INDUSTRIAL CLUSTER GOVERNANCE IN A DEVELOPING COUNTRY CONTEXT: EVIDENCE FROM THE PETROCHEMICAL SECTOR IN THE MEXICAN STATE OF VERACRUZ

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Adrian Duhalt Gómez

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School of Global Studies

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I hereby declare that this thesis has not been and will not be submitted in whole or in part to another University for the award of any other degree

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ABSTRACT

This thesis combines analysis of the political economy of Mexico with the global value chain approach to study the trajectory of the development of the Veracruz cluster and the *governance* structure of vertical inter-firm relationships in the locality.

The petrochemical cluster located in the state of Veracruz is formed by a pool of state-owned and local private companies and is arguably the largest agglomeration of industrial firms in southern Mexico. These firms are linked to one another through output-input relationships. State-owned petrochemical complexes, which are part of Petróleos Mexicanos (PEMEX), Mexico's oil and natural gas company, supply industrial raw materials that local private firms use to process intermediate petrochemical inputs. Empirical evidence demonstrates that state-owned firms exercise a disproportionate degree of authority over input transactions. The latter assertion is illustrated by the fact that PEMEX-Petrochemicals is the only domestic producer (and therefore supplier) of a large number of inputs demanded in the locality. This, along with the hazardous nature of petrochemical inputs and spatial proximity, has contributed to locking local firms into *captive* transactional relationships.

The significance of studying the Veracruz cluster and the nature of inter-firm transactional relationships lies in the fact that both are heavily influenced by drivers inherent in the development path the country has followed in past decades, which is characterised in the first place by the adoption of import-substituting industrialisation (ISI) policies in the 1960s and 1970s and later by the implementation of market-orientated policies in the 1980s and beyond. The discussion is therefore situated in a much broader empirical setting that pays considerable attention to economic, political, and institutional factors. For instance, *external determinants* such as the extent of state intervention in economic planning in the 1960s and 1970s, the economic liberalisation process embarked on by Mexico in the 1980s and 1990s, the institutionalisation of sectoral regulatory policies, the reliance of the government on PEMEX revenues, and the implications of the North American Free Trade Agreement (NAFTA), among others, will help us understand the trajectory of the petrochemical industry and the *governance* of inter-firm transactional linkages in southern Veracruz.

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GLOSSARY

ANIQ	Asociación Nacional de la Industria Química
BIS	Bank for International Settlements
BTU	British Thermal Unit
CEPAL	Comisión Económica para América Latina y el Caribe
DOF	Diario Oficial de la Federación
EBIT	Earnings before interest and taxes
ECC	Eastman Chemical Company
ESF	Exchange Stabilisation Fund
GAN	Grupo Acerero del Norte
GATT	General Agreement on Tariffs and Trade
GDP	Gross domestic product
GVC	Global Value Chains
IDB	Inter-American Development Bank
IDESA	Industrias Derivadas del Etileno
IEA	International Energy Agency
IEPES	Instituto de Estudios Políticos, Económicos y Sociales
IMF	International Monetary Fund
INEGI	Instituto Nacional de Estadística, Geografía e Informática
ISI	Import-substituting industrialisation
MMM	Methacrylate monomer
NAFIN	Nacional Financiera
NAFTA	North American Free Trade Agreement
NPRA	National Petrochemical and Refiners Association
OECD	Organisation for Economic Co-operation and Development

OPEC	Organisation of Petroleum Exporting Countries
PECE	Pacto para la estabilidad y el crecimiento económico
PEMEX	Petróleos Mexicanos
PET	Polyethylene terephthalate
PVC	Polyvinyl chloride
SEPANAL	Secretaría del Patrimonio Nacional
SIC	Secretaría de Industria y Comercio
SQCI	Soluciones Químicas para el Campo y la Industria
STPRM	Sindicato de Trabajadores Petroleros de la República Mexicana
TELMEX	Teléfonos de México
TPA	Terephthalic acid
VCM	Vinyl chloride
VEC	Valero Energy Corporation
WB	World Bank

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INTRODUCTION

PRESENTATION

In recent years, scholars from different branches of learning have cast light on the development of industrial clusters in the developing world. At first, much of the analysis focused on the dynamics within localities, that is, co-operation between firms, the importance of local externalities, and the role of associated institutions. To a significant degree these lines of reasoning were opened by the work on industrial clusters and industrial districts carried out by scholars such as Becattini (1990, 2004), Porter (1990, 2000), and Pyke and Sengenberger (1992). Subsequently, as the geographical organisation of production continued to be reconfigured by the globalisation of the world economy, the debate threw light on the external linkages of industrial clusters; more specifically, on cross-national transactional relationships established with and governed by developed country firms, as illustrated by the contributions of Gereffi (1999), Bair and Gereffi (2001), Humphrey and Schmitz (2002), and Schmitz (2004). In this sense, the concept of global value chains (GVC) managed to account for some of the key implications these features of the world economy represent for firms in developing countries (Gereffi 1994, Kaplinsky 2004).

In reviewing both schools of thought, what is important to observe is that existing literature underlines the prospects of firms to enhance their competitive performance in the light of the nature of prevailing linkages. While the theory of clusters emphasises the importance of local relationships, the global value chain approach stresses the value of external linkages (Humphrey and Schmitz 2000). In this way, work on industrial clusters and global value chains appears to take little notice of both the aggregate (economic, institutional, and political) context in which such relationships are rooted and the local policy setting that outlines development for clustered firms. The

petrochemical cluster situated in southern Veracruz, Mexico, embodies empirical evidence that contributes to addressing this gap in the literature.

The Veracruz petrochemical cluster is made up of a pool of state-owned[1] companies, which are part of Petróleos Mexicanos (PEMEX), Mexico's oil and natural gas company, and a number of local private petrochemical firms that are connected to one another through output-input relationships, that is, state-owned petrochemical complexes produce and *supply* industrial raw materials that private firms[2] use to yield intermediate inputs. Of the many empirical attributes of the Veracruz petrochemical cluster, the fact that private firms are locked into *captive* transactional relationships with state-owned firms is the most important one; and epitomises one of the two building blocks of analysis in this thesis. The other fundamental line of discussion centres on the range of *external* drivers - categorised as *sectoral*, *national* and *supranational*[3] - shaping the quality of transactional linkages in the locality. This is to say that the significance of studying the Veracruz cluster and inter-firm relationships lies in the knowledge that both are heavily influenced by economic, political, and institutional determinants inherent in the development path Mexico has followed in past decades - characterised in the first place by the adoption of import-substituting industrialisation (ISI) policies in the 1960s and 1970s (Chapter 5) and later by the implementation of market-orientated policies in the 1980s and beyond (Chapter 6 and 7).

