}^{China} + \beta_3 RCA_{i,t}^{China,ROW} + \delta_t \qquad (5.5)$$

In order to make sure that the response probability lies between 0 and 1, we use the nonlinear logit model. The logistic distribution function can be represented by Equation (5.6):

$$P(Y=1|X_i) = \frac{1}{1+(\frac{1}{e^{(Z_{it})}})} \qquad (5.6)$$

where $Z_{i,t} = \beta_1 Y_{i,t-1}^{China} + \beta_2 Ratio\ of HS6_{i,t}^{China} + \beta_3 RCA_{i,t}^{China,ROW} + \delta_t$

Our sample is panel data for the period 1992-2008. We use the lagged dependent variable to explain the function, following what previous authors have done (Söderbom and Teal, 2001). The theory would suggest β_1 being positive, as the firm's ability to export in the previous period would likely increase its ability to export again this year.

We now provide an explanation of how to derive the $Ratio\ of\ HS6_{i,t}^{China}$. As emphasised by Andrews (1949), the concept of 'cross-entry competition' can happen if firms that are already established in other products diversify and move into the market if conditions are right. We will treat the HS4 classification as specific groups that contain products classified at the HS6 level. It is assumed that it will be easier for a firm to export a potential product if it has already exported many other products in that group. Our approach is to find the total number of HS6 subheadings under each HS4 heading for each year that China exports to the USA, which we define as the

$Ratio\ of\ HS6_{i,t}^{China}$. Since our main focus is on the potential set of products – that is, products that Mexico exports to the USA without direct Chinese competition – we take Mexico's total export headings to the US market as the reference set to find the ratio of Chinese exports. The $Ratio\ of\ HS6_{i,t}^{China}$ will be used as an explanatory variable in the logit model. We expect products within a specific HS4 subheading to be closely related and hence firms within an industry (HS4) will find it easier to shift production to other products within that group.

For a potential product, we find the number of product headings (HS6) under HS4 that China exports in a given year. This is done without taking into account the product itself during the calculation to avoid simultaneity issues. It is noted that this method of calculation will tend to provide a higher HS6 ratio for the potential products compared to products in actual competition, which is slightly perverse, but we have not discovered a better formulation. The example in Table 5.15 shows how the ratio of HS6 products is obtained. In 2000, there were five different products at the HS6 level that Mexico exported to the USA under the HS4 group (2811), where China exported a total of four out of the five products at the HS6 level. Without taking into account the product itself during calculation, the denominator (Mexico export) is 4 and the numerator depends on the number of products within the HS4 group that China exports to the USA. In this example, the ratio of the number of HS6 products within the HS4 category for the potential product has a value of 1, as China exports all the other four products to the US market. The values for the ratio of HS6 are obtained for each product, which is then used as an explanatory variable to find the probability of China exporting.

Table 5.15: Ratio of HS6

			China Export	China Export	Mexico Export	Ratio of HS 6 Digits
Year	HS4	HS6	0 = No Export, 1 = Export	(Product Headings)	(Product Headings)	
2000	2811	2811-11	1	3	4	0.75
2000		2811-19	1	3	4	0.75
2000		2811-22	1	3	4	0.75
2000		2811-23	0	4	4	1.00
2000		2811-29	1	3	4	0.75

The probability of China exporting a potential product also depends on the competitiveness level of China to the ROW (excluding the USA), as measured by the Revealed Comparative Advantage (RCA) index. China's RCA index for each product is obtained and calculated using Equation (5.3) above. The theory would suggest that China is more likely to export to the USA if it has a comparative advantage in the other markets. After we have obtained the values for each of the explanatory variables, the model is run using the ordinary logit regression model as in Equation (5.6) above.

The regression results in Table 5.16 show the estimation using the ordinary logit regression. The coefficients for the logit model are expressed in the log odds ratio and cannot be read as normal OLS coefficients. The marginal effects show that an increase in each of the explanatory variables increases the probability of China exporting to the USA in period t; the effect is in the expected direction. We need to generate a new set of variables, so we need to estimate the predicted probability of China exporting for each observation in our sample.

Table 5.16: Ordinary Logit Regression Results

	Coefficient	Marginal Effects
$Y_{i,t-1}^{China}$	3.30***	0.50***
	(0.034)	(0.01)
Ratio of HS6 Digits	1.23***	0.09***
	(0.041)	(0.00)
RCA Index	0.27***	0.02***
	(0.013)	(0.00)
Constant	-1.29***	
	(0.068)	
Time Dummies	Yes	
N	49861	
	Prob > chi2 = 0.0000	

We will refer to the same example, product 281123 for the year 2000, where the probability of China exporting to the US market is calculated with a predicted value of 0.45. In order to estimate the probability of exporting that product, we insert the values of X_1, X_2 and X_3 into Equation (5.7). The predicted probability of China exporting a particular product in period t is obtained by plugging the estimated coefficients and the values of the relevant explanatory variables into Equation (5.6). Thus we use Equation (5.7), with year dummies included (not shown in Equation)

$$z_{i,t} = -2 + 3.3(0) + 1.23(1) + 0.27(0.02) + \delta_t \qquad (5.7)$$

We then proceed to find the predicted probability of China exporting for each product year. We calculate that the average probability of China exporting is 0.41 for potential products, while the probability of exporting for actual products, used for reference purposes, is 0.91. The figures in Table 5.17 show the probability distribution for actual and potential products. For the products that China exports to the US market (actual competition), we find that 94.2% of these product-years have a probability of exporting of more than 0.5, while the remaining 5.8% have a probability of less than 0.5. For convenience purposes, the probability of 0.5 will be used as the benchmark; those product-years with a value greater than 0.5 will be referred to as high-probability products, while those with a value less than 0.5 will be referred to as low probability. This supports our model specification, which suggests that the probability of exporting to the US market is definitely higher for products that are already in China's export basket to the USA.

Table 5.17: Probability Distribution Table (Ordinary Logit)

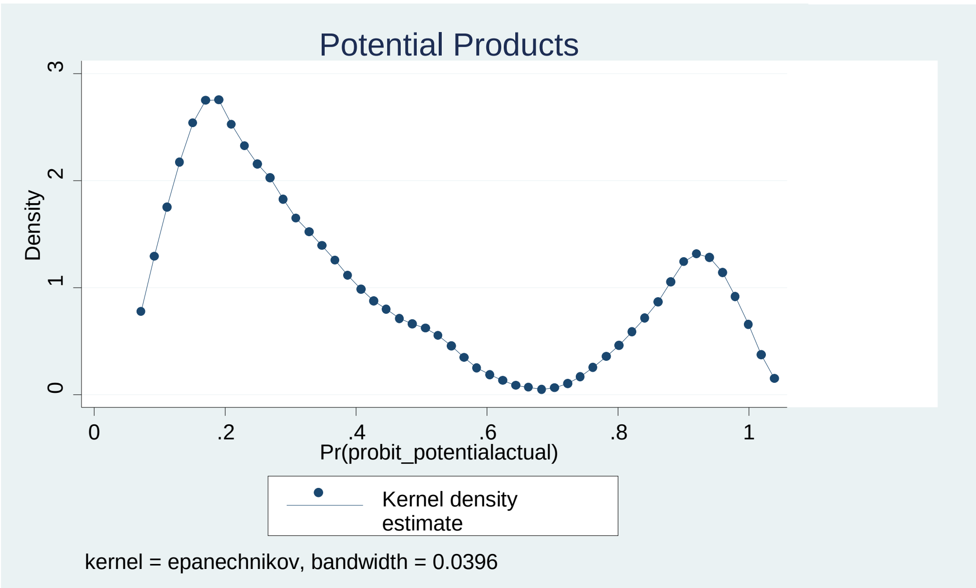
	Count	**Count**	**Total Count**
	Prob ≥ 0.5	Prob < 0.5	
China Export (actual)	38708(94.2%)	2403(5.8%)	41111
China Do Not Export (potential)	2415(27.6%)	6335(72.4%)	8750

For the potential products, our results showed that 27.6% of the product-years have a probability of exporting that is greater than 0.5, while the remaining 72.4% of product-years have a predicted probability value that is less than 0.5. The high probability of exporting is driven mainly by China exporting that product in period T-1, which implies a high probability of exporting in the first year during which exports cease. However, on the whole it seems that the model does provide acceptable probability estimates, as almost all of the products in actual competition that have a high export probability are exported, while those with low probability in potential competition are not exported. For products with a high probability of exporting but that China did not export, this would suggest that there are some unknown factors that are not captured in our model specification; that is, restrictions and bans on Chinese imports.

5.6.1 Probability Density Function

We sketched the Kernel density function to look at the probability of exporting pattern for just the potential products. There are two distinct peaks, as shown in Figure 5.5, as the probability of exporting model has the implication that the probability of exporting in the current period (T) leans towards whether China exported in the previous period (T-1). As we have calculated, the average probability of exporting for those products where China exited the market is very high, at 0.91, while the other group has an average value of 0.27, which seems to be pretty close to the two peaks in Figure 5.5. Mexico might be less concerned with those products where China exited the market, but not assuredly so, as China might still re-enter.

Figure 5.5: Probability Density Distribution



5.7 Methodology

Again we emphasise that China's increased productivity is the exogenous shock which is independent of Mexico's pricing decisions. We thus derived China's probability to export as an additional control variable which isolates the effect of Chinese entry. We introduce a model to study the competitive price effects from products that China does not yet supply to the US market which we termed as ‘potential competition’.

5.7.1 Econometric Model

Our approach is similar to that of actual competition where we focus on one market – the USA – and one other middle-income supplier – Mexico. The econometric equation that we use for potential competition is constructed similarly to that for actual competition. Potential competition in this case can be examined by regressing Mexico’s unit prices on the estimated price if China enters, referred to as the predicted Chinese price. Equation (5.8) is the main equation to find the competitive effect on Mexico and this is similar to that in actual competition with product fixed effects. A product at the HS6 level is categorised as i and the period defined as t. The exchange rates for both countries can be better represented by time dummy variables in Equation (5.8), as they are invariant across products and will be absorbed into the fixed effect regression.

$$lnP_{i,t}^{M} = A + \beta_1 \widetilde{lnP_{t,\iota}^{C}} + \lambda_t + \varepsilon_{i,t} \qquad (5.8)$$

$lnP_{i,t}^{M}$ is the tariff-inclusive price of Mexico’s product in the United States and $\widetilde{lnP_{t,\iota}^{C}}$ is the estimated Chinese price in logs. This regression is used on the set of potential products in order to find β_1, which is the price effect of China on the potential set of products. However, as data is not available for the set of potential Chinese exports to the USA, we need to find a way to predict their price. When working with potential products, we are actually dealing with something that is not physically there and predicting what its price would be if China entered.

5.7.2 Generating the Predicted Chinese Prices

These potential products can be further grouped into two main categories, namely products that China does export to the ROW and those that China does not export at all.

As mentioned, we identify the threat of entry by looking at China's exports to the other markets for the set of potential products. For those products that China does not export at all, it will not be possible to know whether China has the capacity to produce those products domestically, as the Chinese classification of products internally is different from the HS6 classification. We will ignore these products. The products that China has the capacity to export to the ROW but not the USA can be termed the set of potential products.

As there are no actual prices to the USA for the set of potential products, we will need to generate the predicted Chinese price using Equation (5.9)

$$lnP_{i,t}^{C} = c + dlnz_{i,t} + \lambda_t + u_{i,t} \qquad (5.9)$$

In order to generate the predicted Chinese price, we need to look for suitable regressors ($z_{i,t}$) that can provide some kind of indicator to the Chinese price in the US market. This in a way is similar to instrumenting for the Chinese price in the first-stage IV regression that we performed for actual competition. However, in potential competition, the Chinese prices simply do not exist, as these products are not exported to the USA but we have to generate their price based on the set of suitable regressors. The suitable regressors that we will use to predict the price for the potential products are mostly the same set of variables for the first-stage regression in actual competition; that is, the sectoral mean price, Japan and Korea's reported prices and also China's reported price to the ROW.

We estimate Equation (5.9) based on the mixed sample, where lnP^{C} is known, and use it to predict where it is not (potential products); that is, to generate the predicted price for the potential products. Once we have generated the predicted Chinese price, we will work only with the sample of potential products. We obtain different samples for the predicted Chinese price ($\widetilde{P_{t,\iota}^{C}}$) as the chosen regressors change. Thus we have generated the predicted Chinese prices for the potential set of products, which can be seen as the equivalent of using IV to generate the Chinese price effect as in actual competition.

As mentioned in the chapter on actual competition, there is also concern that Mexico's prices in the other markets might also be influenced by China's presence and hence affect its prices in the US market, thus we chose markets in which Mexico is a small player. Japan and Korea are the two markets in which Mexico has a relatively small share, as mentioned above. Japan and Korea are the major export markets for China, so we will be able to obtain more observations to predict Chinese prices in the USA. We assume that Chinese prices to these markets are direct indicators of the forces influencing Chinese prices in the US market, but have only an indirect effect on Mexico's prices in the USA. Similarly to actual competition, we use importer data for consistency and efficiency purposes.

In order to increase our sample size, we use the unit price of China's exports to the ROW (excluding the USA). These are for the products that China exported to the ROW (excluding the USA) and the unit prices are those reported by China. There are of course many advantages in using the prices reported by China's trading partners, as we have done previously, but here it is noted that different countries use different units of measurement for traded products, thus it will not be ideal to take the average unit price as reported by the ROW. However, to solve this problem, we can take the data reported by just one country, namely China's exports to the ROW. Data as reported by China will have similar units for exports to other countries, hence there will not be a unit inconsistency problem. If China does export to the ROW, this will mean that China already has the capacity to export that product and will find it easier to shift its export path into the US.

After generating the predicted Chinese price, the next step involves replacing the predicted $\widetilde{lnP}^{C}{}_{i,t}$ in Equation (5.8), where our main subject of interest is China's price effect represented by β_1. The estimated results rely heavily on the predicted Chinese prices (estimated price that China would have charged if it entered) generated by the set of explanatory variables in the first stage. We expect the Chinese price effect to be positive, as Mexico will react to the predicted Chinese products in order to prevent China from entering the US market for potential products following limit pricing theory.

5.8 Regression Results

The results in Table 5.18 show the regression results for predicting Chinese prices using the four suggested explanatory variables, namely Japan's reported price, Korea's reported price and China's reported price to the ROW. The regressors we use are similar to those used for actual competition, except that we have added in China's reported price to the ROW. Here we get slightly more observations in the first stage as compared to that in actual competition, as we do not restrict our sample to only Mexico's exports to the US market; that is, for Japan, an observation is taken into account if China exports to Japan and the USA even if it is not in Mexico's export basket to the USA. However, other than the slightly different observations, the first-stage estimates are similar to those obtained for actual competition. The R^2 are not high for the regressions to generate the predicted Chinese price and this casts doubt on the strength of our regressors. Nevertheless, all the regressors have an F statistic well over 10, which according to Staiger and Stock (1997) is a necessary condition to suggest that the regressors are adequately strong.

Table 5.18: Predicted Variable Estimates

Dependent Variable is Mexico's Price			
	(1)	(2)	(3)
	Japan Price	Korea Price	China Exports ROW
Predicted China Price	0.29***	0.26*	0.37***
	(0.1)	(0.14)	(0.091)
Time Fixed Effect	Yes	Yes	Yes
Product Fixed Effect	Yes	Yes	Yes
R^2	0.029	0.027	0.02
N	3966	3749	8469
First Stage to get Predicted Price			
Predicted Price	0.17***	0.11***	0.18***
	(0.0053)	(0.0044)	(0.0065)
F-Stats (Prob>F)	88.09 (0.00)	68.75 (0.00)	71.49(0.00)
R^2	0.045	0.038	0.032
N	35430	33469	41085

The Chinese price effect is significant and ranges from 0.26 to 0.37, depending on the instruments used. The first-stage regression shows the relevance of the selected variables with the Chinese price. We then use these estimates to generate the predicted Chinese unit prices for these potential products. The Chinese price in the US market is expected to fall by 0.17% for every 1% decline in prices of Chinese exports to Japan. The coefficient for the Korean price is significant and positive at 0.11. We obtained a coefficient of 0.18 in the first stage when using Chinese reported price as our explanatory variable. The results show that the selected regressors all provide statistically significant estimates, which is used to generate the predicted Chinese price.

The product sample used to generate the predicted Chinese prices varies with the different regressors chosen. We will thus obtain different predicted prices for the set of potential products based on the regressors chosen. There must be observations for these indicators in order to predict the Chinese price that is not there in the first place. We lose further observations doing this and the number of observations we are left with using each indicator are shown in Table 5.18. Using average sectoral means and China's reported price to the ROW, we get to preserve most of the sample, while we are left with fewer than 4000 product-years when using Japan and Korea's reported prices. After we have obtained the predicted Chinese prices to the USA for the set of potential products, we proceed to find its competitive effect on Mexico. In potential competition, we use only individual indicators to predict Chinese prices, as using a combination of these explanatory variables will result in the loss of further observations.

After controlling for product fixed effects, the regression results in Table 5.18 show that the Chinese price effect is positive and statistically significant. This supports our theory of potential competition, where Mexico will try to constrain its prices based on the estimated price that China would charge if it entered the market. The Chinese price effect ranges from around 0.26 to 0.37 depending on the predictors used; these are slightly lower than the values we obtained for actual competition. If Mexico predicts that the estimated Chinese price to enter the market will be 10% lower, Mexico will reduce its price by 3.7% compared to China's price to the ROW.

In the previous sections, we found the probability of China exporting a product to the US market based on the ordinary logit model. One might hypothesise that the competitive effect will increase when China has a higher probability of exporting a product. To do this, we controlled for the interaction term $(\widetilde{P_{i,t}^{C}} * \widetilde{ProbX_{i,t}^{C}})$ to measure the marginal changes in the Chinese price effect with China's probability of exporting, which we will call the interaction effect of the Chinese price. Our equation specification is represented by Equation (5.10), which makes use of two generated regressors, $\widetilde{P_{i,t}^{C}}$ and $(\widetilde{P_{i,t}^{C}} * \widetilde{ProbX_{i,t}^{C}})$. Our specification and regression results in Appendix 5.2 include adding in the $\widetilde{ProbX_{i,t}^{C}}$ separately; however, as our main objective is the Chinese price effect and the results are quite similar for both specifications, we decided to drop $\widetilde{ProbX_{i,t}^{C}}$ in Equation (5.10):

$$lnP_{i,t}^{M} = \alpha + \beta_1 \widetilde{P_{i,t}^{C}} + \beta_2 \left(\widetilde{P_{i,t}^{C}} * \widetilde{ProbX_{i,t}^{C}}\right) + \lambda_t + u_{i,t} \quad (5.10)$$

In Equation (5.11), the individual Chinese price effect is β_1 and if $\beta_2 > 0$ this implies a competitive price effect when China's probability of exporting increases. We will refer to β_2 as the interaction effect brought about by China's probability of exporting.

$$dlnP_{i,t}^{M} \Big/ d\widetilde{P_{i,t}^{C}} = \beta_1 + \beta_2 ProbX_{i,t}^{C} \qquad (5.11)$$

The predicted Chinese price effect is still statistically significant and positive when using the full regression in Table 5.19. We expect to see positive coefficients for the interaction effects, but it is surprising to see that the interaction effects on Chinese prices are all insignificant and even in the wrong direction.

Table 5.19: Full Regression

Dependent Variable is Mexico's Price			
	(1)	(2)	(3)
Instrument is	Japan Price	Korea Price	China Exports to ROW
Predicted China Price	0.38***	0.25*	0.43***
	(0.11)	(0.14)	(0.096)
Interaction (Pc*Prob Export)	-0.050	-0.027	-0.038
	(0.039)	(0.037)	(0.028)
R^2	0.031	0.029	0.022
N	3730	3542	7761
Time Fixed Effect	Yes	Yes	Yes
Product Fixed Effects	Yes	Yes	Yes

Our specification to generate China's predicted probability of exporting to the USA is a function of China's RCA to the ROW, the ratio of HS6 and whether China exported in the previous period using the logit model. However, a problem arises, as the probability of exporting relies strongly on China actually exporting in the previous period (T-1); that is, if China exports in the previous period, we expect China also to export in this period. As shown in Table 5.19 above, China's probability of exporting in the current period increases by about 50% if it exports in the previous year. If China exited the market, Mexico might not be too worried about constraining its own price, as the logic behind potential pricing is to deter entry, although there is the worry that China might re-enter the market.

Before we rule out the impact of the probability of exporting on the Chinese price effect, we drop those product-years in potential competition where China exited the market. We lose further observations doing this; the results in Table 5.20 show that the coefficients on the interaction term are still statistically insignificant and in the wrong direction, except when using China's reported price to the ROW, where the interaction effect is in the expected direction but insignificant. It is surprising that we did not obtain a positive effect for the interaction term, but we feel assured that potential pricing exists and that the predicted Chinese price effect is still positive and statistically significant; the predicted Chinese price acts as a constraint on Mexico's price even if China has not entered the market.

Table 5.20: Full Regression (China Exported in Neither T nor (T-1))

Dependent Variable is Mexico's Price			
	(1)	(2)	(3)
Instrument is	Japan Price	Korea Price	China Exports to ROW
Predicted China Price	0.52***	0.27	0.42***
	(0.13)	(0.17)	(0.12)
Interaction(Pc*ProbExport)	0.27*	0.014	0.13
	(0.15)	(0.14)	(0.11)
R^2	0.052	0.052	0.027
N	2669	2502	5981
Time Fixed Effect	Yes	Yes	Yes
Product Fixed Effects	Yes	Yes	Yes

We could argue that if China had a high probability of exporting but did not do so, this is probably due to some barriers of entry. Brambilla et al. (2010) found that Chinese exports under the MFA are still relatively restricted in the USA, as it faces a stronger quota system than other countries. The quota restrictions are most likely to affect actual competition. Bown and McCulloch (2009) also mention that the USA tried to reduce the trade deficit through slowing down imports from China by applying more restrictive measures on Chinese products. If there exists a ban on China's product in period t, then this will not be picked up by our equation specification; however, there is no available data on China's products banned by the USA at the disaggregated level. Although there are data on quota restrictions available for the MFA, these are most likely to affect competitive effects for actual competition. According to Bown (2009:30), some of the reasoning behind the US ban on Chinese products included 'claims of unsafe chemicals found in Chinese products such as pet food and toothpaste, lead paint in toys, defective radial tires and banned antibiotics applied to farmed seafood'. If there exists a ban on Chinese products, then this will not be picked up by our equation specification; however, there is no available data on the banned products.