That said, the objective of this thesis is twofold. The first one is to examine the trajectory of the Veracruz petrochemical cluster within the context of the political economy of Mexico. This means examining the degree of state intervention that permitted the establishment and expansion of the petrochemical industry in the 1960s and 1970s and the process of economic liberalisation the country embarked on since the 1980s. This latter stage of development entailed the institutionalisation of *sectoral* policies that yielded rather questionable outcomes, hence, the second overarching

[1] The Cosoleacaque, Cangrejera, Pajaritos, and Morelos petrochemical complexes make up PEMEX-Petrochemicals, which is one of the four divisions of PEMEX, Mexico's oil and natural gas firm. Throughout the thesis, I will be using the terms state-owned petrochemical complexes and PEMEX-Petrochemicals interchangeably to refer to these four companies. Also, when it is clearly evident, I will use the term PEMEX to refer to these four firms.

[2] Although the locus of the debate is on producer-driven linkages, Chapter 8 also sheds light on two examples in which a state-owned petrochemical complex is the buyer and the governor of the relationship.

[3] External drivers are schematised in Chapter 3.

objective of this thesis is to analyse the extent to which *external* determinants have shaped *governance structures* prevailing in vertical transactional linkages between producer and buyers of petrochemical inputs in southern Veracruz. This means examining the extent of *transactional dependency* that private firms bear in relation to state-owned petrochemical complexes (PEMEX-Petrochemicals).

In order to address both objectives, the discussion in this thesis is therefore situated in a much broader empirical setting that pays considerable attention to economic, political, and institutional factors that will help us understand the current standing of the petrochemical industry in general and the quality of inter-firm relationships in the locality in particular. To that end, it is necessary to briefly depict the empirical building blocks of our analysis.

First, it is important to point out that the Veracruz cluster is embedded in a multidimensional, complex context (Chapter 6, 7). Over the course of recent decades, the development of the Veracruz petrochemical cluster has been weighed down by an array of *sectoral, national, and supranational* determinants. Of these, the economic liberalisation process embarked on by Mexico in the 1980s and 1990s; the institutionalisation of sectoral regulatory policies; the reliance of the government on PEMEX revenues[4]; the energy security strategy of the United States; and the implications of the North American Free Trade Agreement (NAFTA) are among the most obvious. The impact of these on the locality has proved to be overwhelming in many regards since they have not only considerably shaped upgrading expectations and the type of transactional linkages between producers and buyers, but these external determinants have also led to sharp output contraction at state-owned firms. This contraction has, in turn, served to strangulate the production processes of many local buyer firms (Chapter 8). By and large, it is the intricate political economy of Mexico which has shaped the trajectory of the development of the Veracruz petrochemical cluster.

Second, state-owned petrochemical complexes, also referred to as PEMEX-Petrochemicals, produce and supply industrial raw materials that private firms in the

[4] According to the author's estimates, based on official figures from Banxico, Mexico's central bank, 31 percent of government income came from PEMEX in 2009.

locality use to process intermediate petrochemical inputs[5]. With regard to this vertical relationship, PEMEX-Petrochemicals exercises a disproportionate degree of authority over input transactions and most vertical linkages in the Veracruz cluster are therefore acknowledged to be *producer-driven*[6]. A fundamental determinant in this sense is the fact that state-owned firms are the only domestic producers (and therefore suppliers) of a large number of inputs demanded locally. This, along with the hazardous nature of petrochemical inputs, means that the character of *external* determinants, and other important features discussed later, has contributed to locking local buyer firms into *captive* transactional relationships. Furthermore, such transactions, as the empirical evidence suggests, are shaped by PEMEX-Petrochemicals through certain practices considered detrimental for local buyer firms. A case in point is the role of the state-owned complexes as erratic suppliers. Overall, the point here is that the latter scenario not only jeopardises the performance of private petrochemical firms (Chapter 8), it also minimises the significance of horizontal collective action.

Another relevant attribute of the Veracruz cluster is the fact that both types of firms, state-owned and private, are significantly geared towards the domestic market. A large share of the output yielded in the cluster is believed to feed a wide range of national-orientated value chains in which local firms are engaged. Regardless of the extent to which firms are engaged in extra-cluster relationships, the issue to be emphasised here is that forward and backward external linkages lie outside the boundaries of this analysis.

With respect to conceptualising the *governance structures* of inter-firm linkages in the Veracruz petrochemical cluster, it must be pointed out that the global value chain (GVC) approach provides solid foundations for the construction of several related arguments. Despite the fact that this thesis analyses *supplier-driven* relationships within a (heavily) national-orientated industrial cluster and does not deal with external forward and backward linkages, the use of fundamental concepts of the GVC approach remains viable. Given that the GVC approach provides the conceptual underpinnings to study

[5] The only final product produced in the locality is fertilisers.

[6] Whenever PEMEX-Petrochemicals plays the role of supplier, which is in the vast majority of cases, the relationship is considered producer-driven. At times local firms supply inputs to PEMEX-Petrochemicals and although this pattern is less frequent, PEMEX-Petrochemicals as buyer also wields a greater degree of control. In this case, the inputs transaction is deemed buyer-driven. Although the locus of the debate is on producer-driven linkages, Chapter 8 also sheds light on an example in which a state-owned petrochemical complex is the buyer and the governor of the relationship.

the governance of transactional linkages between producers and buyers, and PEMEX-Petrochemicals links with local private firms provides one example of this, I contend that this school of thought offers an important framework for addressing the empirical evidence embodied by the Veracruz petrochemical cluster.

In the light of these arguments, the question that arises is: what is value chain governance? To begin with, it must be acknowledged that governance is undoubtedly associated with the manner in which authority is exercised over value chain participants. In other words, which firm rules the transaction of inputs? In that regard two types of value chains are distinguished: those driven by producers and those in which buyers rule the transactions (Gereffi 1994: 97). The existing literature around GVC is predominantly enthusiastic about buyer-driven transactional relationships, in which firms in industrialised countries, normally referred to as buyers, set the parameters under which suppliers in developing countries must operate (Schmitz 2004). On the other hand, it is evident that producer-driven value chains have received little if any attention by this school of thought. In this form of industrial organisation 'the state is believed to play a more interventionist role at the point of production', as argued by Gereffi (1994: 101), and the Veracruz petrochemical cluster is a case in point since the state - via PEMEX-Petrochemicals - is the player that governs the transaction of inputs in the locality. All in all, it is the governance structure of such transactional cross-border linkages that is at the centre of the discussion for, as explained by Humphrey and Schmitz (2001: 21-22), the notion of governance refers to the quality of relationships between firms and the mechanisms (practices, values, codes of conduct) that determine the non-market co-ordination of value-adding activities.