5.8.1 China Price Effect by Sector (OECD)

We classify the potential products into five different sectors as characterised by their technology intensity, as shown in Table 5.21; most of the potential products are in the non-industrial to medium high technology groups.

Table 5.21: Product Headings by OECD Classified Sector

	OECD sectors	Product Years
Non-industrial	1	1,740
Low Technology	2	2,810
Medium Low Technology	3	1,619
Medium High Technology	4	3,151
High Technology	5	245

The simple bivariate regression results in Table 5.22 show the Chinese price effect as classified by the five different OECD sectors. The regressors are allowed to have their own slopes, classified by the five OECD sectors. The Chinese price effect varies according to the indicators used; we get the perverse sign for the high technology sector, but the results should not be taken seriously as there are very few potential observations in this sector. The Chinese effect is most notable in the low and medium low technology sectors, which are exactly the sectors in which we would expect Chinese competition.

Table 5.22: China Price Effect by OECD Sector (Second Stage)

Dependent variable is Mexico's price			
	(1)	(2)	(3)
Instrument is	Japan Price	Korea Price	China Exports to ROW
Predicted Chinese Price			
Non-industrial	0.65**	-0.19	0.69***
	(0.26)	(0.29)	(0.20)
Low Technology	1.54***	0.70**	1.07***
	(0.22)	(0.27)	(0.16)
Medium Low Technology	0.99***	0.35	1.28***
	(0.25)	(0.31)	(0.20)
Medium High Technology	-0.26**	0.23	-0.43***
	(0.13)	(0.17)	(0.13)
High Technology	-0.52	1.38	-1.51***
	(1.24)	(1.56)	(0.53)
R^2	0.053	0.030	0.034
N	3948	3749	8469

5.8.2 Robustness Tests

5.8.2.1 First Difference

The first difference method is another way to get rid of the time-invariant unobserved effect. Although our assumption is that the predicted Chinese price in the USA acts as the main shock causing Mexico to adjust its price under limit pricing, a potential problem that can occur is when P_{it}^{m} and $\widetilde{P_{\iota,t}^{c}}$ both follow a deterministic trend, which we assume to be independent of each other. If this is the case, first differencing and first difference fixed effects provide a way to get rid of the trend; the regression results are shown in Table 5.23.

Table 5.23: First Difference and Fixed Effects of First Difference

Dependent Variable is Mexico's price			
	(1)	(2)	(3)
Instrument is	Japan Price	Korea Price	China Exports to ROW
First Difference			
Predicted Chinese Price	0.49***	0.38**	-0.15
	(0.11)	(0.15)	(0.095)
R^2	0.0001	0.01	0.0001
N	2237	1992	5759
Fixed Effect of First Difference			
Predicted Chinese price	0.45***	0.28	-0.095
	(0.14)	(0.20)	(0.11)
R^2	0.01	0.002	0.0002
N	2237	1992	5759

The first difference method shows that the Chinese price effects are positive and statistically significant when instrumented using Japan and Korea's reported price. The results show that the Chinese price effect is around 0.49 to 0.38 when predicted using Japan and Korea's prices respectively. However, we are left with only about 2000 observations when predicting using Japan and Korea's reported prices. We would expect to get more accurate results when using China's reported price to the ROW, as we get to retain more observations; however, the predicted Chinese price effect is not significant using those indicators. It is noted that we get a low R^2 in all cases, indicating that the predicted Chinese prices do not explain the variation in Mexico's prices very well for the potential products. However, we think it is more important to have a correctly specified model than it is to have a large R^2.

First differencing fixed effects will get rid of the unobserved time-invariant factors α_i and the trend for both China and Mexico's prices. If we assume the trend to be product specific, then first difference followed by fixed effects estimation will get rid of the product-specific trend. The Chinese price effect is only significant when instrumented and predicted using Japan’s reported price. The fixed effects of first difference for the full regression are shown in Appendix 5.3. We found China’s predicted price to have a significant impact, restricting Mexico’s price using Japan and Korea as indicators. These results also tend to suggest no effect for the interaction term.

5.8.2.2 Controlling for Global Export Price

As there is also the worry that prices might be correlated, we also included the global export to take out the trends in product price and also be seen as a control for the other competitors’ as a further robustness test. The regression results in Table 5.24 are obtained following Equation (5.12). The global export price is calculated using the same method as specified in the section on actual competition.

$$lnP_{i,t}^{Mexico} = A + \beta_1 \widetilde{P_{t,\iota,t\iota}^{C}} + \beta_2 (\widetilde{P_{t,\iota,t\iota}^{C}} * ProbX_{i,t}^{C}) + \beta_3 \ln P_{t,i}^{globalP} + \lambda_t + u_{i,t} \quad (5.12)$$

Table 5.24 : IV Regression (Controlling for Global Export Price)

Dependent Variable is Mexico’s price			
	(1)	(2)	(3)
Instrument is	Japan Price	Korea Price	China Export Price
China Final Price	0.19*	0.21	0.23***
	(0.11)	(0.14)	(0.089)
Price*Share	-0.020	-0.014	-0.014
	(0.037)	(0.036)	(0.026)
Global Export Price	0.61***	0.35***	0.56***
	(0.036)	(0.039)	(0.018)
N	3708	3541	7755
R^2	0.138	0.065	0.158
Product Fixed Effect	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes

We find that the Chinese price influence is still statistically significant when predicted using China's export price, Japan prices and Korea's price. The results with the global export price are comparable with the regression results as shown in Table 5.20 above. This further justifies that the Chinese price effect is indeed present in potential competition and the results are not driven by other competitors, pricing.

5.8.2.3 Bootstrapping to Correct for Standard Errors

When dealing with potential products, we are looking at 'invisible' prices, as the products are not exported to the USA in the first place, thus when we use predicted values we need to recognise that they are measured with error. This is a potential problem with our regression, because the standard errors and test statistics obtained will be incorrect, as they ignore the sampling variation in the generated regressors; hence inferences might be incorrect. We can use the bootstrapping method as proposed by Cameron and Trivedi (2010) to adjust for standard errors and test statistics. In general, bootstrapping is a nonparametric resampling method to approximate for standard errors based on the sample data. In using the bootstrap method, we are pretending that the sample is a proxy for the population, and hence the estimates of the sample are assumed to be close to the population estimates. The bootstrap method draws repeated random samples with replacement from the entire dataset to generate a bigger dataset that allows estimates of each sample. The bootstrapped standard errors are simply the distribution of each sample estimate across all the selected samples. Efron and Tibshirani (1994) found that 50 replications are often enough to give good estimates for the standard error estimates. For this study, we executed 100 and 400 bootstrap replications, a number that is generally adequate for correcting standard errors. The bootstrap sample contains the same number of observations as the true sample, however some observations appear several times and others never.

Table 5.25: Bootstrapping for the Standard Errors

Dependent Variable is Mexico's price			
	(1)	(2)	(3)
Instrument is	Japan Price	Korea Price	China Exports to ROW
Predicted China Price	0.52	0.27	0.42
No Bootstrap	(0.13)***	(0.17)	(0.12)***
Bootstrap 100 replication	(0.52)	(0.33)	(0.40)
Bootstrap 400 replication	(0.50)	(0.35)	(0.41)
Interaction(Pc*ProbExport)	0.27*	0.014	0.13
No Bootstrap	(0.15)*	(0.14)	(0.11)
Bootstrap 100 replication	(0.28)	(0.15)	(0.17)
Bootstrap 400 replication	(0.26)	(0.14)	(0.16)

* The asterisk denotes the significance level for the coefficients using bootstrapping

The regression results in Table 5.25 are run using product fixed effects for simple bivariate regression where the standard errors are bootstrapped for inference purposes. The standard errors when bootstrapped using 100 and 400 replications are almost identical in all cases, indicating that 100 replications will be enough to get the correct standard errors. The results show that the Chinese price effect after bootstrapping is no longer significant in all cases. The results also show that the Chinese price effect in the USA is not affected by the probability of China exporting to the US market. We also conducted the bootstrapping for the simple equation (results are not shown) and similarly found that bootstrapping blows up the standard error, making the Chinese price effect no longer significant. The Chinese price effect is no longer significant after using the bootstrapping method to correct for the standard errors. The bootstrapped results seem to suggest that China does not affect Mexico's price when it does not export. We acknowledge the presence of other competitors in the USA and that Mexico will be more worried about price competition with the existing competition when China is absent. Another potential explanation is that there might be some kind of barriers to entry imposed on these potential products; Mexico does not respond to changes in the predicted Chinese price. Hence inference on the Chinese price effect in potential competition needs to be treated with appropriate caution.

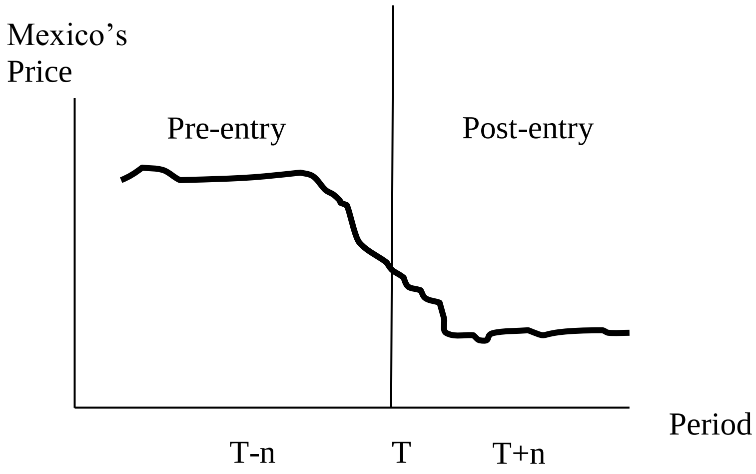
On the other hand it is important to reflect on the way in which bootstrapping works in a panel. Although the resampling with replacements over commodities rather than over individual observations, each observation has a different probability of being selected for an unbalanced panel. When it constructs samples by replacing specific observations by others, it does not attend to whether the two observations refer to the same commodity. Since we include product-specific effects, this is potentially quite inappropriate; it could lead to a spurious increase in the residual errors and hence in the calculated standard errors. Bootstrapped standard errors tend to be larger than the normal OLS standard errors when data is noisy and hence provides a more conservative inference (Banks et al., 2010).

5.9 Temporal Price Effect

The other method of identifying potential competition is to look at the temporal dimension before and after China's entry. To study the effects of potential competition, we need to find the first year in which China entered the US market for each particular product. Thus, all periods before Chinese competition are classified as period T-n, which is defined as pre Chinese entry. Suppose China enters the market in period T, these products will face actual Chinese competition for the periods (T+n) after China's entry, which can be defined as post Chinese entry. Thus, although China does not export those products before period T, Mexico's pricing could be constrained by the ability of China to start exporting. This method can also be used to assess the potential Chinese competitive effect on Mexico: Mexican producers respond to China's entry before and after competition occurs. There are two possible scenarios that can happen when China enters the market: either the countries will engage in price competition, or they will realise that both will be better off if they cooperate.

In Figure 5.6, we show the example of higher pricing by Mexico before Chinese entry and price competition occurring after Chinese entry. Mexico is more likely to charge a higher price if it is protected by some kind of structural entry barrier. An example is in the form of blockaded entry, which occurs when incumbents do not have to resort to any strategies to prevent entry. Under blockaded entry there will be a bigger shock to Mexico when the blockades are removed and China enters the market as compared to non-blockaded entry. . The MFA can be considered an example of a blockaded entry on Chinese textile products that has benefited countries like Mexico that are members of NAFTA, as they face little incentive to reduce prices. On the other hand once the quotas are removed these products will face a bigger shock than would non-blockaded products.

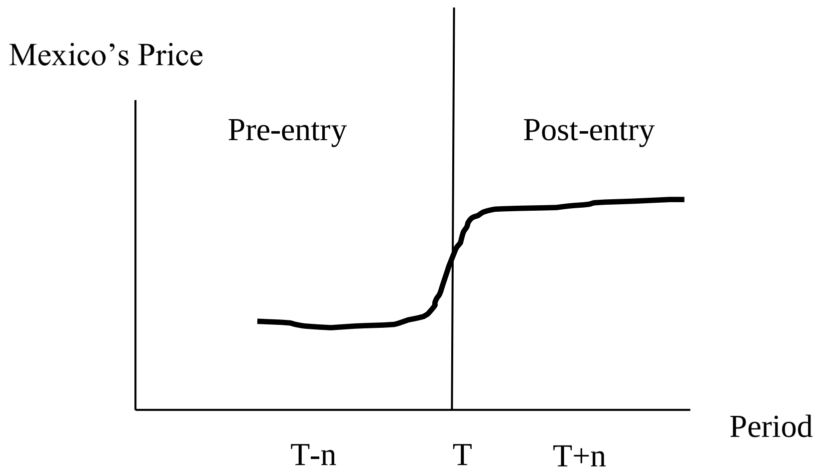
Figure 5.6: Temporal Dimension (Competition)



Under the limit pricing conditions, Mexico will try to take actions before entry even takes place to prevent Chinese products from entering the US market, usually by constraining its own price.

Another possible post-entry scenario that can occur is that Mexico might try to constrain its price to deter Chinese entry, but practise tacit cooperation once China enters, as illustrated in Figure 5.7. Mexico's price rise after entry would tend to suggest price competition before entry, and this pattern would tend to support our hypothesis of limit pricing for potential products. In the case when Mexico's price falls after Chinese entry, there might also have the same form of potential constraint, although in terms of price rises the inference in fairly strong.

Figure 5.7: Temporal Dimension (Cooperation)



descriptive statistics on Mexican prices for the three periods, where the first consists of observations just before Chinese entry (T-1), the second is when China first started exporting to the US market and the third (T+1) can be defined as the period after China's entry.

An example to examine the temporal dimension is illustrated for product 010600 in Table 5.26. China started to export product 010600 (Animals Live except Farm Animals) in 2000, thus 1999 (T-1) can be considered the last period in which potential competition happens; hence we will look at the price pattern for Mexico's products for period (T-1). Similarly, the year 2001 will be termed (T+1), the first period after China enters the market. We will create dummy variables for each of the three specified periods, T-1, T and T+1, to find Mexico's possible different reactions to Chinese competition before and after China enters the market.

However, for Chinese exports of some products there might be some breaks during certain periods. We will treat it as the case that China has stopped exporting to the US market for whatever reason if exports stopped for three years or more. The implication is that China's next entry will be considered a new product. If China did not export the product for just one or two years, we will treat it as a missing value and assume that China has not actually stopped exporting. Our sample consists of data for the period 1992-2008, but 1992 cannot be counted as the first year of exports, since the product might already have been exported before 1992. We thus dropped those observations where China's first recorded batch of exports was in 1992. Using the full sample set we managed to identify 3743 product-years where an entry is recorded. It is particularly important that a product is genuinely a new export and not one that arises because of the HS classification issue.

Table 5.26: Temporal Potential Competition for Product (010600)

		China Export to US
T-3	1997	No
T-2	1998	No
T-1	1999	No
Period T	2000	Start 1st batch of exports
T+1	2001	Yes
T+2	2002	Yes

In order to avoid this classification issue, we will use only the sample of clean products, as these have not undergone any HS changes during the past revisions. Manova and Zhang (2009) provided a comprehensive view on Chinese firms' participation in the export market; they found that big multinationals have a better chance of continuing to export, while small Chinese trading firms are the most likely to exit and re-enter the export market. Furthermore, they found that firms, especially smaller ones, are more likely to switch their export structure and trading partners compared to the bigger multinationals. The number of first-entry products (period T) in the clean sample is given in Table 5.26, where we are left with a total of 2693 product-years for the sample period. However, we are also interested in finding Mexico's price pattern before entry takes place. China's average share in the US market for its first-entry products was relatively small (5%) in 1993, but is seen to have increased after 2000 (16%). Taking into account that these are new-entry products, we are measuring different products for every year. We show that China's average product share in the Japanese and Korean markets is relatively higher, at around 20% to 30% for these first entry products as shown in Table 5.27, indicating that it has a big player in the other markets already.

There seems to be a relatively high Chinese share in the USA for the first-entry products from 2005 onwards. To reconcile this with the fact that the MFA quotas were lifted starting in 2005, we wanted to check whether the high Chinese share arises because of this particular reason. We categorised Chinese first-entry products to the USA into two groups: products that are subject to MFA quotas (blockaded entry) and those that are not affected by quotas (non-blockaded entry). China only started to enjoy the quota phase-out during the third phase-out in 2002, soon after it joined the WTO. Brambilla et al. (2010) found that Chinese exports in textiles and clothing rose 39% in quantity terms the year after quotas were abolished in 2005; China's unit prices also fell in the years after each quota phase-out. They also added that China's gains came almost entirely at the expense of other US trading partners rather than domestic firms.

In Table 5.27, it can be seen that the average product share for first-entry products (period T) is relatively higher for quota-restricted products compared to non-quota-restricted products.

Table 5.27: China's First-Entry Products in the USA (Clean Products)

Year	Product Count	Average Chinese Share in USA	Average Mexican Share in USA	Average Chinese Share in Japan	Average Chinese Share in Korea
1993	257	0.05	0.09	0.19	0.20
1994	196	0.07	0.05	0.25	0.22
1995	213	0.10	0.06	0.24	0.23
1996	193	0.07	0.05	0.18	0.16
1997	149	0.06	0.07	0.22	0.25
1998	126	0.05	0.09	0.21	0.25
1999	147	0.05	0.08	0.19	0.21
2000	492	0.13	0.08	0.23	0.17
2001	113	0.08	0.04	0.25	0.19
2002	123	0.07	0.09	0.21	0.24
2003	123	0.08	0.06	0.29	0.27
2004	134	0.09	0.06	0.25	0.25
2005	129	0.10	0.05	0.30	0.28
2006	109	0.15	0.05	0.29	0.26
2007	114	0.14	0.03	0.32	0.31
2008	75	0.16	0.05	0.33	0.32
Total/Mean	2693	0.09	0.07	0.24	0.22

* Data obtained from Comtrade and tabulated using own calculations
* We also noticed an unusual number of new-entry products in 2000 and concluded that these are all new-entry products following the method of identification.

The quota affected products are those that gradually integrated in each of the four phase out. We constructed the average product share for quota-affected products in each period T. China was only eligible for the third phase-out starting in January 2002. For these products, average Chinese shares for new products showed quite a big jump after 2005 when quotas were lifted; they reached 38% in 2008. After quotas were lifted starting in 2005, Chinese textile products entered the US market in a big way, acting as a shock to Mexico. It was surprising that China entered the market for many products before 2002, considering that quotas are applied to them.

For those products that are not subject to quotas as shown in Table 5.28, we see only a slight increase in China's shares in the USA since 2005, which is not surprising given that average Chinese product shares in the USA have increased over time.

Table 5.28: China's First-Entry Products (Quota Effects)

	Not Subject to Quotas		Quota-Affected Products	
Year	Product Count	Average Chinese Share in USA	Product Count	Average Chinese Share in USA
1993	209	0.04	48	0.09
1994	155	0.04	41	0.16
1995	159	0.07	54	0.18
1996	162	0.06	31	0.16
1997	112	0.05	37	0.08
1998	97	0.05	29	0.05
1999	103	0.04	44	0.07
2000	459	0.13	33	0.16
2001	101	0.07	12	0.10
2002	110	0.08	13	0.02
2003	109	0.08	14	0.10
2004	118	0.09	16	0.11
2005	101	0.09	28	0.11
2006	89	0.13	20	0.23
2007	97	0.12	17	0.24
2008	65	0.12	10	0.38
Total	2246		447	

* Data obtained from Comtrade and tabulated using own calculations

In order to identify the temporal dimension of Chinese competition, we will look at Mexico's price pattern in periods T-1 and T-2, two periods before Chinese competition actually takes place. Similarly, we will also be looking at post-Chinese competition for periods T+1 and T+2. However, to make sure that we are comparing unit prices for the same products over time, the products have to be present in all time periods: T-2, T-1, T, T+1 and T+2. There are a total of 458 products for which Mexico's price is observed for all five periods, leaving us with 2290 product-years. These are inclusive of quota-restricted cases, but we will look at quota cases separately when comparing relative prices later on. These can be considered Mexico's established products, as they are exported for five consecutive periods, two periods before China's entry and two periods afterwards. For China, these can be considered new products in the US market and they will be competing against already established Mexican products.

The sample is, however, a little restricted, since we are constraining Mexico's exports to be present for all five periods. It can be noted that China exported only 292 out of these 458 products in the next period (T+1). In the subsequent period (T+2), only 291 out of the 458 were still exported by China. This leaves 230 common products that China still exported in both periods T+1 and T+2 out of these 458 products. These are Chinese firms that exited from the new export market. The small product share of these restricted products might indicate that they are small-scale exporters, who are more likely to exit the new export market. China is considered a new entrant and a small player for these products, but nonetheless Mexico might be worried about the continual expansion of these new Chinese products. We also found that Chinese import shares in these restricted products in the Japanese and Korean markets were a remarkable 17% and 16% respectively.

Now that we have categorised the products into three different periods, we can find the relative price for each of the 458 products for comparison between the five different time periods. To make sure that different products are comparable across different periods, we need to normalise each product's price by its own price in period T, which is represented as ${x_{i,T-n}}/{x_{i,T}}$. We can then compare the normalised price for all products in the different periods. Table 5.29 shows the average Mexican price for the 458 different products that Mexico exports for all five periods. Since all prices in logs are weighted relative to period T, the weighted price in period T is 0.