This very issue of who exercises authority over chain participants leads us to ask: what determines the co-ordination of value-adding activities? In that regard there is a widespread consensus that the lead firm, or buyer, controls the production process through a set of parameters that basically establish: i) what is to be produced (product design and specifications); ii) how it is to be produced (the technology and quality systems to be employed as well as the labour and environmental standards to comply with); and iii) how much is to be produced and when (production scheduling and logistics) (Humphrey and Schmitz 2001: 21-22). As compliance with this set of parameters indicates that the capabilities to meet the demands placed by the buyer can

vary from one supplier to another, value chains embody different governance structures. A substantial wealth of empirical studies permitted Gereffi et al. (2005) to craft a comprehensive analytical framework that resulted in the categorisation of five patterns of governance, that is, *market* (inter-firm relationships are mostly associated with the production of standardised products, the cost to switch partner remains low, and as product specifications are easy to codify the supplier is competent at meeting the requirements set by the lead firm); *modular* (although the complexity of the transaction increases, the supplier possesses the capacity to interpret product and production specifications); *relational* (inter-firm relationships are complex, the exchange of information implies high degrees of co-ordination for mutual dependence and the cost of switching partners is high); *captive* (high level of transactional dependence means the supplier is locked into relationships that increase the cost of exiting the chain, and the degree of power asymmetry is high); and *hierarchy* (the firms vertically integrated firms).

The pool of private petrochemical firms in the Veracruz cluster are viewed as *captive* buyers for a number of reasons, among which the fact that stands out is that PEMEX-Petrochemicals is the only domestic supplier of certain petrochemical inputs and the hazardous nature of petrochemical inputs (which coerces firms into sourcing raw materials locally). As regards the former driver, for example, what must be elucidated is: what turned PEMEX-Petrochemicals into the only domestic supplier of certain inputs? This issue demonstrates that construction of a clearer picture of vertical linkages in the Veracruz cluster - characterised by a high level of transactional dependence and power asymmetry - requires us to include elements from the wider empirical context, as previously noted. Analysis of *external* factors not only helps us comprehend the character of local governance and what hampers the competitiveness of state-owned and private petrochemical firms, but it also validates the need to highlight the repercussions that the deteriorated standing of PEMEX (in particular its heavy tax burden) has over both the development of value chains of petrochemical origin and the wider economic landscape.

This point can be elaborated by understanding that, since the oil boom in the late 1970s, a sizeable proportion of PEMEX revenues have been devoted to financing public expenditure. From 2000 to 2009, for example, PEMEX contributions represented 34

percent of the government budget, according to Mexico's central bank (Banxico n.d.). As Mexican authorities have failed to collect a larger proportion of GDP in the form taxes, a figure that roughly corresponds to just 9.4 percent as of 2008 (México, último lugar de AL en recaudación tributaria: CEPAL, 2010, May 31), oil revenues continue to plug the government's income gap. This heavy tax burden has prevented PEMEX from investing in key areas such as exploration and refining. Crude output has shrunk from 3.383 mbpd in 2004 to 2.576 mbpd in 2010 – a slump of 24 percent over a period of six years (PEMEX 2010a, 2010b). In relation to the atmospheric distillation capacity, which refers to the process of turning crude into refined products, PEMEX reports that over a period of three decades, 1980 to 2009, the figure grew by only 21.26 percent, from 1,270 thousand barrels per day to 1,540 thousand barrels per day (PEMEX 1990, 2010a).

Another consequence of the confiscation of hydrocarbon profits is observed in the case of PEMEX-Petrochemicals since Mexico's largest company continues to keep the state machinery running at the expense of upgrading its own petrochemical complexes, the installed capacity of which achieved little growth over a period of two decades. While in 1990 the overall installed capacity of the petrochemical division of PEMEX stood at 12,353 thousand tonnes, by 2009 it had increased just 7 percent to 13,061 thousand tonnes. Output, on the other hand, plummeted from 13,447 thousand tonnes in 1995 to 6,835 thousand tonnes in 2000, although it bounced back slightly to 7,587 thousand tonnes in 2009. With respect to installed capacity and output, it is worth noting that in the same year the four petrochemical complexes in the Veracruz cluster accounted for 92.16 percent and 99.8 percent[7] of PEMEX-Petrochemicals, respectively (PEMEX 2001, 2003, 2010a). This state of affairs has wider repercussions. At the local level, it has constrained the availability of basic petrochemical inputs buyer firms request for their own production processes, as Chapter 8 illustrates; and by extension it has distressed the development of value chains of petrochemical origin. Nonetheless, the most detrimental consequence of a falling petrochemical output, at least from a national perspective, is the rapid pace at which imports are swelling. The profits made from crude exports are on course to being offset by imports of petrochemical inputs, goods of petrochemical origin, and refined products.

[7] Similar figures have been reported since the 1990s. From 1990 to 2009, the four petrochemical complexes represented 90.99 percent of the overall output of PEMEX-Petrochemicals. In relation to installed capacity, the proportion is estimated at 91.4 percent (PEMEX 2001, 2003, 2010a).

Any analysis of transactional linkages in the Veracruz cluster must take into consideration the scenario portrayed above. To a lesser extent, this thesis illuminates that the development of the Veracruz cluster is central to encouraging the articulation of value chains of petrochemical origin since this entails at the same time the vertical integration and expansion of the industrial apparatus of the country.

Overall, the approach adopted to study inter-firm linkages and the trajectory of the Veracruz petrochemical cluster in this thesis seeks to demonstrate that enhancing the performance of developing country firms is not only associated with the type of governance structure characterising input transactions, as the GVC literature suggests, but also with the indigenous context of development.

THE ORGANISATION OF THE THESIS

It is worth reiterating that this thesis is not only focused on examining the type of vertical linkages in the locality. Much of the discussion also centres on the aggregate context that has, in one way or another, hampered the development of the Veracruz cluster. A large share of this thesis is, therefore, devoted to studying this latter aspect.

The thesis consists of eight chapters and conclusions and is organised in the following way. After this introduction, Chapter 2 describes the methodology I utilised and provides a detailed outline of the main features of the case study. The first sub-section contextualises the way research techniques were put into practice, namely: how fieldwork was conducted; the use of semi-structured interviews; the gathering of information through secondary sources; and the challenges faced in the field. The second sub-section of the chapter elucidates the configuration of the Veracruz petrochemical cluster.

Chapter 3 brings together the global value chain approach with empirical evidence from the Veracruz cluster and suggests that the conceptual underpinnings of governance structures found in cross-national inter-firm relationships can be used to distinguish the type of vertical linkages within an industrial cluster, which in our case study are for the most part *captive* in nature. The chapter also schematises both the dynamics that influence local transactional dependence and the external determinants (the aggregate environment) shaping the predominantly local pattern of governance.

Chapter 4 discusses the origins of PEMEX and focuses on the role played by foreign capital during the first decades of the 20th century. It also touches on the rise of economic nationalism and the events that led to the expropriation of the oil industry in 1938. The aim of the chapter is to elucidate both the early development of the oil industry in Mexico and the circumstances that laid the ideological, political, and economic foundations that validated the instrumentation of a state-led industrial strategy after World War II – the period when the petrochemical industry established itself.

Chapter 5 focuses on the establishment and remarkable rise of the petrochemical industry in the context of import-substituting industrialisation policies. This helps to illustrate that under State tutelage the sector grew rapidly and in line with an approach favouring vertical integration of the country's industrial apparatus. In so doing, the debate identifies the drivers that help explain the current organisation of production in the Veracruz cluster. Similarly, the chapter describes how both the oil boom that Mexico experienced in the 1970s and the economic policy mismanagement on the part of the ruling elite which culminated in the 1982 debt crisis set the tone for the dismantling of the sector in the following decades.

Chapter 6 demonstrates the complex scenario that arose as a result of market-orientated policies introduced by the Mexican authorities in the 1980s and 1990s within which the Veracruz cluster currently operates. The discussion follows a timeline that includes the strategy adopted by the government to stabilise the economy in the wake of the 1982 debt crisis, increasing U.S. dependence on imported oil and the role of the Mexican hydrocarbon industry in relation to this dependency. The chapter analyses how these *national* and *supranational determinants* contributed to persuading government officials to reduce the scope of state intervention in the petrochemical industry on the one hand and determine the horizontal restructuring of PEMEX on the other. These political decisions (or rather *sectoral determinants*) are understood as a step towards the dismantling of the state-owned petrochemical sector. The post-NAFTA era context, and the threat of privatisation for PEMEX-Petrochemicals resulting from the 1994 peso crisis, are also discussed.

Chapter 7 seeks to explain the repercussions of the aggregate setting on the current standing of PEMEX and its petrochemical division. In addition to the context provided in the previous chapter, the company's heavy tax burden and the nature of the country's

energy matrix (the increasing use of natural gas for energy generation) are mentioned here for the important role they have also played. To put this in perspective, the analysis emphasises the paradoxical scenario of the Mexican oil industry which is based on the fact that the country has become a mere supplier of crude, and a net importer of value-added hydrocarbon inputs and refined products. In this respect, the chapter also briefly compares PEMEX with large international oil firms in terms of revenues and output.

Chapter 8 serves to contextualise the empirical evidence from the Veracruz cluster with respect to the quality of relationships between PEMEX-Petrochemicals and the pool of private petrochemical firms. It describes the circumstances that indicate the extent of transactional dependence in the locality and the development trajectory of firms. This debate focuses on firms that demonstrate similar characteristics.

Last but not least, the objective of Chapter 9 is to enumerate the array of conclusions regarding the trajectory of the Veracruz cluster, underline the contributions of this thesis, and indicate potential research directions that could be explored in the future.

2

METHODOLOGY AND CASE STUDY OVERVIEW

How fieldwork challenged pre-established conceptions

INTRODUCTION

This thesis is a continuation of the Master of Science (MSc) dissertation I completed in September 2006 at the University of Sussex. On that occasion I analysed the scenario of adverse condition of the state-owned petrochemical industry in Mexico in the recent past. This research, in many respects, represented a preliminary perspective on the political economy of development of the Veracruz petrochemical cluster – a subject I discuss in more detail in the present thesis.

As I continued into the DPhil in 2006, I initially set my sights on broadening the range of the research I conducted during the MSc by linking it to the dynamics of economic development taking place in the locality. Nonetheless, early fieldwork inquires firmly indicated that these two subjects were inconsistent with one another because, even though the role of the petrochemical industry in driving local economic development was deemed a very important feature, the point to highlight is that it was not the foremost determinant as I had initially believed. It is worth underlining that this finding not only challenged pre-established assumptions in my research, it also served to illustrate the fundamental role of research methods such as fieldwork in discerning the extent to which certain issues are more important than others when studying the Veracruz petrochemical cluster.

One of the objectives of this chapter is precisely to throw light on the importance of fieldwork and other research methods. Discussion is therefore not restricted to show how the locus of analysis of this thesis shifted from one preliminary hypothesis to another that emerged from interviews in the field, it also seeks to set out relevant research techniques and contextualise the way in which they were put into practice. The

second aim of this chapter is to describe comprehensively the most noteworthy features of the object of study.

RESEARCH METHODS

As a student performing geographical research, I can argue that the literature around research methods in the discipline in recent years provides fruitful support for this research. A handful of contributions explored here are those of Limb et al. (2001), Holloway et al. (2003), Hay (2005), Flowerdew and Martin (2005), and Clifford et al. (2010) who underline and explain the mixture of techniques and methods geographers and researchers from overlapping fields can resort to. This subsection intends to lay emphasis on the most important methods and techniques I employed to examine the trajectory of the Veracruz petrochemical cluster.

Fieldwork

I undertook fieldwork activities during two periods, with the main phase being late 2007 and the first half of 2008 primarily in the cities of Coatzacoalcos, Minatitlán, and Cosoleacaque. As access to certain key figures was not obtained on that occasion, I planned a shorter phase of fieldwork for December 2008 and January 2009 in Mexico City and Xalapa, the capital of the state of Veracruz[8].

The initial argument of this thesis, as briefly mentioned at the start of this chapter, lines above, focused on demonstrating that despite the deterioration of the standing of the petrochemical sector during the second half of the 1990s and beyond, the industry played an important role in the expansion of other types of productive activities in the locality. During these years the growth of banking, retailing, construction, private education, leisure, urban infrastructure, and transport services was both noticeable and significant. This was the hypothesis I intended to explore while in the field. The first interviews, however, indicated that analysis of the Veracruz petrochemical cluster needed to follow another direction. Participants pointed out that economic expansion in the locality was to a significant extent connected to the process of economic liberalisation the country has experienced since the 1990s, which is illustrated by the

[8] I also managed to obtain two interviews on a visit to Mexico in July 2010.

fact that companies began to expand operations to cities where the supply of services demanded was either poor or non-existent. This phenomenon did not only occur in southern Veracruz; in fact most of the country was also experiencing the same type of service sector expansion. After understanding what lay behind economic expansion in southern Veracruz, there was little doubt that the petrochemical industry had been less influential in that respect than originally estimated.