Table 5.29: Average Mexico Price Pattern Relative to Period T

Variable	Observation	Mean	SD of mean
T-2	458	-0.01	0.04
T-1	458	-0.04	0.03
T (China enters)	458	0	0.00
T+1	458	-0.01	0.04
T+2	458	0.04	0.05

On average, the results seem to support price cooperation between the two countries, where Mexico's price increases slightly in period T, but the result is not significantly different from no effect. The standard error obtained for our sample is the standard deviation of the sample mean calculated using $\sigma/\sqrt{n}$, which is representative of the population. The slight increase in Mexico's price in period T compared to period T-1 suggest price competition from potential entry before entry. Our theory assumes limit pricing before entry and Mexico, being the incumbent firm in the US market, might have engaged in cooperative pricing with China once it realised that it could no longer prevent Chinese entry.

To check whether Mexico's temporal reaction to entry varied by sector, we break down our 458 products into different sectors in order to find their average prices (Table 5.30), which are appended together to find their average log unit price by sector, although behaviour may vary by product. There is no obvious pattern for the different sectors.

However, there must be some products that follow the price pattern in Figure 5.6 (price competition), where the countries engage in price competition after Chinese entry. Thus, we categorise our sample into two groups, the first group engaging in price competition on Chinese entry and the second group those that follow the cooperation price pattern after Chinese entry. The two groups are defined by the change in Mexico's price between period T-1 and period T. Products are divided into Group 1 (price competition), when Mexico's price in period T falls relatively to period T-1, and the rest in Group 2 (price cooperation). We found that there are indeed two quite distinct patterns, as shown in Table 5.30. The results show that 206 (45%) of products follow the price pattern in Figure 5.6 (price competition) where Mexico's price post Chinese entry is lower. For this group (price competition), the figure shows that Mexico's prices fell when Chinese competition occurred in period T, but started to rise slightly, although not as high as T-1, in the subsequent period.

Table 5.30: Average Prices by Sector

Sector	Product Headings	T-2	T-1	T (China Enters)	T+1	T+2
Animals (0)	14	0.00	-0.06	0	0.02	-0.02
Vegetables (1)	50	-0.05	0.00	0	0.08	0.04
Foodstuffs (2)	28	0.03	-0.12	0	-0.18	-0.17
Minerals (3)	22	0.12	0.22	0	0.29	0.28
Chemicals (4)	101	0.07	-0.03	0	-0.12	-0.19
Plastics (5)	31	0.11	0.13	0	-0.07	-0.12
Wood (7)	9	0.11	-0.02	0	0.12	0.60
Textiles (8)	79	0.03	0.01	0	-0.14	-0.05
Stone (10)	14	0.05	0.02	0	-0.1	0.08
Metals (11)	53	-0.05	-0.12	0	0.02	0
Machinery (12)	39	0.17	-0.05	0	-0.03	0.36
Transport (13)	15	0.17	0.18	0	0.27	0.09
Misc (14)	3	-0.78	-0.36	0	-0.15	-0.37

* Data obtained from Comtrade and tabulated using own calculations

There are also 252 (55%) out of the 458 products that experienced an increase in price after Chinese entry following a cooperation pattern as in Table 5.31. Mexico might be limiting its price to deter entry, as illustrated by its considerably lower price pre Chinese entry, but its price does seem to have increased after Chinese entry.

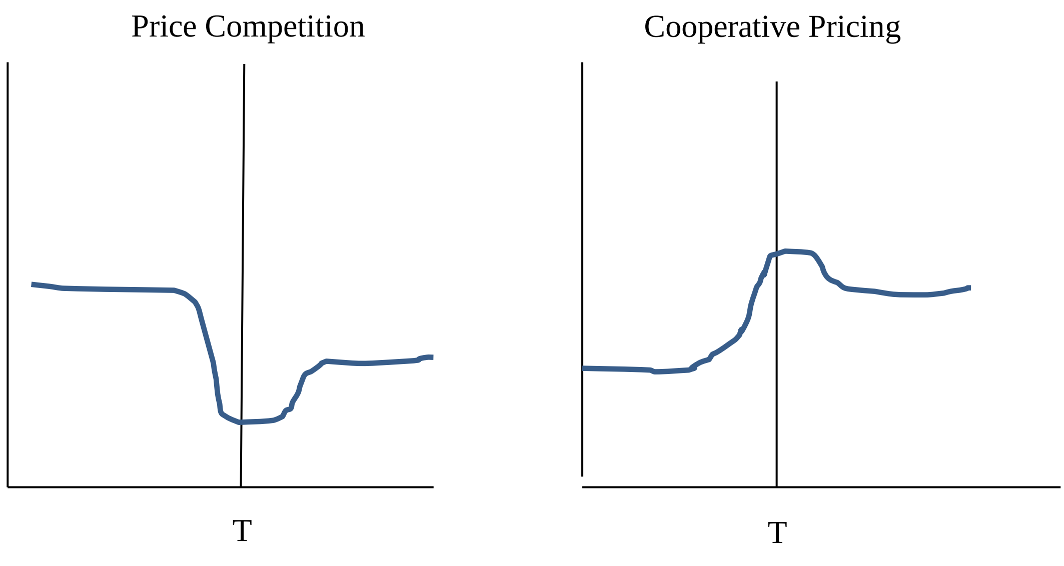
Table 5.31: Mexico's Price Pre and Post China Entry (Price Competition vs Cooperation)

Price Pattern	Product Headings	T-2	T-1	T (China enters)	T+1	T+2
Price Competition	206	0.30 (0.07)	0.38(0.04)	0(0.00)	0.14(0.05)	0.15(0.6)
Cooperation	252	-0.25 (0.04)	-0.38(0.03)	0 (0.00)	-0.12(0.06)	-0.05(1.08)

* In parenthesis is the standard deviation of the estimate of the mean

The price pattern for the two sets of products is sketched in Figure 5.8, where there seems to be a mean reversion pattern in both cases. One potential problem for this pattern is that we sort products according to whether year T exhibits an increase or a decline in price, so that on average the former group will tend to have positive errors of observation (or other random shocks) and the latter negative ones. Thus in year T+1 we would expect the former to fall and the latter to rise, even if there is no change at all in the underlying price. This is what we observe on average. However, for products in price cooperation, we note that the price in T+1 does not fall all the way back to the level in T-1; that is, there is an increase between the two years that we have not used to classify observations. Similarly for price competition, we find that the price increase in T+1 does not rise all the way up to the level in T-1.

Figure 5.8: Mexico's Price Pattern (Competition vs Cooperation)



Since we are dealing with China's first-entry products, we are interested in whether China's entry can somehow be explained by the probability of exporting index that we derived earlier; also we assume that China has a comparative advantage in this product if it starts to export to the USA. Table 5.32 shows China's RCA and probability of exporting index for its first entry on the restricted sample (458 products), classified by sector. We find China's RCA (ROW) and its probability of exporting for the two different groups. The Chinese RCA index (ROW) is greater than 1 in sector 8 (textiles and clothing) for both cooperation and competition; however, its average probability of exporting is less than 0.5 for all sectors after controlling for other factors affecting its propensity to export. This indicates that China does not have a comparative advantage for these products (except in textiles), as represented by their small RCA to the ROW; these might be small private Chinese firms exporting. As mentioned above, the probability of exporting relies heavily on China exporting in T-1; our sample are first-entry products, hence their low probability of exporting.

Table 5.32: China's RCA and Probability of Exporting by Sector

	Cooperation			Price Competition		
Sector	Product Headings	China RCA (ROW)	Prob Export	Product headings	China RCA (ROW)	Prob Export
Animals (0)	5	0.01	0.21	9	0.08	0.31
Vegetables (1)	26	0.53	0.31	24	0.49	0.32
Foodstuffs (2)	15	1.34	0.35	13	0.45	0.3
Mineral (3)	12	0.68	0.3	10	0.25	0.32
Chemicals (4)	60	0.34	0.32	41	0.25	0.31
Plastics (5)	12	0.14	0.36	19	0.08	0.32
Wood (7)	3	0.29	0.44	6	0.04	0.2
Textiles (8)	50	1.02	0.35	29	1.77	0.39
Stone (10)	9	0.16	0.29	5	0.16	0.26
Metals (11)	27	0.4	0.3	26	0.27	0.26
Machinery (12)	21	0.16	0.38	18	0.13	0.3
Transport (13)	10	0.04	0.29	5	0.05	0.25
Misc (14)	2	0.44	0.45	1	0.01	0.38
Total/Mean	252	0.43	0.33	206	0.31	0.30

We use the t test to check whether the RCA is similar for the two groups (Mexican firms engaging in price competition versus cooperation after China entry); our t test (p value = 0.23) fails to reject that the two samples are statistically different from each other. We also tested for RCA equality by sector and failed to reject that the two groups are different for every sector. Similarly, we tested for the equality of the probability of exporting between the two groups: the t test (p value = 0.01) rejected the null hypothesis that the two groups have an equal probability of exporting. However, the differences between the two groups are not significant between the different sectors in the economy.

The distribution for the number of products that follow the two different price patterns seems to be quite evenly distributed between the different HS groupings, as in Table 5.33. However, we want to test the proportion between the two groups by their different

HS groups. The process looks like the binomial distribution with two outcomes (i.e. 0 and 1) and an independent probability p of success. The mean of the binary variable indicates the proportion or the percentage of success. The null hypothesis is to test whether each group has the same probability of occurrence; the probability of a product being in the cooperation group is the same as of it being in the price competition group. We cannot reject the null hypothesis that both groups are equal at the 5% confidence interval, except for textile products and chemicals.

$$H_0: \pi_C = \pi_P = 0.5$$

Table 5.33: Testing Proportions

Sector	z Score	Cooperation	Price competition
	Pr(|Z| < |z|)	(mean)	(mean)
Animals (0)	0.13	0.36	0.64
Vegetables (1)	0.69	0.52	0.48
Foodstuffs (2)	0.59	0.54	0.46
Minerals (3)	0.55	0.55	0.45
Chemicals (4)	0.01	0.59	0.41
Plastics (5)	0.08	0.39	0.61
Wood (7)	0.16	0.33	0.67
Textiles (8)	0.00	0.63	0.37
Stone (10)	0.13	0.64	0.36
Metals (11)	0.85	0.51	0.49
Machinery (12)	0.50	0.54	0.46
Transport (13)	0.07	0.67	0.33
Misc (14)	0.41	0.67	0.33
Total	0.002	0.55	0.45

We further restrict our sample to two distinct groups: continued exports and dropped exports after entry because, as mentioned above, firms with continued exports are usually associated with bigger firms. The price pattern for the two groups is shown in Appendix 5.4. For continued exports, we are left with just 222 products. Mexico's average price dropped slightly after Chinese entry, but started to rise in T+1 and T+2. For the 236 products that China dropped in either year, Mexico's average price rose when China entered. We tested for the equality of the RCA and probability of exporting between the two groups and we failed to reject that they are similar. We concluded that there is nothing distinct between the two groups. We also removed the quota-restricted products and were left with just 384 products shown in Appendix 5.5, for which we found that Mexico's price did not change much before and after China's entry. The test statistics also failed to reject that the two groups are similar.

China's Exit from the Market

We also tried to identify potential competition by looking at the period when China exited the market. China is considered to exit the market in period t if the product is exported in periods T-1 and T-2 and also it did not export for the subsequent periods T+1 and T+2; this is shown in Table 5.34. The example in Table 5.33 illustrates a product where China exits the market. Product 030232 is considered a dropped product, as China first exited the market in 1997, given that it exported the product before that in 1995 and 1996. In order to make sure that China stopped exporting the product and it is not some kind of missing data, we have to make sure that the selected product is not exported by China for the subsequent two periods after the first exit. We are left with a total of 73 product-years for the whole sample and only 58 product-years after we have filtered out the mixed products.

Table 5.34: China's Exit

Year	China Export
1995	Yes
1996	Yes
1997	First Exit
1998	No
1999	No

The price pattern for Mexico when China exits the market is shown in Appendix 5.6. Because of the low number of observations, we look at the relative price pattern for T-1, T and T+1 only. The results show that once China exits the market, Mexico will raise its price; this is as expected, as Mexico's pricing will be more relaxed. Although China exiting the market is also treated as a potential product, there is different pressure compared to when China is waiting to enter the market.

5.10 Conclusion

This chapter investigates the Chinese price effect on Mexico based on the set of potential products. Overall, we have found some evidence that there is a potential competition effect. The average effect is that Mexico will reduce its price by around 2.5% to 4.3% for every 10% drop in the predicted Chinese price. The results are fairly consistent, but because the margins of error in the estimation are quite large, they may not be statistically significantly different from a null hypothesis of no effect. Of course, it is noted that our sample of potential products consists of many fewer observations compared to those of actual competition, but the results show the significance of the Chinese price effect for potential products, albeit barely and not as consistently as in actual products.

As there is no trade in potential products, we have to generate the predicted Chinese prices in the US market for these potential products using the suggested set of regressors. We identify China's potential entry if China has the capacity to export i.e. we use China's reported prices in destination markets to generate the Chinese price in the US market. We could identify the threat of China by looking at its capability to produce; however due to lack of Chinese domestic data and the difficulty in harmonising the different sets of data, we identify the threat of entry by looking at China's exports to the ROW. However we do not think this is a major problem as majority of China's products are exported.

Using the ordinary logit model, we found the probability of China exporting a particular product that is independent of Mexico's pricing decision. One of the possible problems arising is that the probability of exporting relies strongly on China actually exporting in the previous period (T-1). For those products that China has a high probability of exporting but did not, we believe that there is something distinct about these potential products, as Mexico responds less to Chinese prices when China has a higher ability to export to the USA. Furthermore, China might not have a comparative advantage for products that it does not export to the USA, as China's best products mostly go to the US market. Thus the Chinese price effect might not be apparent, as shown in our regression results. The Chinese price effect is significant when we use the first difference method to get rid of the product-specific trend. Surprisingly, our results suggest a decrease in the Chinese price effect with an increase in the probability of China exporting a potential product. In potential competition we use global price to control for the effects of the other competitors; the Chinese price effect is significant at around 0.19 to 0.23.

One major problem arises as the standard errors from the regular OLS regression are probably biased downwards because the Chinese price is a predicted rather than an observed and known value, but the bootstrapping technique we used to try to correct for this may not be wholly reliable in panel data such as this. The Chinese price effect is no longer significant when the standard errors are bootstrapped. This means Mexico's prices might be influence by the other competitors in direct competition and does not respond to the predicted Chinese price. Hence inference on the Chinese price effect in potential competition needs to be treated with appropriate caution.

Our alternative approach to identifying potential competition effects was to look at price developments when China actually entered. For this temporal dimension, the results show that in about 55% of the products in potential competition, Mexico engaged in price cooperation with Chinese products when they entered. This is reflected in the fact that prices rose when entry actually occurred and from which we can infer that they are arguably depressed before entry. That is, assuming that Chinese entry was not a total surprise, this pattern is consistent with potential competition holding prices down before entry. We tested for equality of the RCA and probability of exporting between the two groups and the results failed to reject that the two groups are similar. However, we note that due to our small sample size of just 458 products, we have to caution whether this is actually representative of the population. It is difficult to predict which strategy Mexico will choose, as no distinct pattern is evident.

Appendices for Chapter 5

Appendix 5.1: Breakdown of Potential Competition Products by Sectors

Year	**1996**	Percentage	**1998**	Percentage	**2003**	Percentage
Sector	USD Millions	(Sector/Total)	USD Millions	(Sector/Total)	USD Millions	(Sector/Total)
Animals (0)	163	0.01	237	0.02	534	0.05
Vegetables	1395	0.09	1500	0.14	1811	0.17
Foodstuffs	113	0.01	155	0.01	73	0.01
Minerals (3)	580	0.04	430	0.04	141	0.01
Chemicals	511	0.03	382	0.04	148	0.01
Plastics (5)	62	0.00	22	0.00	9	0.00
LF(6)	3	0.00	24	0.00	0	0.00
Wood (7)	51	0.00	55	0.01	16	0.00
Textiles (8)	153	0.01	191	0.02	17	0.00
Footwear (9)	0	0.00	0	0.00	0	0.00
Stone (10)	372	0.02	300	0.03	37	0.00
Metals (11)	1083	0.07	611	0.06	730	0.07
Machinery	1805	0.12	168	0.02	69	0.01
Transport	9245	0.59	6725	0.62	7234	0.67
Misc (14)	23	0.00	26	0.00	0	0.00
Total	15560	1.00	10825	1.00	10819	1.00

Appendix 5.2: Full Regression (with Probability of Exporting)

$$lnP_{i,t}^{M} = A + \beta_1 \widetilde{P_{t,\iota,t\iota}^{C}} + \beta_2 (Prob\ X)_{i,t}^{C} + \beta_3 (\widetilde{P_{t,\iota,t\iota}^{C}} * ProbX_{i,t}^{C}) + \lambda_t + u_{i,t}$$

	(1)	(2)	(3)	(4)
	Sector Means	Japan Price	Korea Price	China Exports to ROW
Predicted China Price	0.28***	0.47***	0.25	0.43***
	(0.087)	(0.14)	(0.19)	(0.10)
Interaction (Pc*Prob Export)	-0.063	-0.24	-0.029	-0.028
	(0.084)	(0.17)	(0.25)	(0.094)
prob_export	0.028	0.36	0.0042	-0.023
	(0.15)	(0.31)	(0.45)	(0.19)
R^2	0.019	0.032	0.029	0.022
N	8438	3730	3542	7761
Time Dummies	Yes	Yes	Yes	Yes
Product Fixed Effects	Yes	Yes	Yes	Yes

Appendix 5.3: First Difference and Fixed Effect of First Difference

	(1)	(2)	(3)	(4)
	Sector Means	Japan Price	Korea Price	China Exports to ROW
First Difference				
Predicted China Price	0.078	0.57***	0.40***	-0.069
	(0.084)	(0.11)	(0.16)	(0.10)
Interaction (Pc*Prob Export)	-0.029	-0.069**	-0.083**	-0.040
	(0.026)	(0.033)	(0.036)	(0.025)
R^2	0.001	0.01	0.001	0.01
N	5886	2119	1900	5283
Fixed Effect of First Difference				
Predicted China Price	0.12	0.51***	0.24	-0.013
	(0.095)	(0.14)	(0.21)	(0.11)
Interaction (Pc*Prob Export)	-0.027	-0.051	-0.027	-0.045
	(0.030)	(0.040)	(0.044)	(0.029)
R^2	0.001	0.01	0.001	0.001
N	5886	2119	1900	5283

Appendix 5.4 Temporal Price Effect (Continued and Dropped Exports after Entry)

	Dropped Exports in Either Year		Continuing Exports	
Variable	Observations	Mean	Observations	Mean
T-2	236	-0.06	222	0.05
T-1	236	-0.09	222	0.02
T (China enters)	236	0.00	222	0.00
T+1	236	-0.07	222	0.05
T+2	236	0.02	222	0.06

Appendix 5.5: Temporal Price Effect (Removing Quota-Restricted Products)

Variable	Observations	Mean	SD of the Mean
T-2	384	0.00	0.04
T-1	384	-0.02	0.04
T (China enters)	384	0.00	0.00
T+1	384	-0.01	0.05
T+2	384	0.05	0.06

Appendix 5.6: Mexico Price Pattern (China Exits)

Variable	Observations	Mean	Std. Error of Mean
T-1	57	-0.01	0.09
T (China exits)	57	0	0
T+1	36	0.18	0.11

6. Singapore

6.1 Introduction

In previous chapters, we looked at China's competitive pressure on another supplier: Mexico in the US market. The USA is the largest market for Chinese products and about 22% of China's total exports went to the USA in 2010. The USA is the biggest and most important destination market; we expect China to be more aggressive in pricing its products and, as mentioned in the previous chapter, to divert its best products to the USA. Furthermore, given the fact that Mexico exports nearly all its products to the USA, we expect Mexico's imports to be particularly sensitive to China's pricing.

In this chapter, we want to explore Chinese competitive pressure on another major supplier – Malaysia – in a relatively smaller market – Singapore. Our first choice was to look at the Brunei market, which is very small; however, that was not possible due to incomplete data. Our next alternative was Singapore. This is not a small market absolutely, but it is relatively small compared to the US market. Singapore also has one of the most liberal import regimes in the world, with only a few border measures to control for security, health and environmental issues. Although Singapore has a positive bound tariff rate, its applied tariff rates for Malaysia and China are zero. With fewer controls and restrictions, the Chinese competitive influence on Malaysia is cleaner in the sense that it is isolated from external factors (trade restrictions) influencing prices, although we found little variation in tariffs in the US market. The reason for looking at a smaller market is to investigate a different price response to Chinese price competition in a relatively smaller and more liberal economy.

Singapore has a relatively small domestic market and is engaged heavily in the international market. A large percentage of trade is carried out to meet domestic demand for energy, food and other necessities. Singapore engages heavily in entrepot trade, where a large portion of the imported products are then re-exported to other markets. In 2010, Singapore's total imports were estimated at around USD 311 billion, of which only USD 142 billion worth of products were retained imports.[1]

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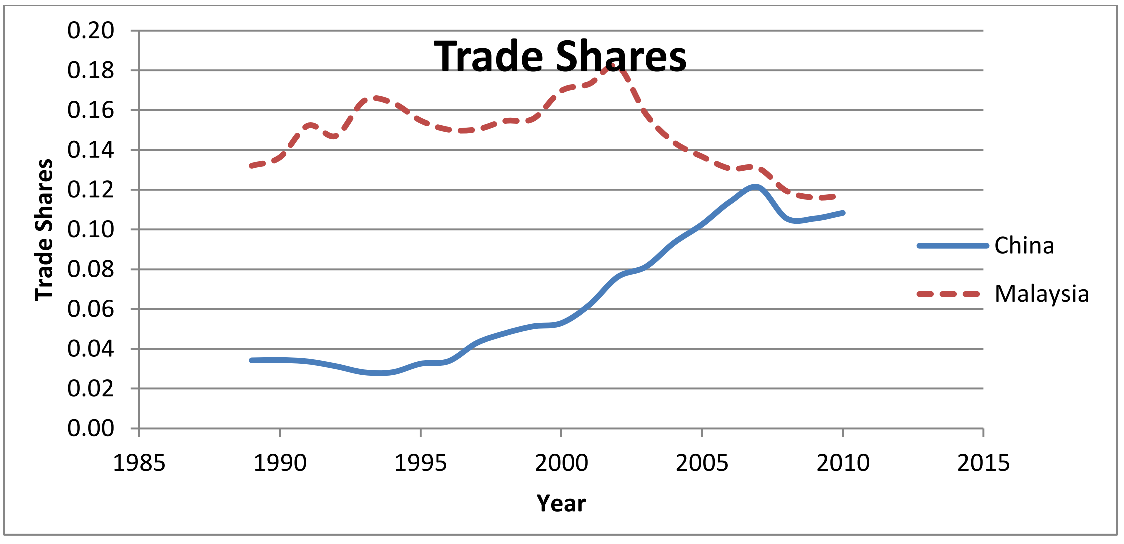
[1] WTO International Trade Statistics 2011.

Malaysia is considered a relatively small player in the world market compared to China, although its market share in Singapore exceeded China's from the early 1990s; while it is still slightly ahead of China, the gap has almost closed. China and Malaysia are middle-income countries and thus it is assumed that there will be a higher degree of similarity in a product exported by the two countries, as compared to the same product exported by a developed country like Japan.

Over the years, China's exports have flooded across the borders of many countries and Singapore is no exception. The trade shares for both Malaysia and China in the Singapore market are shown in Figure 6.1. China's market share in Singapore has had an upward trend since the mid-1990s, but has dropped slightly since 2007. In 2010 China had a market share of around 11% in the Singapore market, compared to just 3% in 1992. Malaysia, on the other hand, was always the larger exporter in the early 1990s and it is currently the largest exporting country to Singapore, although its import shares seem to have trended downwards after reaching a peak of 18% in 2002. In 2010, Malaysia's imports had a 12% share of the Singapore market.

Figure 6.1: Malaysia and China Import Shares in Singapore (1992-2008)



* Data obtained from Comtrade and tabulated using own calculations

As mentioned, our initial approach was to look at the Brunei market, but due to the problems of incomplete trade data and an inconsistent tariff database, we chose Singapore. The other major supplier, Malaysia, exports many of its products to

Singapore, although it is not as reliant on it as the US market is on Mexico's exports. Appendix 6.1 shows the proportion of China's total exports going to Singapore. China is a relatively bigger player in the world market, as the country is larger than Malaysia; its exports to Singapore were relatively small compared to Malaysia's in the early 1990s (about five times smaller). China exported only about USD 2.25 billion worth of exports to the Singapore market in 1992, compared to Malaysia's exports of USD 10.61 billion. However, by 2010, China's exports had almost caught up with Malaysia's. China was a relatively new player in the early 1990s and its role was to play catch-up; it has managed to grow faster and overtake many of the major exporters to Singapore in recent years.

Eichengreen et al. (2007) found that China's export surge could have a negative effect on Malaysia, especially in the textiles and apparel sectors. Loke (2008) looked at the effect of China's growing exports since joining the WTO on Malaysia's comparative advantage in manufacturing sectors. The Revealed Comparative Advantage (RCA) index was used as the comparative advantage index. Results at the SITC 3 digit level showed that Malaysia has had a comparative advantage in labour-intensive electrical and electronic manufactures since the 1990s, although its RCA index has been declining, while China experienced an increasing RCA in these products. Loke attributed this to the constraint of a lack of skilled labour in Malaysia given the relatively cheaper wages in other emerging countries like China. Similarly, Adams et al. (2006) found a systematic decline in the RCAs of most of the East Asian countries for the period 1995-2003. China, on the other hand, experienced an increasing RCA index, indicating the growing competitiveness of Chinese products. The remainder of this chapter will be organised into two main sections: actual competition and potential competition.

6.2 Model for Actual Competition

For Singapore we use the same Bertrand-like model as with the USA, where we want to gauge Chinese competitive effects on Malaysia for the set of products that are in direct competition. We assess price changes directly: how do changes in China's price affect Malaysia's price in the Singapore market? Similar to the US market, the assumption here is that China is able to gain market shares in the Singapore market because of the relatively cheaper Chinese products brought about by increased Chinese productivity. Singapore did not impose any MFA quotas, as it decided not to maintain the right to use safeguarding measurements on textiles products (WTO WTO Agreement, 1999). The Chinese competitive influence on Malaysia is cleaner in the sense that there are fewer controls and restrictions.

6.2.1 Product-Level Data (China's Coverage)

As mentioned in previous chapters, we need to look at the product-level data in order to better assess the competitive pressure of China on other suppliers. We hypothesise that China can affect its rivals' prices at the product level; China's increased influence in the world market is due to a higher number of product headings, which mean wider coverage and the massive volume of its exports. We hypothesise also that cheaper Chinese products can constrain other competitors' prices. A product here is still defined at the HS6 level using data from the HS92 revision, as obtained from Comtrade. We use data recorded by the import country to avoid the differences in classification and timing that might occur when using data recorded by different countries. Our sample will consist of China's and Malaysia's exports to the Singapore market at the product level for the period 1992-2008.

Our sample in Table 6.1 shows the total number of product headings exported by both countries. In 1992 Malaysia had already exported many of its products (3762 product headings) to Singapore, which compares with China's 2810, but China's product headings started to exceed Malaysia's from 2005 onwards. We use the same model as before, which is closely related to the Bertrand price competition model; our assumption is that there will be some sort of competitive pressure on Malaysia's price in the Singapore market, as they both export a common product. Again, our hypothesis is that Chinese productivity is the shock contributing to cheaper Chinese products, exogenous to other external factors. Similarly to the USA, we observe a slight drop in the number of product headings exported by both countries after 2006, which is probably best attributed to the HS classification issue.

Table 6.1: Malaysia and China Exports to Singapore in Product Headings

	Product Headings Imported			Ratio of Common to Total	
Year	From Malaysia	From China	In Common	Common/Malaysia	Common/China
1992	3762	2810	2468	0.66	0.88
1993	3853	2935	2596	0.67	0.88
1994	3923	3049	2747	0.70	0.90
1995	3619	3135	2710	0.75	0.86
1996	3648	3086	2685	0.74	0.87
1997	3627	3139	2748	0.76	0.88
1998	3609	3037	2651	0.73	0.87
1999	3672	3217	2840	0.77	0.88
2000	3879	3388	3097	0.80	0.91
2001	3845	3433	3098	0.81	0.90
2002	3863	3598	3235	0.84	0.90
2003	3807	3686	3283	0.86	0.89
2004	3801	3794	3371	0.89	0.89
2005	3831	3873	3444	0.90	0.89
2006	3797	3935	3466	0.91	0.88
2007	3628	3791	3372	0.93	0.89
2008	3589	3780	3338	0.93	0.88

* Data obtained from Comtrade and tabulated using own calculations

For actual competition, we are dealing with the common products that both Malaysia and China exported to Singapore from 1992 to 2008. In 1992, Malaysia exported a total of 3762 products to Singapore and China competed in 66% of these in 1992, its influence increasing to 93% in 2008. It can be interpreted from this that China has a direct influence on 93% of Malaysia’s products to Singapore by 2010, as compared to 66% in 1992. As a share of China’s markets in Singapore, the common products remained at a range of around 86% to 91% during the period. These products are what we call the common products and these are the products for which we want to investigate the Chinese price effect on Malaysia. As shown in the previous chapter, China’s direct influence on Mexico in the US market also increased from 66% of Mexico’s total export headings in 1992 to around 93% in 2008.

6.2.2 Coverage by Sector

We wanted to find China's coverage of Malaysia for the different sectors, by categorising products into 15 different groups that can also be referred to as sectors of the economy. As shown in Table 6.2, China's coverage of Malaysia was relatively weaker in the primary sectors like animals, vegetables and mineral products in 1992; its coverage had increased for almost every sector except the export of animals by 2008. China's influence lay mainly in the manufacturing sectors in 2008, where it exported almost everything that Malaysia exported, especially in machinery, textiles, miscellaneous manufactures and footwear. China's influence in the machinery sector already covered 81% of Malaysia's product headings in 1992, and its coverage expanded to 98% in 2008, when it exported 647 out of the possible 660 products that Malaysia exported to the Singapore market.

Table 6.2: Actual Competition by Sector

	1992				2008			
Sector	China	Malaysia	Common	China Influence	China	Malaysia	Common	China Influence
	Headings			(Common/Malaysia)	Headings			(Common/Malaysia)
Animals (0)	59	65	37	0.57	57	84	44	0.52
Vegetables (1)	128	147	72	0.49	193	222	174	0.78
Foodstuffs (2)	84	91	62	0.68	126	138	113	0.82
Minerals (3)	48	85	27	0.32	85	72	59	0.82
Chemicals (4)	340	372	194	0.52	553	505	453	0.90
Plastics (5)	98	143	88	0.62	174	180	171	0.95
LF (6)	49	48	37	0.77	35	32	31	0.97
Wood (7)	113	133	91	0.68	169	173	164	0.95
Textiles (8)	499	410	316	0.77	609	494	480	0.97
Footwear (9)	55	39	39	1.00	48	46	45	0.98
Stone (10)	128	132	102	0.77	162	158	150	0.95
Metals (11)	293	339	223	0.66	476	443	432	0.98
Machinery (12)	516	541	439	0.81	682	660	647	0.98
Transport (13)	61	75	50	0.67	84	73	67	0.92
Misc (14)	323	268	239	0.89	327	309	308	1.00
Total	2794	2888	2016		3780	3589	3338	

In the textiles industry, China's coverage increased from 77% in 1992 to 97% in 2008. In the plastics, footwear and miscellaneous sectors, its coverage was almost at 100% of Malaysia's exports. We postulate that Chinese competition occurs largely through the price channel at the product level.

6.2.3 China's Export Structure by Sector (by Export Values)

China exports many of the products that Malaysia exports to Singapore, especially in the manufacturing sectors. We now look at the sectoral share to total exports for 1992 and 2008, shown in Table 6.3. In 1992, China's biggest export sector to the Singapore market was the textile industry, which made up 16% of its total exports; followed by the machinery/electronic industries (14%) and mineral industry (14%). The vegetable industry represented 12% of China's total exports to Singapore in 1992. By 2008, the machinery/electronics industry had clearly become China's largest export sector to Singapore, comprising 63% of China's total exports to Singapore.

Table 6.3: China's Exports by Sector in Actual Competition

	From China				From Malaysia			
Sector	1992		2008		1992		2008	
	USD Billions	Share of Total Exports	USD Billions	Share of Total Exports	USD Billions	Share of Total Exports	USD Billions	Share of Total Exports
Animals (0)	26.6	0.01	43.3	0.00	349	0.03	435	0.01
Vegetables (1)	244	0.12	328	0.01	661	0.06	881	0.02
Foodstuffs (2)	216	0.11	269	0.01	281	0.03	591	0.02
Minerals (3)	279	0.14	1680	0.05	861	0.08	8840	0.24
Chemicals (4)	112	0.06	1130	0.03	174	0.02	679	0.02
Plastics (5)	36.2	0.02	659	0.02	451	0.04	979	0.03
LF (6)	12.5	0.01	176	0.01	18.7	0.00	22.1	0.00
Wood (7)	43.7	0.02	288	0.01	468	0.05	579	0.02
Textiles (8)	311	0.16	968	0.03	795	0.08	577	0.02
Footwear (9)	22.6	0.01	178	0.01	72.4	0.01	42.7	0.00
Stone (10)	36.4	0.02	420	0.01	104	0.01	1000	0.03
Metals (11)	216	0.11	3450	0.10	410	0.04	1950	0.05
Machinery (12)	284	0.14	21100	0.63	5120	0.50	19400	0.52
Transport (13)	82.6	0.04	1220	0.04	178	0.02	519	0.01
Misc (14)	76.9	0.04	1690	0.05	326	0.03	993	0.03
Total	1999.5	1.00	33599.3	1.00	10269.1	1.00	37487.8	1.00

Malaysia's exports to Singapore were mainly concentrated in the machinery/electronics sector in 1992, which comprised 50% of Malaysia's exports to Singapore, increasing slightly to 52% in 2008. The minerals industry is one sector that has shown a substantial increase in exports over the years, comprising about 24% of Malaysia's exports in 2008. China is not particularly competitive in minerals, with exports many times smaller to Malaysia. Malaysia's exports in direct competition to Chinese products are concentrated in just these two sectors, making up just about 76% of its exports in 2008. Similarly to the USA, the trade overlap between China and Mexico is larger in the machinery/electronics sector, as the majority of their common exports fall into this category.

6.2.4 China's Increasing Dominance in the Singapore Market

We now look at the market share for each product, calculated using $M_{i,t}^{S,China} / M_{i,t}^{S,Total}$, where the numerator is Singapore's imports from China for product i in period t while the denominator measures Singapore's total imports for product i. The four groups are defined by products that have market share (s) represented by s<0.1, 0.1≤s<0.2, 0.2≤s<0.5 and s≥0.5 respectively in Singapore total imports. China's export headings to Singapore classified according to market shares are tabulated in Table 6.4.

In 1992, China exported a total of 2810 products to Singapore, of which 26% had a more than 10% share in the Singapore market, increasing to 55% in 2008. We also found that 17% of China's products had shares in the category 0.1≤s<0.2, 25% were in the category 0.2≤s<0.5 and 12% had a more than 50% share in the Singapore market. These values are pretty close to China's average shares in the USA. The total number of products for which China had a more than 50% share increased from 153 products to 462. Malaysia, on the other hand, had 36% of its products with more than 10% in the Singapore market in 1992, dropping to 31% in 2008. In addition, the percentage of product headings with a more than 50% market share dropped to 7% in 2008 from 12% in 1992. To summarise, more Chinese products than Malaysian have gained a larger share in the Singapore market over the years.

Table 6.4: China Export Headings to Singapore by Product Shares[2]

	Total Products (China)	Headings		Headings		Headings		Headings	
		s<0.10	% of Total	0.1≤s<0.2	% of Total	0.2≤s<0.5	% of Total	s≥0.5	% of Total
1992	2810	2067	73.56	280	9.96	310	11.03	153	5.44
1993	2935	2178	74.21	297	10.12	276	9.40	184	6.27
1994	3049	2242	73.53	351	11.51	278	9.12	178	5.84
1995	3135	2270	72.41	348	11.10	324	10.33	193	6.16
1996	3086	2209	71.58	340	11.02	351	11.37	186	6.03
1997	3139	2197	69.99	399	12.71	374	11.91	169	5.38
1998	3037	2100	69.15	399	13.14	363	11.95	175	5.76
1999	3217	2149	66.80	491	15.26	385	11.97	192	5.97
2000	3388	2209	65.20	499	14.73	482	14.23	198	5.84
2001	3433	2180	63.50	506	14.74	521	15.18	226	6.58
2002	3598	2132	59.26	573	15.93	615	17.09	278	7.73
2003	3686	2121	57.54	579	15.71	688	18.67	298	8.08
2004	3794	2080	54.82	598	15.76	765	20.16	351	9.25
2005	3873	1987	51.30	649	16.76	835	21.56	402	10.38
2006	3935	1896	48.18	698	17.74	856	21.75	485	12.33
2007	3791	1751	46.19	648	17.09	927	24.45	465	12.27
2008	3780	1719	45.48	651	17.22	948	25.08	462	12.22

6.2.5 China's Price Relative to Malaysia's in Singapore

We have discussed that fact that China's increasing market share in the world market is due to the cheaper Chinese products brought about by higher productivity. We will look at China's prices relative to Malaysia's as reported by Singapore to provide a rough guide to whether Chinese products are cheaper than Malaysian. As in previous chapters, the unit price for each heading is obtained by dividing the total value of imports of a product by the quantity of exports. For those product-years in actual competition, there are some observations where the quantities for imports are not reported; we dropped these because, as we are dealing with unit values, we lose some observations in doing so. In finding the relative price, we constrain our sample to the common exports for both countries, and are left with 43,657 observations.[3] However, the unit price is very noisy and hence we need to identify and drop these outliers to provide better results for the Chinese price effect. We do this by reference to the distance of the relative price

[2] Refer to Appendix 6.2 for Malaysia's export headings to Singapore by product shares.
[3] These are the number of observations left after dropping those without unit values.

($P^C_{i,t}/P^M_{i,t}$) for each product from its median relative to its interquartile range. This measure is product specific and allows for some products to have a much greater degree of natural variability than others. The problem with this is that the IQR is sometimes zero and often very close to zero for some products, which will wrongly identify outliers, so we add 1 to each statistic:

$$\ln(1+\frac{X}{Median}) \Big/ \ln(1+\frac{Q75}{Q25}) \quad \text{where X is the relative price } P^C_{i,t}/P^M_{i,t} \qquad (6.1)$$

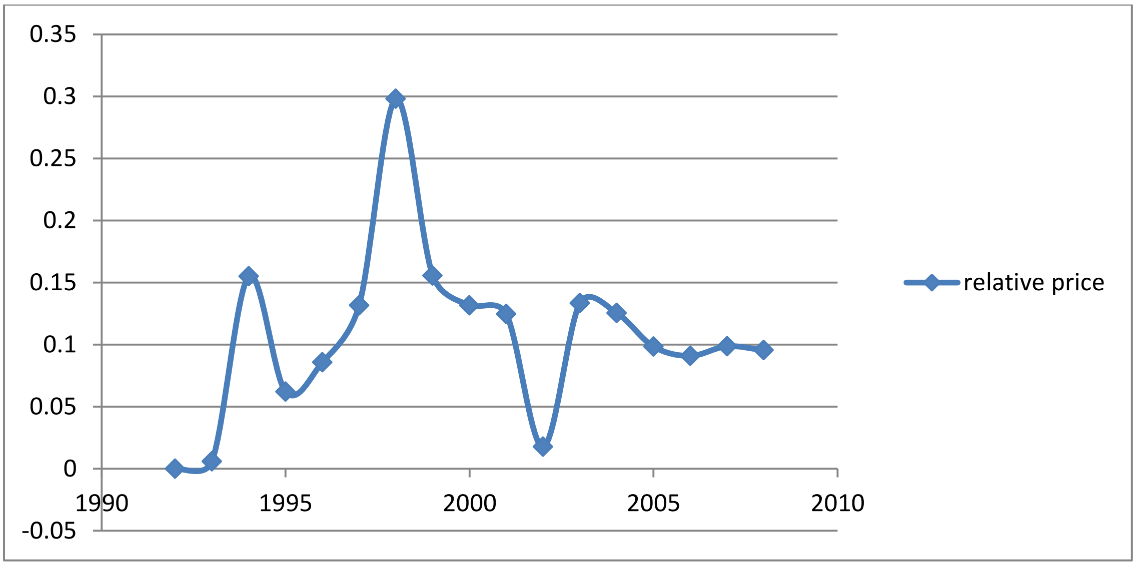
On the basis of Equation (6.1), the outliers are dropped similarly to what we have done for the US market, where we trimmed the top 1% and bottom 1% thresholds respectively.

China's price relative to Malaysia's is derived using the same methods as in previous chapters. As a reminder, the relative price for each product is calculated using the ratio of China's price to Malaysia's. The simple average of the relative product prices is calculated using Equation (6.2), where the index essentially measures the prices changes for each year:

$$\frac{1}{N_t}\sum_{i=1}^{N_t}\ln(\frac{P^C_{i,t}/P^M_{i,t}}{P^C_{i,t-1}/P^M_{i,t-1}}) \qquad (6.2)$$

where P^C is China's unit price and P^M is Malaysia's unit price denoted in US dollars. The subscript i and t indicate the product and year respectively. We then take the average of $\ln(\frac{P^C_{i,t}/P^M_{i,t}}{P^C_{i,t-1}/P^M_{i,t-1}})$ for each year. This way, the relative price index is relative to the previous year, so we need to transform each year's index by accumulating for each year to make it relative to the base 1992. The products being compared are different for each year, as not all products are exported by both countries in every year. We are dealing with more than 2000 products from the year 2000 onwards. The pattern in Figure 6.2 shows an increasing trend, peaking in 1998 (0.30), which coincides with the Asian crisis in which China did not devalue its currency, and then a downward trend until 2008 (0.10). Malaysia experienced an economic slowdown 2001 which resulted in an export slump in its export; this was however short lived and the economy started to recover after 2002. This might probably explain the relative drop in price from 2001-2002 as shown in Figure 6.2. We found that Singapore's imports from Malaysia plunged by 15% relative to its previous year.[4] This might probably explain the relative drop in price from 2001-2002 as shown in Figure 6.2. There was a slightly different pattern in the US market, where China's price relative to Mexico's shows a downward trend after 1997, dropping below the 1992 level.

Figure 6.2: Relative Price (China/Malaysia) Unbalanced Panel

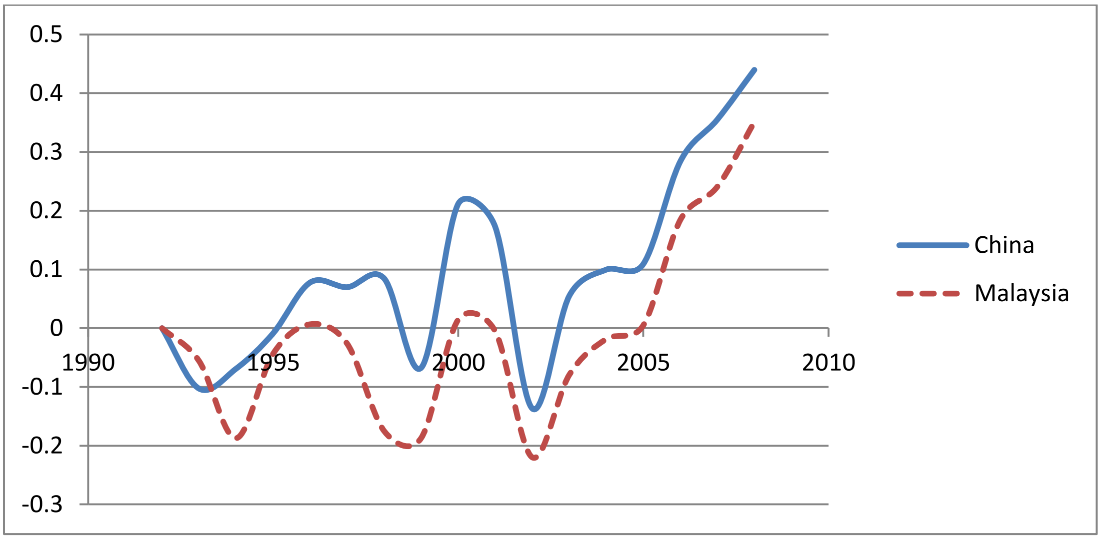


Using the same specification as in the USA[5], we find the price pattern for each individual country using exactly the same sample (Figure 6.3). There does not seem to a particular trend up until 2001, but both China and Malaysia show an upward trend from 2002.