We can move now to consider the strategy behind the interviews conducted. By obtaining access to individuals related to the industry, local government officials (who had held high ranking positions at PEMEX-Petrochemicals in the past), and managers of petrochemical firms, the purpose was not only to understand the trajectory of the Veracruz cluster but also to further distinguish the policy setting and economic circumstances that would help place the adverse industry scenario in a broader perspective (Chapters 5, 6, and 7). In addition to revealing the drivers of local economic expansion, participants pointed out a problem that I had not considered; namely that the development of private petrochemical firms in the Veracruz cluster was hindered by the uncertain role of PEMEX-Petrochemicals as a supplier of basic inputs. This problematic was at the same time strongly associated with a number of external factors beyond the control of local actors. It therefore became apparent that the quality of transactional linkages between PEMEX-Petrochemicals and local petrochemical firms was distressed by the complexity of the external environment and that my thesis should pay considerable attention to this issue and abandon the path of research contemplated at the outset. In a broad sense, the locus of analysis switched from investigating how petrochemical firms are associated with local economic dynamics to examining the quality of vertical inter-firm relationships (Chapter 8) and the influence of external drivers on local governance structures.

This change, however, had implications in relation to the fieldwork inquiries. It must be acknowledged that the value of certain sets of information gathered in the early stages was to a certain degree questionable, first and foremost with respect to the nature of data demanded by the approach I finally utilised. While interviews were originally outlined to cast light on the line of reasoning I intended to develop in the first place, what is essential to emphasize is that interviewees turned out to be eager to give a picture of the high degree of uncertainty prevailing in linkages between PEMEX-Petrochemicals and

local private firms. Despite the fact that these handful of interviews somewhat failed to problematise transactional linkages at length, the information exposed permitted an illumination of both the range of determinants affecting the quality of transactional relationships in the locality and the complexity of the context in which this industry is embedded. It was therefore certain that an analysis of the Veracruz petrochemical cluster should be framed within the political economy of Mexico and, from that moment onwards, interviews were delineated correspondingly. They were thus adapted to address issues such as the implications of the North American Free Trade Agreement and the institutionalisation of sectoral regulatory policies for the development of petrochemical firms in the locality.

The most significant lesson I can draw from this experience is that in the process of preparing my research proposal I came up with a preliminary hypothesis that was later proved imprecise and incapable of capturing the reality of the case study. Without being aware of such inaccurate notion, the value and usefulness of the obtained information would have compromised construction of legitimate arguments in this thesis. Such a change in analytical approaches has been discussed in the literature around methodology. A case in point is Hope (2009: 169) who alleges that 'fieldwork can give us direct experiences that challenge our preconceptions'; and that is precisely the type of situation I confronted at the beginning of fieldwork in Minatitlán and Coatzacoalcos. More specifically, what I discovered in southern Veracruz through interviews was not what I presumed when I had originally designed my research.

All in all, what is important to take notice of is that fieldwork is fundamental in the development of research in social sciences – notion that appears to be widely acknowledged among scholars from disciplines like geography (Clifford et al. 2010, Holloway et al. 2003, Kent et al. 1997).

Semi-structured interviews

Apart from some specific quantitative data I sought to obtain from firms, which requested a more straightforward response, interviews were first and foremost outlined to cover a set of broad topics with the deliberate intention of inducing participants to

elaborate answers in their own words[9]. To do so I systematised the range of topics in such a way that interviews ended up being appeared to be, unceremonious conversations. All topics were related to one another, so when I sensed that participants had disclosed as much information as necessary concerning a particular subject I drove the conversation towards the following topic according to my notes. One key point about this technique is that I had to learn by heart the order of topics I wanted to discuss with the informant, in that way conversations did not appear to be a labored exercise.

Many of the points mentioned above, if not all, are discussed in the literature on geographical research methods. Dunn (2005: 80) indicates that even if semi-structured interviewing can be designed to cover issues in a systematic fashion, one important feature is that it embodies a certain degree of flexibility in the way issues are addressed by the informant. This flexibility is an attribute that has been highlighted by other scholars such as Longhurst (2010: 105) who similarly contends that 'semi-structured interviews allow for an open response in the participants' own words rather than a "yes or no" type answer'.

Moreover, previous research experiences had already taught me that semi-structured interviewing is also a technique that could lead to the uncovering of facts initially unidentified. The literature on research methodology may not explicitly draw attention to the latter assumption, but it suggests that flexibility in conducting semi-structured interviews - which, briefly, refers to interviewees illustrating an issue without being exhorted to respond in a certain manner - greatly facilitates the obtaining of information that could be deemed as more revealing and accurate than initially expected, as Graham (1984) puts it. The analytical shift I exposed in the previous sub-section is a clear example of the latter. Generally speaking, this shift arose as a consequence of the use of semi-structured interviews, which permitted informants to put emphasis on subjects they viewed as important in shaping the development of the petrochemical industry.

Having said this, I believe it is also necessary to portray some key points of the information gathering process in the field and the challenges it presented. It must be mentioned that analysis of the Veracruz petrochemical cluster significantly relies on thirty-one semi-structured interviews I conducted with actors in the locality and

[9] Longhurst (2010) offers a more detailed discussion in that regard.

elsewhere, who ranged from private and state-owned firms, government officials and union and industrial association leaders to former and current employees of PEMEX-Petrochemicals, journalists, scholars, and specialised service providers.

Of the twenty private firms I intended to interview, only thirteen agreed to participate. The information from nine of these companies is what enriched the discussion pertaining to the quality of vertical relationships in the locality, whereas the data made available by the other four firms served to construct arguments regarding broader political economy issues.

In respect of state-owned firms, even if all the complexes under the administration of PEMEX-Petrochemicals granted me access, the quality of the data and that of the informant varied greatly from one another. I requested to interview the managers of Pajaritos and Cangrejera, but they claimed to be extremely busy and thus unable to spend time to discuss the topics set out in the questionnaire. In turn, I was offered to speak to individuals occupying a much inferior category within each firm – a condition that compromised the value of the information since participants failed to elaborate on the topics projected to be discussed and responses tended to rest on personal perspectives rather than on a more institutional outlook. Morelos and Cosoleacaque complexes lie on the other side of the spectrum. In both instances, informants played pivotal roles within their organisations and possessed the knowledge to illuminate the topics covered in the questionnaire. Despite these inconsistencies, the information acquired led me to reflect on the character of PEMEX-Petrochemicals as a provider of industrial raw materials and substantiated the restricted availability of local inputs, as well as on the sort of features making up the complex scenario of the petrochemical industry in Mexico.