[4] Data are obtained from Comtrade and derived using own calculations.

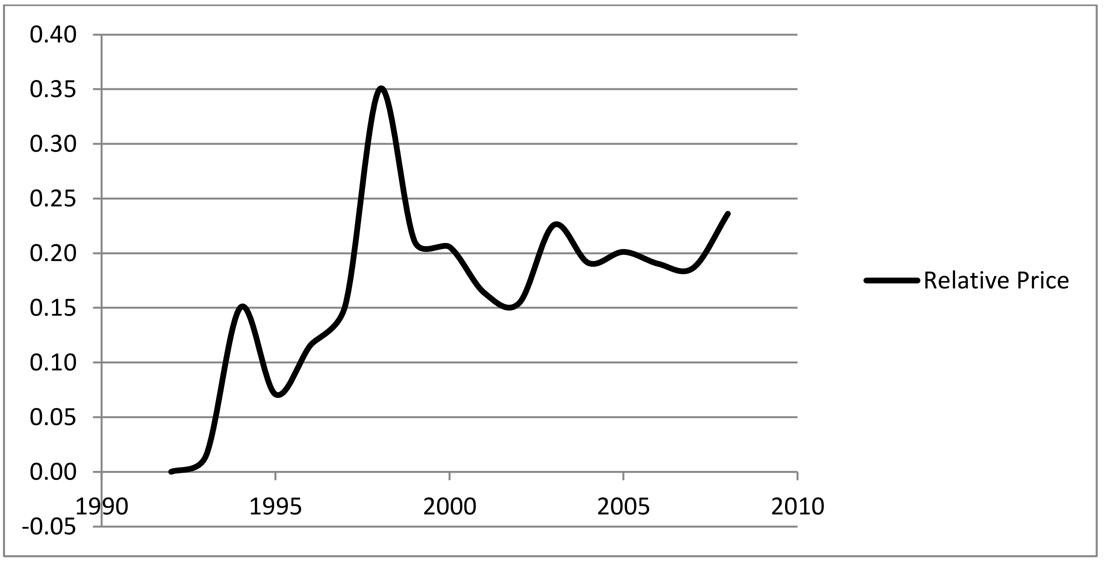
[5] For China $\frac{1}{N_t}\sum_{i=1}^{N_t}\ln(P^C_{i,t}/P^C_{i,t-1})$, For Malaysia $\frac{1}{N_t}\sum_{i=1}^{N_t}\ln(P^M_{i,t}/P^M_{i,t-1})$,

Figure 6.3: Individual Price Pattern for China and Malaysia (Unbalanced Panel)



To check that the results are not driven simply by entry and exit, we include only those common products that are present in all years for both markets. This would also make sure that we are comparing the same basket of products for each year. Then, we are left with 756 products for each year (Figure 6.4). The balanced set is a special set and is restricted in the sense that a product has to be present for all years from 1992 to 2008.

Figure 6.4: Balanced Set - China's Price Relative to Malaysia's (756 products)

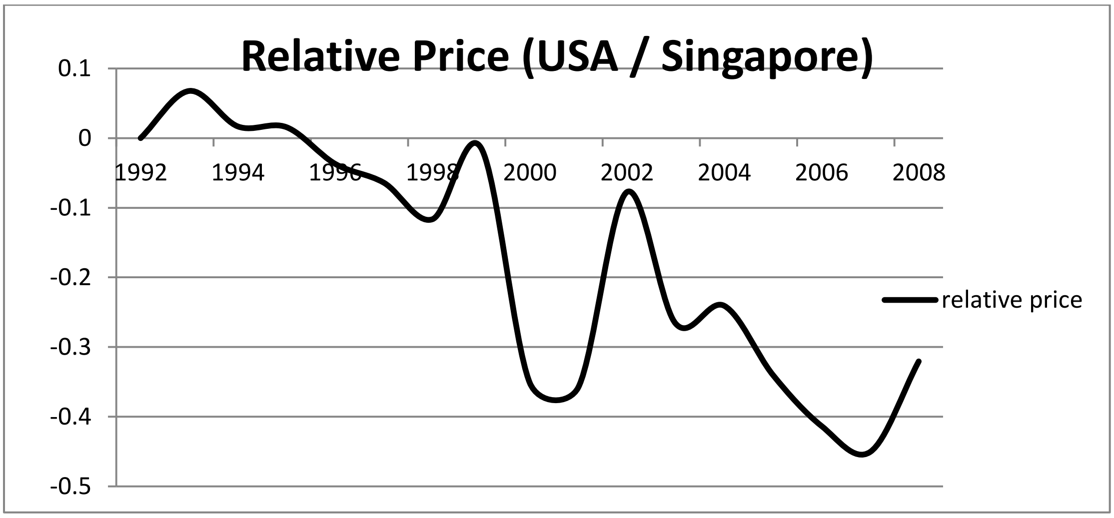


China's relative prices for its exports to Singapore have shown a 24% increase for our sample period. However, this is just a simplistic overview of the relative Chinese pattern. What we are really interested is the degree of the Chinese price effect on Malaysia over the sample period. As mentioned, the unit price data are very noisy; this again prompted the use of product fixed effects regression in order to find the Chinese price effect.

6.2.6 China's Exports to the USA and Singapore (Comparison)

We wanted to compare the products that China exported to the USA and Singapore to compare the relative price pattern of China's exports to the two countries. The unit prices are sourced from two different countries – namely, Singapore and the USA – and hence some products might have different units, so we restrict our analysis to products with the same units. Our sample is the common set of Chinese exports to the USA and Singapore, restricted to only products with the same units. The relative price index is relative to the previous year (for the common products with the same units), and the price pattern in Figure 6.5 is plotted based on $\frac{1}{N_t}\sum_{i=1}^{N_t} \ln(\frac{P_{i,t}^{USA}/P_{i,t}^{Singapore}}{P_{i,t-1}^{USA}/P_{i,t-1}^{Singapore}})$ and so we need to transform each year's index by accumulating for each year to make it relative to base 1992.

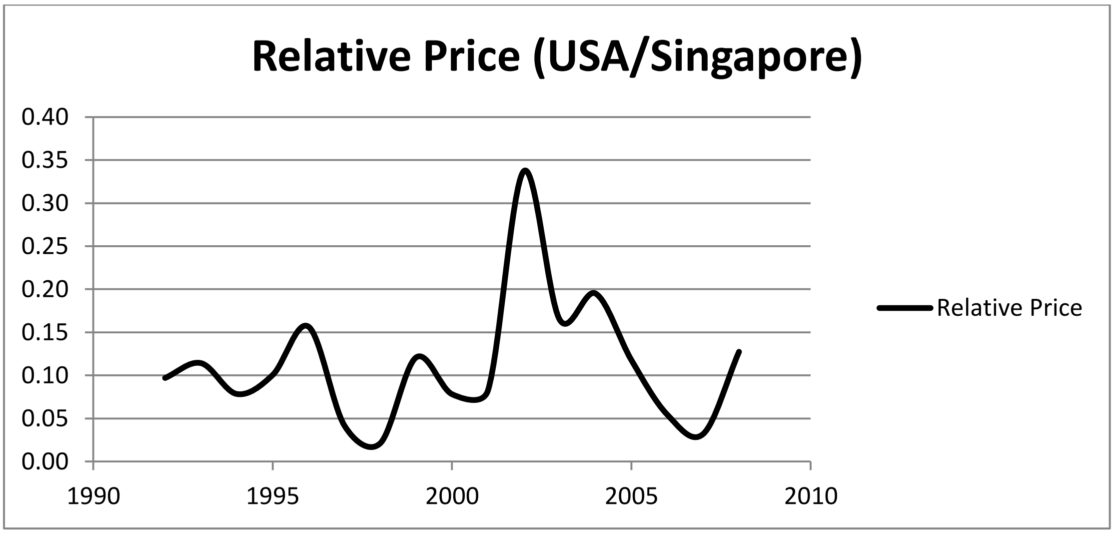
Figure 6.5: Relative Price to Previous Year (USA/Singapore)



China's relative price (USA/Singapore) is plotted in Figure 6.5, where we see a downward pattern over the period. This indicates that Chinese products are becoming relatively cheaper in the USA over time. There seems to be a sudden drop in the relative price for the years 2000 - 2002. We note that the US dollar started depreciating relative to the Singapore dollar from 2001 onwards. Over time, we see that the relative price is falling; although it does not tell us about the relative cheapness.

In order to look at the level of prices for each year, we construct the relative price for all common products exported by China to both countries with the same units based on $\frac{1}{N_t}\sum_{i=1}^{N_t}\ln(P_{i,t}^{USA}/P_{i,t}^{Singapore})$ and then take the average for each year. The relative price pattern are then plotted and shown in Figure 6.6. We found that on average the USA's price is relatively higher than Singapore for all the years. The relative price reached a peak in 2002 and then dropped gradually which might be explained by the depreciation of the US dollar from 2001 onwards. There is again a spike for 2002, the data seem to show unusual pattern for the period 2000–2002. We note that there is a HS revision in 2002 which might result in a classification issue. Furthermore when dealing with unit values for Singapore and the USA, we are comparing data as obtained from different sources and the excess noise in this period. Although China's products are relatively more expensive on average in the USA, the relative prices are falling over time as shown in Figure 6.6.

Figure 6.6: Relative Price (Level Terms)



6.2.7 Our Approach

Our model to find the Chinese price effect on Malaysia in the Singapore market is based on a model closely related to Bertrand price competition, as discussed in the chapter on the US market. China is a newly emerging country whose market shares have increased tremendously over the years. Thus, the Chinese price is seen as the stimulus and will be used as the explanatory variable to explain the variation in Malaysia’s price. The data used here are at the HS6 level using the HS92 system as reported by Singapore (import country) and the equation specification is closely related to the Bertrand model. Singapore's trade policy is very liberal, with a zero applied tariff for imports, as reported by the TRAINS system in WITS. Our regression is as shown in Equation (6.3), which has product fixed effects (u_i) and year fixed effects (λ_t)[6]:

$$\ln P^{M}{}_{i,t} = \alpha + \beta_1 \ln P^{C}_{i,t} + \lambda_t + u_i + \varepsilon_{i,t} \qquad (6.3)$$

The index i refers to the unit of observation for each product at the HS6 level, t refers to the time period, while P^M and P^C represent Malaysia and China’s prices respectively. The variable $\varepsilon_{i,t}$ is the idiosyncratic error, as it represents the time-varying unobservable that can affect Malaysia's price. Our main interest lies in the coefficient β_1, which measures the size of the competitive effect on Malaysia’s price. Similarly to our study in the USA, we accounted for the Chinese influence by controlling for Chinese import shares (S^c_{it}) in the Singapore market. The additional variable included is the interaction of Chinese import shares with Chinese prices $P^c_{it}S^c_{it}$, where the coefficient β_2 measures the effect of trade shares on the Chinese price effect. Our model assumes cooperation, but in reality there will be other countries exporting to the Singapore market. We accounted for the Chinese influence by controlling for Chinese import shares (S^c_{it}) in the Singapore market.

$$lnP^M_{it} = \alpha + \beta_1 lnP^c_{it} + \beta_2(lnP^c_{it} * S^c_{it}) + \beta_3 S^c_{it} + u_i + \lambda_t + \varepsilon_{it} \qquad (6.4)$$

$$lnP^M_{it} = \alpha + lnP^c_{it}(\beta_1 + \beta_2 S^c_{it}) + \beta_3 S^c_{it} + u_i + \lambda_t + \varepsilon_{it} \qquad (6.5)$$

---

[6] As the data on annual exchange rates is constant for all observations in a particular year, they will be differenced out in our fixed effect regression and be represented by λ_t

The Chinese price effect on Malaysia as represented is β_1, plus it also depends on the size of its trade shares. If $\beta_2 > 0$ and statistically significant, this implies a stronger Chinese price effect when China's export shares increase. We will refer to β_2 as the interaction effect brought about by the size of Chinese export market shares.

$$dP_{it}^{m} \Big/ dP_{it}^{C} = \beta_1 + \beta_2 \mathrm{S}_{\mathrm{i,t}}^{\mathrm{C}} \qquad \text{(where } 0 < S < 1\text{)} \qquad (6.6)$$

6.2.8 Endogeneity: Instrumental Variables

The Bertrand model indicates that there might be some kind of reverse causation in our model specification. The Chinese price effect will be biased when endogeneity exists and hence we will need to instrument for the Chinese price in Singapore. The instruments we use here are similar to those in the US market, namely Chinese sectoral prices, Canada’s reported price for imports from China and China’s reported price to Singapore. We chose Canada’s reported price for Chinese products as Malaysia exports barely 1% of its value of exports to Canada. This is an important factor to take into account, as there might be concern that Malaysia’s prices in the other market might also be influenced by China’s presence, which in turn has an indirect influence on its prices in the Singapore market. We thus chose not to use the Japanese and Korean reported prices, as these are large export markets for Malaysia and hence there might be this concern about an indirect influence on its prices in the Singapore market.

A second potential source of endogeneity is China’s import shares in Singapore, which will be affected by the price of Chinese exports relative to other exports, including those from Malaysia. There is a less causal link between China’s shares and the Malaysian price of exports to Singapore; given that market shares may well be influenced by distance, we have opted to use China’s import share in Japan as the instrument rather than Canada’s share. The share of Malaysia’s exports to Japan averaged around 4.6% over the period 1992-2008.

6.2.9 Regression Results

The regression results for the simple bivariate regression and the full regression (including shares) and the interaction term are shown in Table 6.5. The R^2 within shows that China's final price alone accounted for around 17.7% of the variation in Malaysia's price and it plus the year fixed effects for 18.8%. For the simple bivariate regression, the Chinese price effect is estimated at around 0.40 and is positive and statistically significant. This means that Malaysia will drop its price by 4% for every 10% fall in the Chinese price. This value is comparable to but slightly smaller than China's competitive effect on Mexico in the USA, which has a value of 0.5.

Table 6.5: Product-Level Regression (Fixed Effects-OLS)

Dependent Variable is Malaysia's Price		
	(1)	(2)
China Price	0.40***	0.40***
	(0.0047)	(0.0049)
Interaction(price*share)		-0.0065
		(0.013)
China share		0.073*
		(0.04)
R^2 (Within)	0.188	0.188
R^2 (W'in excl time FEs)	0.177	0.178
R^2 (Between)	0.84	0.84
R^2 (Overall)	0.77	0.78
N	42784	42784
Year Fixed Effect	Yes	Yes
Product Fixed Effect	Yes	Yes

Asterisks denote significance at 1% (***), 5% (**) and 10% (*)

The Chinese price effect after controlling for its market shares is still positive and statistically significant at around 0.40. The interaction effect (β_2), however, is not statistically significant, so we might infer that the Chinese price effect does not change with China's market share in the Singapore market. This result differs from our study in the US market, where we found that the Chinese price effect grew stronger as its market shares in the US increased. The partial effect of trade shares is significant at the 10% level; however, it has the perverse sign that we did not expect to find. The positive effects of Chinese shares suggest that Malaysia's price will likely rise for those products in which China has a larger market share. This is different from the US market, where a higher Chinese market share will tend to lower Mexico's price. The results suggest that China does not have a stronger competitive effect on its rival's prices as its market shares increase; and that China's increased share in a smaller market like Singapore does not seem to constrain Malaysia's price.

6.2.10 IV Regression Results

The results above are subject to concerns about endogeneity with Chinese prices possibly responding to Malaysian ones. Hence, we make use of instrumental variables (IVs) to check our results. The regression results for the IV regression are shown in Table 6.6. The Chinese price effects are all statistically significant and range from 0.64 to 0.72 depending on the instruments used. The Chinese competitive effect rises when using IV regression compared to using OLS estimates. As mentioned in the previous chapter, one explanation is that the IVs correct for errors in observation and hence have removed some attenuation bias; alternatively, instrumenting could have reduced the sample sizes in a non-random way.

We get to keep more observations when using China's reported price and the test statistics are strong. Using China's reported price, the Chinese price effect is 0.64, but there may be residual doubts about the exogeneity of the instrument in this case. When we instrument with Canada's reported price, the sample sizes are further reduced and we get a slightly stronger Chinese price effect of 0.72. Using the Hausman test, the null hypothesis is that OLS estimates are efficient; by rejecting the null hypothesis our results support the use of IV estimates. The first-stage regression also shows that all the regressors have a positive effect on China's price in the USA. All the remaining instruments, which are based on trade data, are significant regressors for predicting the Chinese price and have the property of relevance, as indicated by their high first-stage F statistics, suggesting that weak instruments are not a problem.

Table 6.6: IV Results

Dependent Variable is Malaysia's Price		
Price Instrument is:	Canada Reported Price	China Reported Price
China Final Price	0.72***	0.64***
	(0.04)	(0.02)
Hausman	0	0
R^2	0.051	0.142
Product Fixed Effect	Yes	Yes
Time Fixed Effect	Yes	Yes
First Stage Regression		
Instrumental Price	0.25***	0.39***
	(0.01)	(0.01)
F Statistics	F(1, 27447) = 1656.91	F(1, 31471) = 5982.40
N	31094	35077
Product Fixed Effect	Yes	Yes
Time Fixed Effect	Yes	Yes

*standard errors in parenthesis are robust standard errors

In Appendix 6.3, we report the corresponding equations with China's share and interaction terms, which entails a further loss of observations, because now we need to take into account China's exports in Japan as an added necessary condition. The Chinese price effect rises slightly when doing so, but the effect of increasing Chinese trade shares in Singapore is not significant to constrain Malaysia's price. The interaction effect is also not significant and is similar to what we obtained for the OLS estimates.

6.2.11 Technology Intensity (OECD)

By categorising products, we assigned a different price effect for each category, as indicated by their technological intensity. The technological index by product at the HS6 level is obtained from the OECD system, where products are classified according to their level of technology intensity: 'low technology', 'medium low technology', 'medium high technology' and 'high technology'. We drop the trade shares and the interaction term, as the results indicate that they are not significant.

For the simple bivariate regression in Table 6.7, the Chinese price effect has a positive and significant effect on Malaysia's price for each OECD technology intensity sector when using the selected instruments; the effect is strongest for the non-industrial and low technology sectors when instrumented using Canada's price. The Chinese price effect becomes smaller with increasing technology intensity. In column (2), the Chinese price effect is stronger for the low technology and medium technology sectors when instrumented using China's export price. China's price influence is no longer significant in the high technology sector when instrumented using China's export price. When instrumented using Canada's price, Chinese price effect decreased with the increasing level of technology for each sector. The Chinese price effect seems to be less consistent and robust in the higher technology sectors. Most of the higher technology industries are associated with MNEs which might have an influence over prices between destination markets. We would therefore expect a smaller Chinese price effect for high technology sectors.

Table 6.7: IV Regression by Technology Intensity Index (Simple Regression)

Dependent Variable is Malaysia's Price		
	(1)	(2)
Instrument is	Canada Price	China Price
China Price Effect		
Non-industrial	1.17***	0.58***
	(0.20)	(0.16)
Low Technology	0.83***	0.60***
	(0.026)	(0.059)
Medium Low Technology	0.70***	0.76***
	(0.060)	(0.29)
Medium High Technology	0.50***	-0.17
	(0.064)	(1.06)
High Technology	0.45***	-0.19
	(0.17)	(0.61)
N	31094	31821
R^2	0.076	0.120
Hausman	0	0
Product Fixed Effect	Yes	Yes
Time Fixed Effect	Yes	Yes

Another way to differentiate Chinese price effects across sectors is to group products at the HS2 digit level, where we classify all the products into 15 different sectors. The classification is identical to that done in the previous chapter and the regression results are shown in Appendix 6.4. We used just the simple IV regression, as the shares and interaction terms give disappointing results. Using the simple IV regression, the Chinese price effect is mostly in the right direction and significant for the manufacturing sectors, except for the chemical industry, transport sector and the miscellaneous products sector.[7]

6.2.12 Rauch Classification (IV)

As discussed for the USA, the Rauch classification is at the SITC4 digit level for three different groups of products, namely differentiated, homogeneous and referenced products. Rauch defined homogeneous products as those with prices set on the organised exchanges; that is, sugar, oil and so on. Goods that do not set their price but are assigned a benchmark price were defined as reference priced. Finally, products without a reference price and whose price was not set in the exchange market because of their inherent features were labelled differentiated. Rauch suggested two definitions, a conservative and a liberal one, in order to account for the difference in product classification. There are relatively fewer products classified as homogeneous goods under the conservative system as compared to the liberal definition. We reported the regression results using conservative classification as in Table 6.8. The results show that the Chinese price effect is around 0.64 to 0.69 for differentiated products, depending on the instruments used; the Chinese price effects are all statistically significant for all product groups. The price elasticity is around 1 for homogeneous products; if China's price falls by 10%, Mexico will drop its by 10% as well. This is as expected as price competition is tougher for homogeneous products because there is less room for product differentiation; this is similar to what we found in the US market. China's surge in exports is mainly in manufactures and the significance of the Chinese price effect support that products from China and Malaysia could be seen as close substitues. Our results show that the cheaper Chinese products will constraint the price of other competitors, especially for the middle income competitors. The Hausman test again supports the use of IV regression. We also did the regression for the conservative classification; the results are very similar, so we do not report them here.

[7] The Chinese price effect is positive and significant for miscellaneous manufacture products in the USA.

Table 6.8: Rauch Classification (Liberal)

Dependent Variable is Malaysia's Price		
	(1)	(2)
Instrument is	Canada Price	China Price
(Homogeneous)	1.00***	0.97***
	(0.071)	(0.041)
(Referenced)	0.80***	0.54***
	(0.13)	(0.031)
(Differentiated)	0.69***	0.64***
	(0.026)	(0.016)
Hausman	0	0
R^2	0.044	0.15
N	30046	33782
Product Fixed Effect	Yes	Yes
Time Fixed Effect	Yes	Yes

6.2.13 Established Products

We also divided the sample into the sets of established and unestablished products to investigate the possible different price effects between them. Similarly to the study on the USA, we consider a product to be established if China exports it for a longer period of time; that is, when China exports to the US market consecutively for a period of five years. The Chinese price effect for established products is estimated at 0.65 and is bigger than the unestablished set of products (0.47). The results (Table 6.9) once again show that the Chinese price effect gets weaker as China's market share increases for established products; the interaction term is not significant for unestablished products. We would have expected trade shares to have more of an impact on the Chinese price effect for those products that entered the market compared to the already more established products. This is different in the US market, where China's shares matter for the unestablished products but not for the established products. However, in the Singapore market, once again trade shares and interaction term are not significant.

Table 6.9: Instrumental Regression for Established Products

Dependent Variable is Malaysia's Price				
	Simple Bivariate Regression		Full Regression	
	Established	Unestablished	Established	Unestablished
Combined Instruments	China Price, Canada Price	China Price, Canada Price	China Price, Canada Price and Japan Share	China Price, Canada Price and Japan Share
China Final Price	0.65***	0.34***	0.71***	0.10
	(0.02)	(0.08)	(0.02)	(0.25)
Price*Share			-0.28***	1.57
			(0.09)	(1.2)
China Share			-0.13	-10
			(0.58)	(10.4)
Sargan	0.01	0.91	0.01	0.74
Hausman	0	0.01	0.00	0.26
R^2	0.11	0.07	0.10	-1.02
N	22856	3019	20450	2463
Product Fixed Effect	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes

The regression results for the clean set of products are shown in Table 6.10. We also found the Chinese price effect to be statistically significant at around 0.57 for the set of clean products. As a reminder, products that have not undergone any HS code changes during any of the three revisions are considered clean products, while mixed products are those that have undergone at least one HS change. The regression results again show that trade shares and interaction term are not significant.

Table 6.10: Clean Products

Dependent Variable is Malaysia's Price		
	Simple Bivariate Regression	Full Regression
Instruments are	China price, Canada price	China price, Canada and Japan Share
China Final Price	0.56***	0.57***
	(0.02)	(0.03)
Price*Share		-0.06
		(0.09)
China Share		0.07
		(0.48)
Sargan	0.06	0.19
Hausman	0	0
R^2	0.11	0.11
N	20658	19505
Product Fixed Effect	Yes	Yes
Time Fixed Effect	Yes	Yes

6.2.14 Robustness Test

6.2.14.1 First Difference and Long Difference

As discussed in previous chapters, there is also the worry that both China's and Malaysia's prices might follow a time trend, causing both variables to move together. To solve for this problem, we use the first difference method to get rid of the time-invariant factors, followed by the fixed effects on the first difference to get rid of the time trend. The regression results after taking the time trend into account are shown in Table 6.11. The results show that the Chinese price effect is around 0.21 to 0.22; the effect increases slightly with increases in trade shares. The Chinese price effect is slightly smaller than the USA's (0.32). Using the fixed effects of the first difference, Malaysia's price will tend to fall by 1.9% for every 10% increase in Chinese shares. The sign on the interaction term seems to support the hypothesis that the Chinese price effect will be stronger when it has a larger market share. Overall, the Chinese price effect is smaller compared to its effect in the US market. We also tried IV fixed effects regression for the first difference, but the results for the Chinese price effects became very large and the signs for the trade shares were in the opposite directions; for this reason, we did not include this in our results table.

Table 6.11: First Difference and Fixed Effects of First Difference

Dependent Variable is first difference of Malaysia's Price		
	(1) OLS	(2) OLS
	First Difference	Fixed Effects of First Difference
fd.china_FinalPrice	0.22***	0.21***
	(0.0057)	(0.0061)
fd.interaction	0.049***	0.066***
	(0.017)	(0.019)
fd.China share	-0.14***	-0.19***
	(0.050)	(0.054)
R^2	33977	33977
N	0.048	0.047

*fd stands for first difference

Similarly, the long difference regression shows that the Chinese price effect is positive and statistically significant at around 0.43 to 0.50 (Table 6.12). The Chinese price effect is similar for both the simple bivariate and the full regression. This price effect increases slightly when Chinese shares in Singapore increase, as shown by the long difference using lag 16.

Table 6.12: Long Difference

	Simple Bivariate		Full Regression	
	Long Difference	Long Difference	Long Difference	Long Difference
	(lag 8)	(lag 16)	(lag 8)	(lag 16)
China Price	0.43***	0.50***	0.44***	0.49***
	(0.015)	(0.027)	(0.016)	(0.028)
Interaction			-0.046	0.071
			(0.041)	(0.077)
China Share			0.18	0.13
			(0.13)	(0.22)
Constant	0.065***	0.070	0.060***	0.026
	(0.020)	(0.043)	(0.022)	(0.053)
R^2	3518	1053	3518	1053
N	0.186	0.255	0.186	0.257

6.2.14.2 Taking Out Trends in Product Prices

In order to take into account general trends in product prices, we controlled for the variable $lnP_{it}^{globalP}$, which is the global export unit price at the product level and is included in our IV fixed effect regression. The global export price is obtained net of China and Malaysia’s exports to Singapore. For the simple regression following Equation (6.7), the Chinese price effects are all still statistically significant, ranging from 0.58 to 0.69 (Table 6.13). The global export price has explained part of the variation in the Malaysian price. Malaysia reacted positively to the world export price, as prices are more or less correlated.

$$lnP_{it}^{M} = \beta_0 + \beta_1 lnP_{it}^{C} + \beta_2(\ln P_{it}^{c} * S_{it}^{C}) + \beta_3 S_{it}^{C} + \beta_4 lnP_{it}^{globalP} + u_i + \lambda_t + \varepsilon_{it} \qquad (6.7)$$

Table 6.13: Taking Out Trends in Global Prices

Dependent Variable is Malaysia's Price		
	(1)	(2)
Instrument is	Canada price	China price
Predicted China Price	0.69***	0.58***
	(0.041)	(0.025)
Interaction (Pc*Prob Export)	-0.16*	-0.11
	(0.086)	(0.071)
China share	-0.17	0.27
	(0.49)	(0.40)
Global Export Price	0.083***	0.17***
	(0.022)	(0.013)
Hausman	0	0
N	28571	31821
R^2	0.092	0.188
Product Fixed Effect	Yes	Yes
Time Dummies	Yes	Yes

Similarly to what we did in the USA, we ran separate regressions every product to obtain their individual coefficients; each product now has its own slope. The regressions were done for products that are common exports for both China and Malaysia and have been present for at least eight years. For the simple OLS regression, the average price effect is 0.72 (Table 6.14). We get slightly fewer observations when using IV regression; the average Chinese price effect is around 0.88. On average, our results show that the Chinese price is nonetheless positive and consistent with the overall story.

Table 6.14: Summary Statistics of Chinese Price Coefficient

	Variable	Product Years	Mean of Parameter Estimate (Chinese Price Effect)	Std. Error of Mean
OLS Estimates	For Exports≥ 8 years	1078	0.72	0.02
IV FE Estimates	For Exports≥ 8 years	1068	0.88	0.04

*all estimates are significant at 10%

Next, we plot the Kernel density function and also the normal distribution function (Figures 6.7 and 6.8). Kernel density plots are usually a much more effective way to view the distribution of a variable, which in our case is the coefficient of Chinese price. Similar to the USA, the estimates are concentrated around the mean and have higher peaks around the mean compared to the normal distribution. For the Singapore market, our results also show that on average the Chinese price effect has the correct positive sign and is consistent with the overall story.

Figure 6.7: Distribution of Coefficients (OLS)

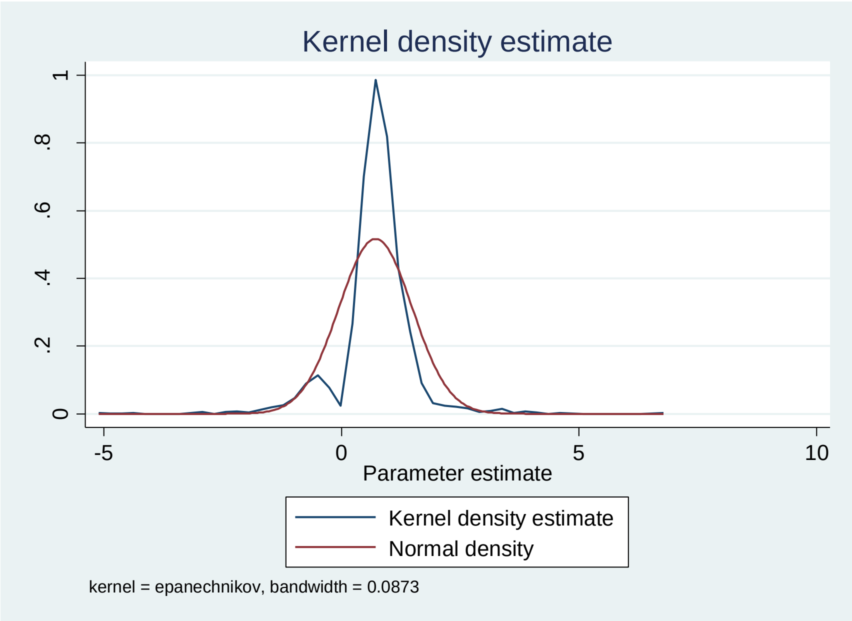
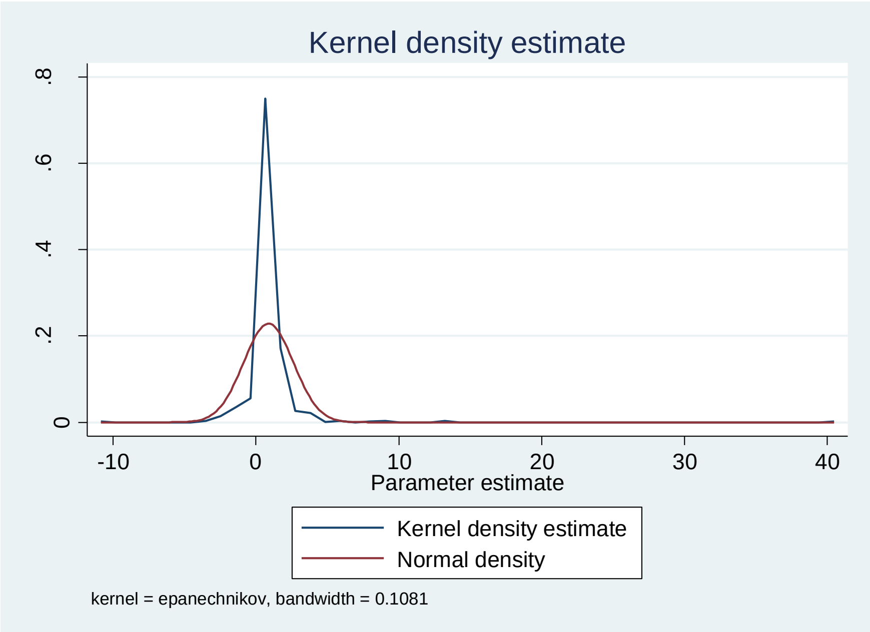


Figure 6.8: Distribution of Coefficients (IV)



6.3 Potential Competition

Our approach is similar to that in the US market, where we wanted to investigate whether the mere presence of China in other markets acts as a constraint on Malaysia's pricing decision, even if China is not actually supplying to Singapore. We get slightly more observations for both actual and potential products in the Singapore market compared to the USA. By duplicating the equation specification we used for the USA, our results shows that China's presence in other markets does constrain Malaysia's price in Singapore; the effect is slightly larger compared to Mexico in the US market. We did not find evidence that China's competitive effect increases with its probability of exporting. Our robustness test using the fixed effects of first difference supports China's potential competitive price effect, but the marginal effect on the probability of exporting on China's price effect is disappointing. Another way to identify potential competition from China is the temporal dimension, where we look at Malaysia's pricing before and after China enters. The distribution of the number of products that follow the two different price patterns (price competition and price cooperation) seems to be quite even between the different sectors once China enters.

6.3.1 Stylised Facts

In actual competition, our sample consists of only the common exports between China and Malaysia in the Singapore market. In this section, we will focus on the remainder of the product-years that Malaysia exports to Singapore without any Chinese competition. As mentioned in the previous chapter, the Chinese price effect is not only for the set of products that it exports to Singapore, but also for those products that it has the potential to export. We identified the threat of entry if China exports to the ROW, which may constrain Malaysia from charging a higher price. This is known as the potential competition from China and the model used is similar to that discussed in the USA. As China does not export these products to Singapore in the first place, we need to generate their predicted prices. We will use our instruments in actual competition as mentioned above to generate the predicted Chinese prices for potential products in Singapore. First, we will provide some stylised facts on the set of potential products from China.

Malaysia exported a total of 12,604 product-years to Singapore without any Chinese competition. As seen in Table 6.15, most of the potential competition occurred during the early 1990s and the number of products dropped to around only 251 by 2008. This is no surprise, considering that China's exports exploded starting from the early 1990s and over time China has started to compete in almost all products. These are the product-years on which we will work to find the Chinese price effect. There are slightly more observations for the set of potential products here as compared to the US market (9662 observations).

Table 6.15: Potential Products by Heading

Year	Product Headings
1992	1294
1993	1257
1994	1176
1995	909
1996	963
1997	879
1998	958
1999	832
2000	782
2001	747
2002	628
2003	524
2004	430
2005	387
2006	331
2007	256
2008	251
Total	12,604

As mentioned in the previous chapter, there are four possible scenarios for potential competition and the possible explanations are tabulated in Appendix 6.5. A product can be termed a 'potential product' if Malaysia exports to the Singapore market without any Chinese competition in a particular period (T). The total number of product headings categorised by the different cases is shown in Table 6.16. In Case 1, both countries exported the particular product in period T-1, but China stopped exporting while Malaysia continued with its exports in Period T. In Case 2, China did not export in either period, while Malaysia exported for both periods. In Case 3, neither country exported in period (T-1); the product would become a potential product if Malaysia started to export in period (T) and China did not. In Case 4, China exported in period T-1 but not in period T, while Malaysia exported in period T. In Cases 3 and 4, the product would be considered a new export for Malaysia. In Table 6.16, we classify the total number of product headings into the four different groups for the period 1992-2008. Most of the potential products occur because China has yet to enter the market and only a small percentage of potential products occur due to China exiting the market; this is quite similar to the story we found in the US market. Cases 1 and 4 show the number of product headings in potential competition due to China exiting the market. We do not have observations for 1992, as our data is for 1992 onwards.

Table 6.16: Product Headings Categorised under Different Cases

Year	Total	Case 1 (China Exit)	Case 2	Case 3	Case 4 (China Exit)
1992	1294	n.a	n.a	n.a	n.a
1993	1257	251	769	206	31
1994	1176	227	712	198	39
1995	909	221	565	102	21
1996	963	244	508	172	39
1997	879	202	511	124	42
1998	958	263	517	136	42
1999	832	196	490	113	33
2000	782	163	429	161	29
2001	747	202	405	115	25
2002	628	145	346	116	21
2003	524	146	269	78	31
2004	430	103	242	52	33
2005	387	105	201	59	22
2006	331	99	161	50	21
2007	256	79	124	36	17
2008	251	88	109	28	26
Total		2734	6358	3040	472

*Case 1 and Case 3 are products in potential competition which China exited the market in T.

The set of potential products are then categorised into the 15 different sectors to further understand the sectors in which potential competition is more prevalent. We tabulate China's product headings and also the volume of exports for the set of potential products in Table 6.17. China competes in almost everything in the miscellaneous manufactures sector (14) and by 2008 there is only one product that Malaysia exports without any Chinese competition, with an export value of a mere USD 10,000. Similarly, we can see major changes in the leather/fur and wood products sectors, where almost all of the competition from China is in actual competition. In addition, by 2008, Malaysia exported only 13 product headings in the machinery sector worth only about USD 400,000, a sector that has no Chinese influence in the Singapore market. By 2008, the share of potential to total Chinese exports is very small in many of the manufacturing sectors like machinery, miscellaneous, transport, textiles and so on. In 2008, the share of potential to total Malaysian exports to Singapore is more prevalent in the animals (0.43), vegetables (0.09) and chemicals (0.19) industries.

Table 6.17: Malaysia's Export Headings to Singapore by Sector (Potential Products)

	1992				2008			
Sector	Product Headings	Potential (USD Millions)	Total (USD Millions)	Share (Potential/Total)	Product Headings	Potential (USD Millions)	Total (USD Millions)	Share (Potential/Total)
Animals (0)	59	235	349	0.67	40	188	435	0.43
Vegetables (1)	108	511	661	0.77	48	81.4	881	0.09
Foodstuffs (2)	61	94	281	0.33	25	8.82	591	0.01
Minerals (3)	42	16.8	861	0.02	13	6.45	8840	0.00
Chemicals (4)	220	43.4	174	0.25	52	128	679	0.19
Plastics (5)	82	237	451	0.53	9	0.93	979	0.00
LF (6)	10	0.6	18.7	0.03	1	0.01	22.1	0.00
Wood (7)	83	143	468	0.31	9	0.06	579	0.00
Textiles (8)	162	75.7	795	0.10	14	0.26	577	0.00
Footwear (9)	6	6.26	72.4	0.09	1	0.01	42.7	0.00
Stone (10)	36	6.14	104	0.06	8	50.9	1000	0.05
Metals (11)	151	75.4	410	0.18	11	10	1950	0.01
Machinery (12)	158	164	5120	0.03	13	0.41	19400	0.00
Transport (13)	45	22.3	178	0.13	6	5.19	519	0.01
Misc (14)	71	40.6	326	0.12	1	0.01	993	0.00
Total	1294	1670			251	480		

In order to assess the influence of China's presence in the market, we calculated Malaysia's share where there is direct Chinese competition and also its share of non-Chinese sales. We calculated Malaysia's market share for each product in the sets of actual and potential products and tabulate the results in Table 6.18. Malaysia's average product share was higher for products in potential competition compared to actual competition for each year from 1992 to 2008. Malaysia has on average a 24% market share in Singapore for products for which there is no Chinese presence (sales), compared to only 12% when China competes. Similarly, Mexico's average market share is higher for those products where there is no Chinese competition. This does explain some of the worries about Chinese exports displacing the exports of many countries, especially as Chinese exports continue to grow in terms of both variety and volume.

Table 6.18: Malaysia's Average Product Share

Year	Potential Products	Actual Products
	Average Product Share	Average Product Share
1992	0.22	0.14
1993	0.22	0.15
1994	0.21	0.14
1995	0.19	0.14
1996	0.18	0.14
1997	0.20	0.13
1998	0.21	0.15
1999	0.22	0.15
2000	0.20	0.14
2001	0.21	0.14
2002	0.23	0.14
2003	0.23	0.13
2004	0.23	0.12
2005	0.28	0.12
2006	0.27	0.12
2007	0.30	0.12
2008	0.24	0.12

6.3.2 Revealed Comparative Advantage (RCA) Index

The Balassa index or the Revealed Comparative Advantage (RCA) index at the product level for China was then constructed for the whole sample set, as we want to capture China's competitiveness between actual and potential products.

The RCA Index is defined as in Equation (6.8):

$$RCA_{it} = \frac{x_{i,t}^{China}}{X_t^{China}} / \frac{x_{i,t}^{ROW}}{X_t^{ROW}} \qquad (6.8)$$

where $x_{i,t}^{China}$ measures China's exports to the ROW (excluding Singapore) for each product i in period t, X_t^{China} is China's total exports for a given year (excluding Singapore), $x_{i,t}^{ROW}$ measures ROW total exports (excluding to the Singapore market) for product i in period t and X_t^{ROW} measures ROW total exports (excluding Singapore) in a given year. This exercise is the same as for the USA, except for the excluded country. We take China's exports to the ROW excluding the Singapore market so that the results will not be biased when we are comparing products in actual and potential competition. The RCAs for all products for a given year are then averaged and the results are shown in Table 6.19. China has a comparative advantage in every year for products in actual competition, as reflected by an RCA index greater than 1. China's average RCA indexes are all less than unity in every year for products in potential competition.

Table 6.19: China's RCA to the ROW for Potential Products

	Actual	Potential
Year	Average RCA Index	Average RCA Index
1992	2.01	0.59
1993	1.78	0.47
1994	1.74	0.50
1995	1.76	0.50
1996	1.84	0.54
1997	1.72	0.45
1998	1.75	0.50
1999	1.74	0.39
2000	1.77	0.51
2001	1.70	0.60
2002	1.63	0.45
2003	1.58	0.43
2004	1.55	0.41
2005	1.56	0.57
2006	1.59	0.58
2007	1.53	0.54
2008	1.61	0.48
Average	1.69	0.50

We also find China's average RCA index by averaging products across the different sectors; the results are shown in Table 6.20. For the set of products in actual competition, China exhibits an average RCA index greater than 1 for all sectors except for vegetables (sector 2) and chemicals (sector 5). As for products in potential competition, it would be expected that the average RCA index would be less than unity. However, there are two sectors, namely textiles and footwear, which have an RCA index greater than 1.