In addition to interviewing petrochemical firms, it soon became clear that it was essential to speak to actors associated in one way or another with the dynamics of the sector. I hence conducted interviews with individuals from different backgrounds such as government officials, former employees of PEMEX, scholars, journalists, and industry association leaders; and since a number of these were not exclusively established in the locality it was also necessary to visit Mexico City and Xalapa, the capital of the state of Veracruz. Even though gaining access to these actors was at first problematical, the networks I established in the field eventually facilitated the obtaining

of interviews. The overall aim of these interviews was to distinguish the array of external factors constituting the complex scenario in which local transactional linkages are embedded and corroborate facts provided by petrochemical firms. Interviews with scholars served to understand, for example, how the U.S. energy security strategy can be linked to the fact that PEMEX-Petrochemicals is processing less oil and natural gas than it did a decade ago. Moreover, interviews with former employees of PEMEX contributed to discerning the extent to which policymakers are responsible for the current standing of the state-owned petrochemical industry and how regulations have constrained at the same time the configuration of value chains of petrochemical origin, to which private firms in southern Veracruz are central.

Turning now to the challenges I confronted in the field, the most notable one was that a number of prospective informants in private firms appeared to be reluctant to discuss certain issues. This is demonstrated by the fact that thirteen out of twenty firms responded favorably to interview requests. I established contact with all of them for the first time prior to arriving to the locality, attaching to emails an institutional letter describing my research as well as a concise personal introduction. Once settled in Minatitlán, I sought to get in touch with specific individuals at firms by means of emails and phone calls. By this time I had prepared a questionnaire that I also attached to emails. Despite these formalities, certain firms seemed to be reluctant to respond so that I presupposed that handing in the appropriate documents in person would help persuade them. This I did in some cases. In relation to those firms that rejected the request to be interviewed, it eventually became evident that what made companies decline my petition was the sort of information I requested in the questionnaire. I was not completely aware that certain questions would entail interviewees disclosing information commonly treated as confidential. This point was, in due course, raised by individuals who I interviewed in the early stages of fieldwork and held high ranking posts at other petrochemical firms. While it is certain that the questionnaire I provided may have deterred specific firms from participating, others adopted a much more flexible attitude and agreed to be interviewed on the basis of excluding those issues considered not appropriate to discuss. The latter did not imply fundamental changes with respect to the research process, on the contrary, it led to craft a down-to-the-point semi-structured questionnaire and for instance a less intrusive manner to approaching firms. In the end the information originally requested was found to be not as pertinent to

both contextualise and conceptualise vertical transactional linkages in the locality, but it did help in orientating position my research in the right direction.

Secondary sources

Although semi-structured interviews bestowed a generous share of empirical evidence to problematise inter-firm linkages in the Veracruz cluster and distinguish external determinants influencing local governance structures, there can be no hesitation in stating that the assembly of a comprehensive analysis in this thesis would have been impossible without having resorted to complementary sources of information, most of which was recommended and sometimes made available by a number of key informants. The literature on research methodology is equally assertive with respect to this statement. White (2010: 63) argues that 'for many geographical investigations, secondary data are indispensable, since the project could not proceed without such data'. As far as the discussion exposed in this work is concerned, secondary sources were fundamental since they contributed to establishing linkages between pertinent political economy issues (external determinants) and dynamics occurring in the locality (inter-firm transactional relationships).

Hence the assortment of secondary sources on which analysis in this thesis rely stretches from existing publications around the Mexican economy and PEMEX, government official documents, and newspapers to specialised magazines and databases. As regards quantitative information, PEMEX yearbooks proved to be the most valuable source given that they made it possible to distinguish particular circumstances worth exploring in order to understand the Veracruz petrochemical cluster from diverse angles. The following examples illustrate the latter: i) annual reports made it possible to trace the extent to which output and installed capacity at petrochemical complexes in southern Veracruz grew larger under state intervention in the 1960s and 1970s and how the former indicator shrivelled while the latter stagnated under market-orientated policies from the 1990s onwards (Chapter 5 and Chapter 7); ii) PEMEX yearbooks also served to examine how policymakers have articulated crude output with the needs of the United States industrial machinery at the expense of yielding value-added hydrocarbon inputs at domestic state-owned processing facilities (Chapter 6); iii) figures made public by PEMEX similarly demonstrate the extent to which revenues are drained to finance government spending to the detriment of

upgrading petrochemical complexes in southern Veracruz and expanding the installed capacity of the national refining system (Chapter 7).

While the substance of PEMEX annual reports is unquestionable, the value of other sources of quantitative information, namely the national office of statistics (INEGI), the U.S. Energy Information Agency (EIA), and the United Nations Trade Commodity Statistics Database, must not be underestimated since they served to complement and hence strengthen the crafting of arguments concerning scenarios such as those mentioned lines above.

With reference to INEGI, trade figures of crude, petrochemical inputs, products of petrochemical origin (plastics, textiles, and other chemicals), and refined products (gasoline, diesel, jet fuel) led to reflections on the extent to which Mexico is increasingly becoming a simple supplier of crude to the U.S. and a net importer of hydrocarbon by-products processed north of the border. This paradoxical scenario is extensively examined in Chapter 7.

Furthermore, discussion around the U.S. energy dependency is elaborated by making use of quantitative data computed by the EIA, which permitted a contextualisation of i) how U.S. policymakers viewed the hydrocarbon wealth of Mexico in the 1970s at a time when the political and economic repercussions of the 1973 Arab oil embargo lingered, and ii) the extent to which a growing oil dependency on hostile and volatile suppliers in the late 1980s and early 1990s may have coerced U.S. policymakers to sign a free trade agreement with Mexico, a much more friendly, trustworthy supplier and holder of sizeable hydrocarbon reserves at that point of time. Chapter 6 provides a more detailed discussion in that respect.

Another important source of data was the United Nations Trade Commodity Statistics Database, whose figures contributed to tracing imports of a number of petrochemical inputs PEMEX-Petrochemicals ceased to produce in southern Veracruz. The aim of doing this was to contextualise the erratic role of state-owned complexes as suppliers of inputs and the degree of transactional dependency local buyer firms endure. Chapter 8 elaborates these two issues in a more specific manner.

In relation to qualitative data, the official gazette of the Mexican government[10] (Diario Oficial de la Federación, DOF, in its Spanish acronym) stands out as important. While PEMEX annual reports served to illustrate how petrochemical output and installed capacity grew under state intervention, information published in several issues of the DOF made it possible to distinguish i) how policymakers orchestrated the withdrawing of the state from the petrochemical industry (Chapter 6), and ii) elucidate the roots of output contraction at state-owned petrochemical complexes in the 1990s. The impact of this new regulatory framework on both the petrochemical industry and the Veracruz cluster is further examined in Chapter 7.

Snowballing

In attempting to gain access to participants who appeared to be reluctant at first, I also resorted to snowballing. Flowerdew and Martin (2005: 177), for example, make clear that such a method refers to 'using one contact to help you recruit another contact, who in turn can put you in touch with someone else'. The initial contact, as the authors describe, is usually 'a friend, relative, neighbor, or someone from a social group or formal organisation' (Flowerdew and Martin 2005: 117) whose own network may facilitate the process of recruiting prospective participants.

At one point in time I approached the Director-General of an automobile retailer in Minatitlán who turned out to be a past employee of PEMEX-Petrochemicals and therefore a well-connected individual in the local industrial scene. Conversation with this informant was at the beginning related to his view on the local economy, but it quickly shifted towards the dynamics of the petrochemical industry given his expertise on it. As we ran out of time on that first occasion, he invited me to visit him again some days later in order to continue our discussion. He eventually became more interested in the research and inquired whether I had found it problematic to gain access to managers of petrochemical plants and government officials. I then revealed the identity of those who had not replied to my interview requests up to that point. After I mentioned the situation arising from the sort of questions I initially incorporated to the questionnaire, he suggested he would contact these potential participants by email and insist on the importance of the research I was carrying out. I am not entirely certain of the extent to

[10] DOF stands for Diario Oficial de la Federación, the official gazette in which government stipulations and decrees are made public.

which his intercession was successful, nor of the information he wrote down in those emails, though I must concede that, in the end, I did interview some of the individuals he got in touch with.

Another important feature of such a snowballing experience is that this initial contact also identified who I should speak to at particular organisations, that is, local governments and industry associations. Thanks to his intervention I managed to interview a government official at the economic development department of the municipality of Coatzacoalcos, who also was a former employee of PEMEX. The point to emphasise is that this informant served to provide a more institutional perspective in relation to external determinants affecting inter-firm relationships in the locality.

It was not only contacts I came across while in the field who helped me obtain access to participants, but my own set of connections also contributed to recruiting prospective informants. By the time fieldwork was coming to an end, of the four state-owned petrochemical complexes, only one had not responded favorably to interview requests. In this specific case, however, I first need to reveal that some of my own relatives either have worked, or are working, at this firm. This said, I now wonder whether my surname prompted the potential interviewee to speculate how I was related to employees under his authority. I first took for granted that this subject would significantly facilitate access to the manager of the petrochemical complex, but it turned out not to be the case. Interview requests continued to go unanswered. Nonetheless, a window of opportunity appeared a while later given than a relative drew attention to the fact that the manager was on holiday and that one of his subordinates had temporarily taken over. I established contact with this person and introduced myself once again. The fact that I relied on an insider made the interview possible a few days before I returned to England.

Another occasion in which snowballing emerged as an important technique was when a interviewer in Mexico City, a journalist and scholar, contacted on my behalf a highly respected former employee of PEMEX who at present is a key figure in a pressure group opposing many of the changes the current administration plans to put into action. The interview with this individual turned out to be the most challenging of all since it ended up being an exchange of questions, where the participant tested my technical knowledge of the industry as I inquired about certain topics related to the petrochemical

division of PEMEX. At the same time, this interview turned out to be one of the most rewarding ones not only in terms of the quality of information obtained, but also due to the amount of secondary sources provided. This individual, for example, shared digital copies of several presentations he and other colleagues had performed before members of the Congress and at other forums, as well as a book he had written on PEMEX, which contains data that later allowed for the construction of very valuable arguments in this thesis.

Analytical approach

As fieldwork came to an end, there was no doubt that discussion in this thesis must centre on the quality of transactional linkages between PEMEX-Petrochemical and local private firms. To have a much more lucid understanding of the latter, as pointed out by informants, it was fundamental to look at the wider picture and take into consideration certain political, institutional, and economic factors associated with the development path Mexico has pursued in recent decades. For instance, analysis with respect to the trajectory of the Veracruz petrochemical cluster was built upon crafting a systematic manner to study such factors and determining how the external environment influences inter-firm relationships in the locality.

Upon establishing what constitutes the aggregate context in which the petrochemical industry is embedded, it became apparent that external determinants could be categorised in three dimensions of analysis, namely sectoral, national, and supranational.[11] The sectoral dimension, for example, encompasses the regulatory framework that government officials instigated in the 1980s and 1990s as a result of embracing market-orientated policies. The heavy tax burden of PEMEX is also contemplated in this category. The national dimension illustrates the extent to which economic crises in 1982 and 1994, economic liberalisation in the 1990s, the increasing use of natural gas for electricity generation, and the country's weak tax collection serve to outline inter-firm dynamics in southern Veracruz. The supranational dimension of analysis mostly refers to both the U.S. energy security strategy and the role of multilateral institutions in shaping Mexico's economic foundations. This said, the point

[11] Figure 3.4 schematises the dimensions of analysis. The reason why such figure is not included in this subsection is because Chapter 3 conceptualises the case study.

to highlight is that governance structures of vertical transactional linkages in the Veracruz cluster are in one way or another embedded in these three dimensions.

Given the complexity of the external environment, the question that arises is as to how the trajectory of the Veracruz cluster and the nature of inter-firm relationships are to be assessed. The former required developing a systematic way to present the contextual and empirical evidence. For instance, discussion in this thesis could have been organised by focusing on one dimension of analysis at a time, but this proved problematic as a number of factors are linked to one another in a sequential fashion. For example, regulations encouraging participation of private firms (at the expense of state intervention) in the petrochemical industry materialised in the context of economic liberalisation put into practice in the late 1980s and early 1990s, which is simultaneously rooted in the debt crisis of the early 1980s. From this point of view, the most appropriate method to contextualise the aggregate environment was by establishing a timeline. While Chapters 4 and 5 discuss the origins of the oil industry in Mexico and the establishment of the petrochemical industry under the tutelage of the state, respectively, Chapters 6, 7, and 8 concentrate on the range of economic, political, and institutional factors above mentioned in a somewhat chronological manner, exposing analytical dimensions indistinctively.