Table 6.20: China's RCA Index to the ROW by Sector (1992-2008)

	Potential		Actual	
Sector	Product Headings	RCA Index	Product Headings	RCA Index
Animals (0)	582	0.71	737	1.18
Vegetables (1)	1159	0.25	2427	1.69
Foodstuffs (2)	615	0.37	1648	0.91
Minerals (3)	444	0.49	789	1.21
Chemicals (4)	2302	0.39	6276	1.03
Plastics (5)	589	0.14	2430	0.78
LF (6)	105	0.52	481	4.51
Wood (7)	677	0.17	2414	1.19
Textiles (8)	1317	1.68	7992	3.01
Footwear (9)	30	2.44	769	5.67
Stone (10)	330	0.4	2200	1.27
Metals (11)	1287	0.35	6528	1.24
Machinery (12)	1416	0.24	9975	1.07
Transport (13)	394	0.23	938	0.94
Misc (14)	397	0.78	5218	2.62

Though Singapore is a liberal country that does not impose MFA quotas on Chinese products, nonetheless there are more than 1300 product-years in the textiles industry without any Chinese influence in the Singapore market; further investigation shows that 558 out of these 1317 product-years (42%) have an RCA index greater than 1. We found that China did not export 180 out of the 558 product-years to the USA; 304 product-years are being exported but are subject to US quotas under the MFA; and China exported the remaining product-years to the USA without being subject to quotas. Thus there are many product headings that China exported to the USA but not to Singapore, even though there are no known restrictions on textiles. We also found that China has a 19% global market share for the 558 product-years (RCA>1), but only a 1.9% market share for the other product-years in which it does not have a comparative advantage (RCA<1). We infer from all this that as in the US case, China has a comparative advantage in these products but does not export to Singapore for specific reasons.

To our knowledge, the Singapore market is more liberal and there are no known import restrictions on Chinese textiles that we know of. The RCA index is certainly a crude way to represent comparative advantage, but there seems to be information in these findings. Moreover, textiles and clothing do not seem likely to be very market specific in their design or other characteristics, so there are unlikely to be product reasons for not supplying Singapore. We also calculated China's RCA to just the developed countries (OECD high-income countries); however, we could not identify China exporting many low-quality textiles to developing countries. The fact that many of these textiles products are being exported to OECD high income countries indicate that these are not just low quality products exported to just poorer developing countries. We found that China has a comparative advantage to OECD countries for these textile products (1314 product-years), as indicated by the RCA index of 1.5, but it simply does not export to Singapore. Overall, we could not find any specific quotas or barriers that Singapore imposes on China for textile products, or any evidence that China exports these products (which we assume are low-quality products) only to developing low-income countries. Hence we infer that there might be some kind of import restrictions that are not known to us.

6.3.3 Probability of Exporting

Our assumption is that China's increased productivity is the exogenous shock that is independent of Malaysia's pricing decisions. However, there is the worry that Chinese entry could occur due to the failure of Malaysia to deter entry, hence we may get biases in estimating its effects. We need find a control variable that isolates the effect of Chinese entry. We thus propose a method to find the probability of China entering the market that is independent of Malaysia's pricing. We derive the probability of China exporting to Singapore based on the same model specification as in the US market. We use the logit model to find the probability of China exporting each particular product year to the Singapore market. The logistic distribution function is derived from the three explanatory variables that are identical to the previous exercise in the US market, where we use the lagged value of the dependent variable itself $Y_{i,t-1}^{China}$, the ratio of the HS6[8]and China's RCA to the ROW index (excluding the Singapore market). Once we have obtained the coefficient of β_1, β_2 and β_3, we can find the probability of China exporting a product in a given year. The probability of China exporting a product to the Singapore market is represented by the specification in Equation (6.9) using the logit model:

[8] Similar to the exercise on potential competition in the USA, the $Ratio\ of\ HS6_{i,t}^{China}$ is defined as the total number of HS6 sub-headings under each HS4 classification for each year that China exports to Singapore. Refer to the example given for the USA

$$P(y = 1|x_{i,t}) = \beta_1 Y_{i,t-1}^{China} + \beta_2 Ratio\ of HS6_{i,t}^{China} + \beta_3 RCA_{i,t}^{China,ROW} + \delta_t \qquad (6.9)$$

We calculated the average probability of China exporting as 0.50 for the potential products, while the probability of exporting for products in actual competition has an average value of 0.88. For the products that China did not export to the Singapore market (potential competition), we find that 62% of these product-years have a probability of exporting of less than 0.5, while the remaining 38% have a probability of more than 0.5 (Table 6.21). As we did for the USA, the probability of 0.5 will be used as the benchmark. Those product-years with a value greater than 0.5 will be referred to as high probability products, while those with a value less than 0.5 will be referred to as low probability. There are still some product-years (4310) that China does not export to Singapore, although it has a considerably high chance of exporting.

Table 6.21: Probability Distribution Table (Ordinary Logit)

	Count	Count	Total Count
	Prob ≥ 0.5	Prob < 0.5	
China Export	45238(93%)	3442(7%)	48680
China Do Not Export	4310(38%)	7000(62%)	11310

As discussed for the USA, the probability of exporting will be biased upwards for products that China exported in the previous period; these are the potential products in which China exited the market, as represented by Cases 1 and 4 in Appendix 6.5. We categorised our potential sample into two groups according to the different case scenarios; one group consist of products where China exited the market (about 3100 product-years) in the current period, while the other group consisted of products (more than 9000 product-years) that China did not export for either period. Similar to the pattern in the USA, the average probability of exporting for those products where China exited the market is very high at 0.83, while the other group has an average value of 0.36. In potential competition, we are more interested in Malaysia’s response when China tried to enter the market as opposed to those products for which China exited the market.

6.3.4 Regression Results for Potential Competition

In the regression, we are using the full sample in which Chinese prices are present to predict for instances where prices are not present. The equation specification used to predict the Chinese price in Singapore is similar to in the US case. We have three sets of predicted Chinese prices generated by each of our three regressors: sectoral mean, Canada reported price and Chinese reported price to the ROW. The Chinese price effect on Malaysia can be represented by Equation (6.10):

$$lnP_{i,t}^{Malaysia} = A + \beta \widetilde{lnP_{t,\iota}^{C}} + \lambda_t + \varepsilon_{i,t} \qquad (6.10)$$

The term $\widetilde{P_{\iota,t}^{C}}$ is the predicted Chinese price, which is generated from the suggested regressors; we are trying to generate a set of prices that were not present in the first place and for this purpose this is strictly not IV regression. The results in Table 6.22 show a positive and significant Chinese price for each of the predicted regressors used. Our results show that Malaysia will reduce its price by around 0.47%–0.59% for every 1% drop in predicted Chinese prices. Although China does not export these products to the Singapore market, the mere threat of China entering the market will induce Malaysia to constrain its price as well. We get more observations when using China reported price to the ROW, whereas we are left with just around 3400 observations when using Canada reported price.

Table 6.22: Simple Bivariate Regression Results

Dependent variable is Malaysia's Price		
	(1)	(2)
Indicators for Price	Canada Price	China Export ROW
Predicted China Price	0.59***	0.47***
	(0.17)	(0.032)
Product Fixed Effect	Yes	Yes
Time Dummies	Yes	Yes
R^2	0.028	0.037
N	3492	10592
'First Stage': Regression to generate predicted price		
China Price	0.25***	0.39***
	(0.01)	(0.01)
F-Stats (Prob>F)	1656.91 (0.00)	5892.40 (0.00)
R^2	0.10	0.20
N	31094	35077

Similar to the study in the US market, we added in the interaction term, which is the predicted Chinese price and the probability of China exporting, where β_2 measures changes in the Chinese price effect with the probability of exporting, which we will call the interaction effect of the Chinese price. The specification is shown in Equations (6.11) and (6.12). We would expect the Chinese price effect to be stronger if the probability of exporting is higher.

$$lnP_{i,t}^{Malaysia} = A + \beta_1 \widetilde{P_{t,\iota,t\iota}^{C}} + \beta_2 (\widetilde{P_{t,\iota,t\iota}^{C}} * ProbX_{i,t}^{C}) + \lambda_t + u_{i,t} \quad (6.11)$$

where the total Chinese price effect is given by

$$dlnP_{i,t}^{Malaysia} \Big/ d\widetilde{P_{t,\iota,t\iota}^{C}} = \beta_1 + \beta_2 ProbX_{i,t}^{C} \quad (6.12)$$

As shown in Table 6.23, the Chinese price effect increases slightly with the interaction term; the price effect ranges from 0.56-0.73 depending on the predicted Chinese price. The results indicate that the Chinese price effect will fall as the probability of exporting increases. Using the China's export to the ROW to predict Chinese prices, the results imply that if China's probability of exporting to Singapore increases by 10%, the Chinese price effect falls from 0.56 to 0.548 (0.56 - 0.012), which is not a large drop but has the opposite effect to what we expect. In the US market, there might exist some factors like non-tariff barriers that are preventing China from exporting these products; Singapore, on the other hand, seems to have a more liberal approach to Chinese imports. We also tried to include $ProbX_{i,t}^{C}$ by itself, but the price effects increased to more than unity and, furthermore, the coefficients of the interaction and the probability increased as well; again, it has the opposite sign to what we expect. The large coefficient suggests multicollinearity probably exists. Multicollinearity will tend to increase the variance; the rule of thumb indicates that a variance inflation factor (v.i.f.) greater than 10 suggests multicollinearity might be present. We found that the two variables ($\widetilde{P_{t,\iota,t\iota}^{C}} * ProbX_{i,t}^{C}$) and $ProbX_{i,t}^{C}$ have a v.i.f. of 30 and 26 respectively; hence we cannot include both of them into the specification.

Table 6.23: Regression Results with Interaction

Dependent variable is Malaysia's Price		
	(1)	(2)
Indicators for Price	Canada Price	China Export ROW
Predicted China Price	0.73***	0.56***
	(0.17)	(0.04)
Interaction (Pc*Prob Export)	-0.23***	-0.12***
	(0.07)	(0.02)
Product Fixed Effect	Yes	Yes
Time Dummies	Yes	Yes
R^2	0.033	0.043
N	3365	9590

The probability of exporting will be biased upwards for products in which China exited the Singapore market; we drop those product-years in potential competition where China exited the market. We lose further observations doing this. The results in Table 6.24 show that the Chinese price effect is still significant and in the expected direction; however, the interaction term is still in the perverse direction. It is surprising that we did not get the results we expected for the interaction term, but we feel assured that potential pricing exists; the predicted Chinese price acts as a constraint on Malaysia's price even if China has not entered the market.

Table 6.24: Regression Results with Interaction (Entry Cases Only)

Dependent variable is Malaysia's Price		
	(1)	(2)
Indicator for Price	Canada Price	China Export ROW
Predicted China Price	0.71***	0.52***
	(0.25)	(0.050)
Interaction (Pc*Prob Export)	0.17	-0.17**
	(0.28)	(0.075)
Bootstrap	No	No
R^2	0.047	0.040
N	1988	6512
Product Fixed Effect	Yes	Yes
Time Fixed Effect	Yes	Yes

6.3.5 Regression by Technology Intensity Sector

We classify the potential products into five different sectors as characterised by their technology intensity, shown in Appendix 6.6; most of the potential products are in the low technology to medium high technology groups. There are only 509 product-years in the high technology sector. The Chinese price effect and its interaction term classified according to their different intensity levels are shown in Table 6.25. For the potential products, the Chinese price effect is very large in the non-industrial and low technology sectors. The Chinese price effect is surprisingly negative when predicted using the sectoral mean for the medium to high technology sector. The Chinese price effect does not seem to be statistically significant in the medium high technology sector. In general we note that the results in this section are getting unstable; we test for multicollinearity as many of the individual slopes are insignificant but the overall *F* test is jointly significant. Our results show that that multicollinearity is not an issue here[9] as variance inflation factor (vif) for each of the variables has a v.i.f. of less than 2. The Chinese price effect does not seem to be statistically significant in the medium high technology sector.

Table 6.25: China Price Effect by OECD Sector

Dependent variable is Malaysia's Price		
	(1)	(2)
Indicators for Price	Canada Price	China Export ROW
Predicted Chinese Price (Non- Industrial)	1.77***	0.60***
	(0.28)	(0.077)
Predicted Chinese Price (Low Technology)	1.22***	0.99***
	(0.25)	(0.057)
Predicted Chinese price (Medium Low Technology)	0.34	0.79***
	(0.39)	(0.086)
Predicted Chinese Price (Medium High Technology)	-0.14	-0.025
	(0.22)	(0.051)
Predicted Chinese Price (High technology)	-0.58	0.097
	(0.54)	(0.11)
Product Fixed Effect	Yes	Yes
Time Dummies	Yes	Yes
F-Stats (Prob>F)	4.91 (0.00)	25.55 (0.00)
R^2	0.050	0.062
N	3492	10592

[9] According to the rule of thumb, a vif greater than 10 means that multicollinearity might be an issue

6.3.6 Robustness Test

6.3.6.1 Control for Global Export Price

As prices might be correlated, we also included the global export to take out the trends in product price and also be seen as a control for the other competitors' as a further robustness test. The regression results in Table 6.26 are obtained following Equation (6.13). The global export price ($\ln P_{t,i}^{globalP}$) is calculated using the same method as specified in Section 6.2.15.2.

$$lnP_{i,t}^{Malaysia} = A + \beta_1 \widetilde{P_{t,\iota,t\iota}^{C}} + \beta_2 (\widetilde{P_{t,\iota,t\iota}^{C}} * ProbX_{i,t}^{C}) + \beta_3 \ln P_{t,i}^{globalP} + \lambda_t + u_{i,t} \quad (6.13)$$

The Chinese price effect is no longer statistically significant when predicted using Canada's price probably because of the loss of many observations. However we find that the Chinese price influence is still statistically significant when predicted using China's export price. The results with the global export price are comparable with the regression results as shown in Table 6.23 above. This further justify that the Chinese price effect is indeed present in potential competition and the results are not driven by other competitors, pricing.

Table 6.26: IV Regression Controlling for Global Export Price

Dependent variable is Malaysia's Price		
	(1)	(2)
Indicator for Price	Canada Price	China Export ROW
Predicted China Price	0.27	0.43***
	(0.17)	(0.037)
Interaction (Pc*Prob Export)	-0.21***	-0.11***
	(0.066)	(0.024)
Global Export Price	0.56***	0.32***
	(0.040)	(0.018)
N	3365	9590
R^2	0.123	0.084
Product Fixed Effect	Yes	Yes
Time Dummies	Yes	Yes

6.3.6.1 Bootstrapping

As mentioned in the previous chapter, we use the bootstrapping method to correct for the standard errors of the generated regressors. The coefficient of the regression is unchanged, but the standard errors and inference will be affected. The results in Table 6.27 show the regression results where we bootstrapped the sample using 100 replications. The Chinese price effect is statistically significant at 0.47 only when we use China's export to the ROW to predict Chinese prices. As mentioned, bootstrapping will tend to generate much larger standard errors, thus making some variables insignificant. In the case for the USA, the price effect is no longer significant when using bootstrap method. In order to check on the robustness result of Chinese price effect in potential competition, we use the bootstrapping method on the fuller regression as in Table 6.28.

Table 6.27: Bootstrap for Standard Errors (Simple Regression)

Dependent variable is Malaysia's Price		
	(1)	(2)
Indicator for Price	Canada Price	China Export ROW
Predicted China Price	0.59	0.47***
	(0.42)	(0.11)
Product Fixed Effect	Yes	Yes
Time Dummies	Yes	Yes
Bootstrap	100 replications	100 replications
R^2	0.028	0.037
N	3492	10592

We also bootstrapped for the standard error for the specification, which included the interaction, and the results are shown in Table 6.28. The Chinese price effect is significant for both cases after bootstrapping; while for the USA the Chinese price effect is no longer significant after bootstrapping. The interaction effect is statistically significant but is not in the expected sign which we thought to.

Table 6.28: Bootstrap for Standard Errors (with Interaction Term)

Dependent variable is Malaysia's Price		
	(1)	(2)
Indicator for Price	Canada Price	China Export ROW
Predicted China Price	0.73**	0.56***
	(0.36)	(0.11)
Interaction (Pc*Prob Export)	-0.23***	-0.12***
	(0.072)	(0.034)
Product Fixed Effect	Yes	Yes
Time Dummies	Yes	Yes
Bootstrap	100	100
R^2	3365	9590
N	0.033	0.043

6.3.6.2 First Difference

The first difference followed by fixed effects is a method we have used to get rid of the time trend that might have caused prices for both countries to move in the same direction. The results for the first difference regression to get rid of the time-invariant unobserved effect are shown in Table 6.29. The Chinese price effect is positive and statistically significant, and ranges from 0.17 to 0.52 depending on the indicators used to predict Chinese price. To get rid of the possible time trend, which is product specific, we apply the product fixed effects to their first difference. The Chinese price effect is positive and statistically significant when predicted using China's export price (0.13).

Table 6.29: First Difference and Fixed Effects of First Difference

Dependent variable is Malaysia's Price		
	(1)	(2)
Indicator for Price	Canada Price	China Export ROW
First Difference		
Predicted China Price	0.29**	0.17***
	(0.14)	(0.036)
R^2	0.002	0.003
N	1758	7019
Fixed Effect of First Difference		
Predicted China Price	0.19	0.13***
	(0.18)	(0.042)
R^2	0.001	0.002
N	1758	7019

6.3.7 Temporal Price Effect

Similar to the US case, we will investigate Malaysia's price pattern pre and post China entry. Before China enters the market, we assume a limit pricing strategy and test for it above; once China enters, actual competition occurs where Malaysia and China can either cooperate or engage in price competition. Similarly to the USA, we first need to define the period of China's entry for each product. We will treat it as the case that China has stopped exporting to the Singapore market for some particular reason if exports stopped for three years or more. The implication is that China's next entry after three or more years will be considered the first entry (new entry), defined as period T. If China did not export the product for just one or two years, we will treat it as a missing value and assume that China has not actually stopped exporting.

Because of the uncertainty of the nature of the product, we make sure that we are comparing the unit price for the same products over time (clean sample). We will look at Malaysia's price pattern in the periods T-1 and T-2, two periods before Chinese competition actually took place, and also at post Chinese competition for the periods T+1 and T+2. In the USA, we found that there are two possible price patterns that can occur before and after China's entry; here we check Malaysia's behaviour to China's entry. To make products comparable, we need to normalise each product's price in the different period by its own price in period T. We can then compare the logs of the normalised prices for all products in the different periods. There are a total of 619 products where Malaysia's price is observed for all the five periods that have not undergone any HS revision (clean products). Malaysia's price on average went up in period T (China's first entry) and then went down in the following period (T+1). There does not seem to be much of a pattern, as shown in Table 6.30.

Table 6.30: Average Malaysia Price Pattern

	Obs	Mean	Std Error of Mean
T-2	619	0.01	0.05
T-1	619	-0.02	0.04
T	619	0	0.00
T+1	619	-0.02	0.04
T+2	619	0.02	0.05

*Prices are in logairthm

We grouped the products into two: products for which Malaysia's price fell on China's entry and those products that incur an increase in price when China enters. As discussed, there might be some kind of mean reversion, as we sort products in period T according to whether period T has a price increase or fall, so that on average the former group will tend to have positive errors of observation and the latter negative ones. Hence after China enters, we expect the former to fall, although again it does not fall back to period T-1. Out of the 619 products, there are 298 products where Malaysia's price dropped once China entered the market (T). The average price of these products increases slightly in subsequent periods, but we can see a pattern that Malaysia's prices in T+1 and T+2 are still lower compared to its prices pre Chinese entry (Table 6.31). The standard error for the mean, $se(\bar{x})$ indicates that the price difference is significant. The other group of products also exhibit a pattern, showing a price increase when China first enters the market. Malaysia's price in periods after T has shown a slight drop, but is still higher compared to its pre Chinese entry prices.

Table 6.31: Malaysia's Price Pre and Post China Entry (Price Competition vs Cooperation)

	T-2	T-1	T	T+1	T+2
Price Competition (298 Products)	0.46 (1.09)	0.59 (0.81)	0.00 (0.00)	0.21 (0.99)	0.26
$se(\bar{x})$	0.06	0.05	0	0.06	0.07
Cooperation (321 Products)	-0.41 (1.12)	-0.59 (0.80)	0.00 (0.00)	-0.22 (0.93)	-0.20 (1.01)
$se(\bar{x})$	0.06	0.04	0	0.05	0.06

We categorised the two groups into the different sectors and we wanted to test whether the two groups are statistically the same across sectors. For each sector, we averaged the probability to export and also China's RCA. Table 6.32 shows China's RCA and probability of exporting index for its first entry for the restricted sample classified according to the different sectors. The probability to export between the 2 groups; the t test (p value= 0.11) also failed to reject the null that the two groups have equal probability to export.

Table 6.32: China's RCA and Probability of Exporting by Sector

Sector	Price Competition	RCA	Prob Export	Price Cooperation	RCA	Prob Export
Animals (0)	17	0.15	0.35	15	0.89	0.41
Vegetables (1)	32	0.2	0.36	36	0.05	0.39
Foodstuffs (2)	20	0.46	0.44	15	0.26	0.4
Minerals (3)	7	0.12	0.33	13	0.08	0.35
Chemicals (4)	60	0.22	0.39	72	0.38	0.43
Plastics (5)	25	0.11	0.35	31	0.07	0.36
Wood (7)	4	0.05	0.38	11	0.18	0.4
Textiles (8)	26	1.32	0.49	27	1.57	0.49
Stone (10)	5	0.2	0.34	5	0.22	0.44
Metals (11)	42	0.19	0.37	34	0.18	0.38
Machinery (12)	45	0.17	0.41	46	0.17	0.43
Transport (13)	10	0.07	0.29	9	0.36	0.45
Misc (14)	5	0.07	0.45	7	0.29	0.44
Total	298			321		0.41

The sector that stands out is textiles, which has an RCA greater than 1. We use the Wald test to check whether the RCA are similar for the 2 groups (Malaysian firms engaging in price competition versus cooperation once China entry); our t test (p value=0.29) fails to reject that the 2 samples are statistically different from each other. We also tested for RCA equality by sectors and fail to reject that the 2 groups are the same across sectors. Similarly we tested for the equality of the

Although the products seem to be quite evenly distributed between the two market structures, as in Table 6.33, we tested for the proportion between the two groups by sectors. We reject the null hypothesis of equal proportions only for minerals (sector 3) and wood products (sector 7); implying that for these the two populations are different.

Table 6.33: Testing Proportions

sector	Obs	z Score	Price cooperation	price competition
		Pr(|Z| < |z|)	(mean)	(mean)
Animal (0)	32	0.62	0.47	0.53
vegetables (1)	68	0.49	0.53	0.47
Foodstuff(2)	35	0.23	0.43	0.57
Mineral (3)	20	0.06	0.65	0.35
Chemical(4)	132	0.14	0.55	0.45
Plastics(5)	56	0.26	0.55	0.45
Wood(7)	15	0.01	0.73	0.27
Textile(8)	53	0.85	0.59	0.41
Stone(10)	10	1	0.5	0.5
Metals(11)	76	0.19	0.45	0.55
Machine12)	91	0.88	0.51	0.49
Transport(13)	19	0.75	0.47	0.53
Missc(14)	12	0.41	0.58	0.42
Aggregate	619	0.19	0.52	0.48

6.4 Comparing Results

In this section we compare some of the results of the Chinese price effect in the USA and Singapore. Our main aim in the Singapore chapter is to compare and verify Chinese price effects compared to the US market. We conducted several robustness tests as discussed above for products in direct competition and found that the Chinese price effect is statistically significant in both markets. We provide a comparison of our results, looking at the Chinese price effect in the USA and Singapore, in Table 6.34. Our results show that the Chinese price effect is statistically significant in both markets after controlling for endogeneity in the Chinese price. The Chinese price effect ranges from 0.47 (USA) to 0.58 (Singapore). In both markets, the Chinese price effects are a little higher in the IV regressions than the OLS results. One possibility is that the IVs correct for errors in observation and hence remove some attenuation bias. The shares effects give different results across markets. The influence on product share is not significant in the case of Singapore and although it has significant effect in the USA, its effect is not as strong as the price effect. We did further robustness test for both the established products; again the share effect is not significant for established products in both markets while the price effect is present. For the clean products, the Chinese price effect is statistically significant for both markets. The fixed effects first difference to get rid of the product-specific time trend also provides strong evidence that the Chinese price effect exists in both markets. We take the fixed effects of the first difference to get rid of the common productivity shocks for the different products; the Chinese price effect is still consistent and strong.

To summarise, our results show that share effects are different for each market and that they are not as strong and robust as the price effects. However our starting point was that trade shares were not the principal way to approach this question. Rather we were primarily concerned with the Chinese price effect, which we see as an alternate to the share approach, which has generally found little effect.

Table 6.34: Comparing Results for Actual Competition

	USA		Singapore	
	(IV)	Fixed Effect of First Difference	IV	Fixed Effect of First Difference
China Final Price	0.47***	0.32***	0.58***	0.21***
Share*Price	0.13**	0.46***	-0.11	0.066***
China Share	--0.42***	-0.81***	0.27	-0.19***
R^2	0.25		0.188	
N	34970		31821	

*IV estimates are obtained with the global price specification model (using China's reported price)

We argued that China can influence the price of products that it has yet to export but has the potential to export. The Chinese price effect for potential products is statistically significant in both markets, as shown in Table 6.35. However the robustness test (bootstrapping method) is different between markets. The price effect still exists after for the Singapore market but the Chinese price effect is no longer significant in the US market. As mentioned, the standard errors from the regular OLS regression are probably biased downwards because the Chinese price is a predicted rather than an observed and known value, but on the other hand, the bootstrapping technique we used to try to correct for this may not be wholly reliable in panel data such as this. We found that Chinese price effect is present in potential competition but the results are not as robust as in actual competition especially after subjecting to bootstrapping method, especially in the US market. In the US market, the Chinese price effect is less robust probably due to more barriers of entry for potential products which might not be captured in our specification and hence that waters down price competition. Singapore on the other hand seem to practise a much more liberal approach, which might explain why the price effect is more robust.

Table 6.35: Comparing Results for Potential Competition (Controlling for Global Price)

	USA		Singapore	
Indicators for Price	Japan Price	China Exports ROW (except USA)	Canada Price	China Export ROW (except Singapore)
Predicted China Price	0.19*	0.23***	0.27	0.43***
R^2	0.029	0.02	0.028	0.037
N	3966	8469	3492	10592

The results for the temporal price effects are quite similar in both markets, where two different groups exist that either follow a cooperation strategy or engage in price competition with China. We explained that this might be due to mean reversion. However, what is important for the increasing prices in T is that the price in T+1 does not fall all the way back to the level in T-1; the explanation is similar for falling prices in price competition.

For both markets, we hypothesise that limit pricing occurs even before China enters the market. Thus we would expect the incumbent firm to set a price lower price before China's entry; once China enters there is tendency for price to rise once the incumbent realised that it could no longer prevent Chinese entry. In the case when the incumbents' price fall after Chinese entry, there might also have the same form of potential constraint, although in terms of price rises the inference in fairly strong. Once entry occurs, the firms might engage in a Bertrand like price competition as discussed in actual competition.

6.5 Conclusion

Our main reason for doing this exercise is to shed additional insight on and test for the generality of China's competitive price effect. We were able to use the results in the Singapore market and provide a comparison to the USA market. Over our sample period, China exported more product headings to Singapore, although the USA is China's largest export market. Using a data sample of about 31,000 observations covering China's exports to both the USA and Singapore, we found that China's price in the USA relative to Singapore dropped over the period 1992 to 2008. Singapore is more liberal in its approach to Chinese products; Singapore has a zero applied tariff for Chinese products; and it did not participate in the MFA quota restrictions on China. Chinese price competition in Singapore is thus cleaner, in the sense that there are fewer restrictions imposed, which might influence the magnitude of the Chinese price effect.

As Singapore is a relatively smaller market and also more open, we wanted to check whether China's price effect would be very different there than in the USA. In actual competition, the Chinese price effect is statistically positive and significant, even after conducting several robustness tests. We found that Malaysia will reduce its price by around 6% to 7% if the Chinese price falls by 10% for products that are in direct competition, after controlling for endogeneity. According to the Rauch classification, China's influence is greater for homogeneous products as compared to differentiated products which is expected. However China's exports are mainly manufactures; and our results show the significance of China's price effect in differentiated products. This indicates that products from China and Malaysia can be considered as close substitutes and the degree of substitution is quite high at around 0.64 to 0.69. China's price influence on Malaysia is more pronounced in the low technology to medium technology products. The validity of China's effect in the higher technology sector produces mixed results depending on the instruments used. As discussed, trade in sophisticated products usually involves MNCs and hence price competition might be distorted.

We conducted further robustness test to check for the stability of the Chinese price effect. We also included the global price to control for the effects of the other competitors in the Singapore market; this is perhaps the most convincing results. The Chinese price effect is statistically significant around 0.58 to 0.69 while China's share is not statistically significant. Although the influence of China's product share is also not significant in the Singapore market, to study this is not our objective, as we are primarily concerned with the Chinese price effect. The use of first difference fixed effects to get rid of the product-specific effects further supports the existence of the Chinese price effect. Overall, our results points out that the direct Chinese price effect is present in Singapore and that it is stronger than the share effect.

For potential competition, we also found that the Chinese price effect is present and the different robustness method used supports our case. The cheaper Chinese product will increasingly help to contain the prices of the other competitors, especially those in lower- and middle-income countries. China's probability of exporting does not seem to have a positive influence on the Chinese price effect, which is similar to what we found in the USA. This presents a challenge and raises the possibility that the methods used in predicting the probability of exporting (i.e. structural stability) are creating the results, although we cannot work out how that might occur.

Appendices for Chapter 6

Appendix 6.1: Proportion of China and Malaysia's Export to Singapore

	World Import China	Singapore Import China	Proportion	World Imports from Malaysia	Singapore Imports from Malaysia	Proportion
	(USD Billions)	(USD Billions)	(Singapore/World)	(USD Billions)	(USD Billions)	(Malaysia/World)
1992	130.53	2.25	0.02	43.96	10.61	0.24
1993	150.82	2.40	0.02	52.48	14.04	0.27
1994	183.36	2.90	0.02	62.85	16.80	0.27
1995	221.98	4.05	0.02	79.56	19.26	0.24
1996	245.28	4.44	0.02	85.49	19.70	0.23
1997	276.73	5.69	0.02	88.21	19.87	0.23
1998	279.64	4.86	0.02	80.86	15.70	0.19
1999	315.69	5.69	0.02	89.67	17.28	0.19
2000	397.08	7.12	0.02	112.04	22.82	0.20
2001	410.59	7.21	0.02	104.02	20.09	0.19
2002	474.80	8.86	0.02	108.91	21.21	0.19
2003	592.76	11.07	0.02	126.17	21.52	0.17
2004	776.85	16.19	0.02	149.52	24.95	0.17
2005	970.38	20.51	0.02	167.83	27.30	0.16
2006	1171.24	27.21	0.02	190.10	31.09	0.16
2007	1425.93	31.90	0.02	212.70	34.38	0.16
2008	1629.75	33.75	0.02	239.06	38.10	0.16
2009	1370.98	25.92	0.02	188.44	28.35	0.15
2010	1748.23	33.66	0.02	247.93	36.19	0.15

Appendix 6.2: Classification of US Imports from Malaysia by Product Share

	Total Products (Malaysia)	Headings	% of Total	Headings	% of Total	Products	% of Total	Headings	% of Total
		s<0.10		0.1≤s<0.2		0.2≤s<0.5		s≥0.5	
1992	3762	2425	0.64	725	0.19	535	0.14	462	0.12
1993	3853	2410	0.63	851	0.22	617	0.16	491	0.13
1994	3923	2533	0.65	838	0.21	611	0.16	468	0.12
1995	3619	2364	0.65	826	0.23	581	0.16	371	0.10
1996	3648	2395	0.66	805	0.22	596	0.16	351	0.10
1997	3627	2384	0.66	798	0.22	571	0.16	350	0.10
1998	3609	2253	0.62	846	0.23	651	0.18	401	0.11
1999	3672	2261	0.62	916	0.25	681	0.19	402	0.11
2000	3879	2476	0.64	950	0.24	710	0.18	396	0.10
2001	3845	2459	0.64	908	0.24	714	0.19	392	0.10
2002	3863	2461	0.64	916	0.24	739	0.19	397	0.10
2003	3807	2495	0.66	863	0.23	681	0.18	323	0.08
2004	3801	2525	0.66	842	0.22	660	0.17	314	0.08
2005	3831	2540	0.66	820	0.21	685	0.18	316	0.08
2006	3797	2571	0.68	774	0.20	661	0.17	301	0.08
2007	3628	2469	0.68	707	0.19	626	0.17	285	0.08
2008	3589	2482	0.69	663	0.18	600	0.17	262	0.07

Appendix 6.3: Instrumental regression - Full Equation

Price Instrument is:	Sector Means	Canada Reported Price	China Reported Price
China Final Price	0.72***	0.74***	0.68***
	(0.066)	(0.030)	(0.020)
Price*Share	-0.065	-0.16*	-0.13*
	(0.13)	(0.088)	(0.072)
China Share	-0.034	-0.25	0.22
	(0.53)	(0.49)	(0.41)
Hausman	0	0	0
R^2	0.126	0.056	0.147
First Stage			
Instrumental Price	0.31***	0.24***	0.38***
	(0.016)	(0.0071)	(0.0060)
Instrumental Price*Share	0.21***	0.23***	0.20***
	(0.0086)	(0.0066)	(0.0050)
Instrumental Share	0.051***	0.072***	0.16***
	(0.0070)	(0.0080)	(0.011)
F Statistics (Instrumental Price)	F(3, 32700) =138.47	F(3, 25168) =555.68	F(3, 28437) =1836.47
F Statistics (Instrumental Price*Share)	F(3, 32700) =482.33	F(3, 25168) =481.13	F(3, 28437) =875.17
F Statistics (Instrumental Share)	F(3, 32700) =177.75	F(3, 25168) =100.71	F(3, 28437) =134.41
N	36410	28571	31821

Appendix 6.4: IV Regression by Sector

	(1)
Combined Instruments	Sector Mean, Canada
Animals (0)	0.60***
	(0.06)
Vegetables (1)	0.63***
	(0.17)
Foodstuffs (2)	0.74***
	(0.080)
Minerals (3)	0.18*
	(0.097)
Chemicals (4)	0.047
	(0.061)
Plastics (5)	0.58***
	(0.14)
LF (6)	1.13***
	(0.12)
Wood (7)	1.04***
	(0.028)
Textiles (8)	0.79***
	(0.016)
Footwear (9)	0.68***
	(0.051)
Stone (10)	0.80***
	(0.073)
Metals (11)	0.76***
	(0.046)
Machinery (12)	0.42***
	(0.037)
Transport (13)	0.18
	(0.17)
Misc (14)	0.20
	(0.19)
Sargan	5.9e-15
Hausman	0
R^2	0.17
Product Fixed Effect	Yes
Time Fixed Effect	Yes

Appendix 6.5: Different Scenarios for How a Potential Product Can Occur

	Period T-1	Period T		
Case 1	China Exports	China Stopped Export	Malaysia Existing Product	China Exit
	Malaysia Exports	Malaysia Exports		
Case 2	China Does Not Export	China Does Not Export	Malaysia Existing Product	
	Malaysia Exports	Malaysia Exports		
Case 3	China Does Not Export	China Does Not Export	Malaysia New Product	
	Malaysia Does Not Export	Malaysia Exports		
Case 4	China Exports	China Does Not Export	Malaysia New Product	China Exit
	Malaysia Does Not Exports	Malaysia Exports		

Appendix 6.6: Product Headings by OECD Classified Sector

	OECD Sectors	Product-Years
Non-industrial	1	1,853
Low Technology	2	3,669
Medium Low Technology	3	2,001
Medium High Technology	4	4,572
High Technology	5	509

7. Conclusion

This thesis seeks to identify whether China did indeed export deflation globally, given the fact that it exports almost every product available on the market. As China's exports become more competitive as a result of productivity improvements, their prices will tend to influence the prices of competitors. China does not have a large enough direct impact on the price indices of the developed countries to explain any material downward pressure on their prices because of its relatively small share in their total absorption of goods and services; hence the Chinese price effect must rely on the competitive pressure that China exerted on other manufacturing producers' prices. We use a model akin to Bertrand competition among heterogeneous products to represent this interaction. In this model two producers strictly influence each others' prices, but we argue that causation may fairly reliably presumed to flow from Chinese prices to other prices. Our empirical model uses commodity fixed effects to allow for time-invariant differences between commodities (difference in units) and year fixed effects to allow for general factors which could have affected Mexico's prices in the US market (the exchange rate, inflation rate, the US demand etc.)

For both destination markets, we choose middle income developing countries where their exports can be seen as closer substitutes to Chinese exports. Our study focuses on the Chinese price effect in a large market (the USA) and applies the same methodology to a relatively smaller market (Singapore). Our main reason for doing the Singapore exercise is to provide additional insight on and test for the generality of China's competitive price effect. In the case of the US market, tariff preferences were given to Mexico and there was also some form of Non-Tariff Barriers (NTB) imposed on China. Singapore is a relatively more liberalised economy, with zero applied tariffs and fewer restrictions on Chinese products, the Chinese competitive influence is cleaner in the sense that it is isolated from external factors (trade restrictions) influencing prices.

Our work is predicated on the view that Chinese competition occurs largely in terms of prices, driven by rapidly increasing productivity and scale in Chinese industry as producers started to catch up technologically with middle-income countries and absorbed large amounts of surplus labour from the hinterland and financial capital from the rest of the world. This export shock is quite independent of anything pertaining to other individual markets. With this in mind we can start to identify causal links from China to other suppliers using instrumental variables to capture these productivity shocks. The most natural instrument for Chinese export prices would be production conditions at home; that is, Chinese productivity level at the product level. The limitations of this approach, however, are that the available productivity data are nowhere near as finely defined as our trade data; hence we actually have to turn to a series of instruments based on international trade data – mostly China's exports to markets other than the one we are studying. The reliance on trade data is what drives our use of data at the 6-digit level of the Harmonised Trade System Nomenclature – it is the finest level of disaggregation that is internationally comparable.

Our main result is that the direct price effect of Chinese competition is present and is stronger than the share effect; it applies to both the US and Singapore markets. The direct price effect of China is statistically significant after being subjected to several robustness tests; for example, after taking out global trends in price, heterogeneity in groups and the IV test for endogeneity. Using IV to control for the endogeneity of Chinese prices, our results suggest that a 10% reduction in China's price will cause a 4% to 8% drop in the price level of its rivals. The direct Chinese price effect dropped to around 2%-3% when using the first difference fixed effect model, which eliminated the product-specific time trend; however it was still significant. We also proposed a 'clean' sample set which is free of the classification issues associated with the HS revision. The results again show that the Chinese price effect is significant and robust.

Our sample is an unbalanced sample where products may drop in and out of the export basket; hence we created a balanced sample set to similar products over time. We conducted various test for the established products; the price effect is robust and stable. The result also support and is consistent with the theory on the greater degree of substitutability between homogeneous products (Rauch Classification) as compared to differentiated products like manufactures. The price effect is present and robust for the different sectors and also by technology intensity. In the US market, we found that the Chinese price effect is strongest for the low technology and medium low technology sector; this is consistent with the fact that Chinese exports are mainly concentrated in these sectors.

We acknowledge the limitations of a Bertrand duopoly model and included the global unit price to control for other major exporter prices and also to eliminate the general trends in prices. The Chinese price effect is still statistically significant and robust in both Singapore (0.58 to 0.69) and the USA (0.30 to 0.47); although the degree of price competition drops slightly as the global price has explained part of the variation in price. This is perhaps the most convincing results as it proves that the robustness of China's price effect which is isolated from price trends and also the effect of the other major competitors. Although our results also show quite similar impacts of Mexico on China's prices; we argue because of endogeneity, it is hard to find suitable instruments for Mexico's' prices and hence the estimates will be biased.

We conducted various test to examine the price and share effects and found that the share effects are not as robust as the price effects. Although the effect of shares and the interaction term do have the expected signs, they sometimes fail to provide significant effects. Again we emphasise that our thesis is primarily concerned with the Chinese price effect, which is an alternative to the share approach, which has generally found little effect.

In actual competition we are estimating the Chinese competitive effects based on the products which have survived; we are looking at how the variation in Chinese prices affects the other competitors. One of the limitations of evaluating the direct price competition between products is that it does not take into account of the products which exited the market because they could not keep up with the Chinese competitive pricing. On one hand this could underestimate the Chinese price effect because firms which are not competitive enough are dropped. On the other hand studies have shown that exited firms are usually small firms and are therefore less efficient, their exit could lead to a reallocation of resources thereby increasing the overall efficiency in the competing countries like Mexico and Malaysia.

China's abundant labour supply and expanding skills bases imply massive productive potential, especially if China continues to invest heavily in R&D and technological transfers. China's export basket has developed gradually from low cost products to the more sophisticated products through product diversification and product upgrading, its effects is not just constrained to the low and middle income countries. Winters and

Yusuf (2007) argued that as China continue to grow and move up the production ladder, the middle and higher income countries might have to worry about their comparative advantage being taken over by China, while still exerting its influence on lower income countries. China is massive with an abundant reserve of relatively cheap labour, it might still be able to engage and compete in low cost manufactures even though it has now ventured into more sophisticated manufactures.

In order to attain sustainable growth, China would need to improve on innovation and continue to invest heavily in R&D rather than depending on its relative labour surplus. Schott (2008) has also attributed Chinese products to be getting more sophisticated over time, given their relatively low level of income; however there is still the perceived quality gap between Chinese products and the developed countries. Although it might have appeared that China has shifted its production to more sophisticated products, processing trade accounted for a large percentage of China's export in this sector. Fu et al. (2012) stressed that this may lead to an underestimate changes in the changes in the unit value that is added in China. Furthermore we note that there should be a caution on finding the price elasticity especially for sophisticated products as these are usually controlled by the same institutions located in different countries.

The other part of China's competitive effect will have arisen from its 'potential competition' from products that China does not yet supply to the US market. Overall, we also find significant price effects for products in potential competition – products which China does not currently export to the USA but potentially could do so (because they already export them elsewhere). For the USA, we found that the magnitude of the potential price effect ranges from 3% to 5% for every 10% decline in Chinese prices. One of the main obstacles for investigating potential competition is to attain the predicted Chinese price, since as products are not exported in the first place we are looking at 'invisible' prices. We have to estimate these from the prices of China's exports of the same product to other markets. As with actual competition there are worries about endogeneity - not that Mexico's price in the USA influences China's price of exports to other markets, but that Chinese entry to the US market might be related to Mexican prices. We deal with this by estimating the probability of China exporting a particular product that is independent of Mexico's pricing decision. Slightly surprisingly this probability appears to play no role in China's price effects in potential competition. This may reflect a problem in estimating the probability of exporting, but it is not clear to us precisely how that might be. Furthermore the Chinese price effect is no longer significant when bootstrapped from the standard errors. Thus we have to be more modest about these results than those on actual competition, which seem more robust. On the other hand, we believe that this is the first attempt to identify such potential competition effects in global international trade. (Schiff and Chang, 2003, treat potential competition but in the context of regional trading arrangements.)

Turning to the temporal dimension, we try to identify the effects of Chinese entry into the US market on the temporal pattern of Mexican prices. The results show that firms will engage in either price competition or cooperation with China when China first enters the market. Our theory assumes limit pricing before entry and we might expect to see a price increase once entry occurs; cooperative pricing with China once the incumbent realised that it could no longer prevent Chinese entry. In the case when the incumbents' price falls after Chinese entry, we postulate that there might have existed some form of potential constraint on Chinese entry so that once it is removed; the rush of Chinese competition overwhelms the Mexican incumbents.

Overall, our main contribution is that we have managed to determine that the Chinese price effect is positive and is robust in both direct and potential competition. As China's exports becomes more competitive brought about by its increasing productivity, China will help to contain the other producers' price and hence help to stabilise price. Hence as long as the China's productivity level relative to costs continues to rise, we would expect China to supress inflation. One of the necessary conditions for China exporting deflation is its competitive price effect on other manufacturing producers' prices; we tested for this and have found support for this condition.

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