With regard to assessment of the nature of inter-firm relationships in the Veracruz cluster, Chapter 9 casts light on this topic. It can hence be observed that discussion in this thesis first seeks to discern the complexity of the external environment and then illustrates the impact of it on the development of the Veracruz petrochemical cluster. What is the rationale behind this approach to examining our case study? The answer rests on the fact that it sets out beforehand the determinants that help understand the profound degree of transactional dependence that private firms bear with respect to state-owned complexes – the most important feature of the Veracruz petrochemical cluster. That being said, it is worth noticing that contextualisation of these complex relationships, which entails to depict the trajectory of private firms and how linkages with suppliers have evolved over time, serves to illuminate the determinants that lock private firms into *captive* transactional relationships.

THE OBJECT OF STUDY

The group of firms dedicated to the production of hydrocarbon-derived products in the neighbouring municipalities of Coatzacoalcos, Minatitlán and Cosoleacaque in the state of Veracruz is arguably the largest geographical agglomeration of industrial firms in southern Mexico, with this area being home to four state-owned petrochemical complexes (PEMEX-Petrochemicals), one state-owned refinery (PEMEX-Refining), twenty private petrochemical firms, and an array of local institutions such as universities, industry-orientated associations, a pool of specialised service firms, and an infrastructure network that facilitates the distribution of inputs throughout and beyond the cluster. The horizontal and vertical linkages connecting this range of actors to one another are reflected in the following definition of our case study: the Veracruz cluster is a spatially concentrated group of public and private petrochemical firms that are linked through output-input transactions, yield raw materials required by a wide range of industrial sectors (value chains), and operate alongside a pool of local institutions in a rather complex environment.

As one observes, this definition encapsulates the two fundamental features of the Veracruz cluster, that is, vertical transactional linkages embedded in a complex aggregate environment. In order to understand the scope of our case study, I contend that it is essential to situate the description of such features in a somewhat broader setting. This section will therefore briefly describe the external (backward and forward) linkages of the cluster, introduce the drivers that lead to state-owned firms controlling input transactions, and underline the role of the petrochemical industry in the development of value chains. Nonetheless, before starting this discussion, a concise description of the location of the Veracruz cluster is required.

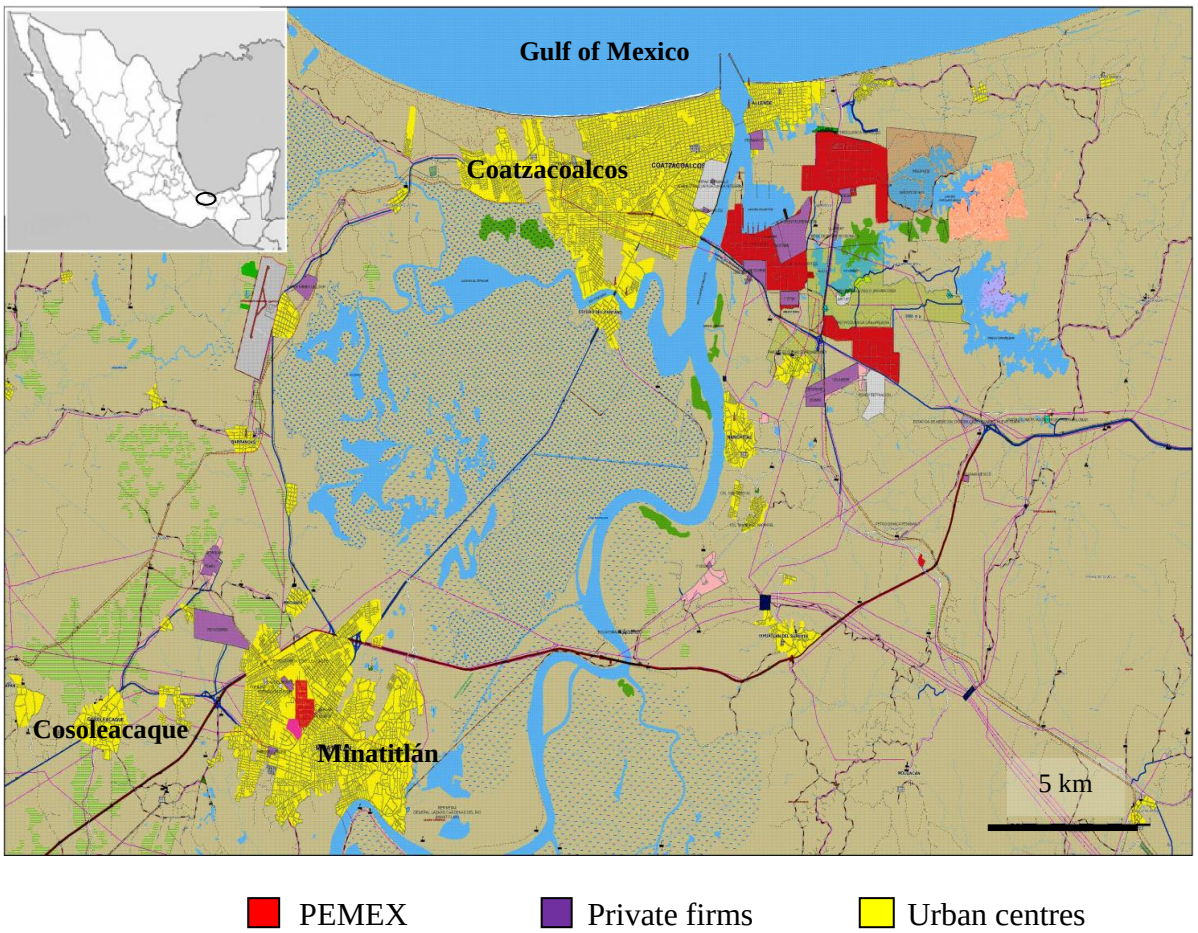
Southern Veracruz

The character of southern Veracruz as an industrial enclave can be traced back to the first decade of the 20th century. S. Pearson & Sons, a British engineering firm, built the first Mexican refinery in Minatitlán in 1905[12] (Brown 1987). Several decades later, more precisely in the 1960s and 1970s, government officials sought to encourage the development of infant industries through the industrialisation of hydrocarbon resources.

[12] This point is briefly discussed in Chapter 4.

To that end, the petrochemical industry was viewed as determinant. At that time, the relative wealth of southern Veracruz with respect to natural gas, crude oil, and water drew the interest of policy makers and private investors for the establishment of petrochemical plants. Similarly, from the government perspective, it was an alternative for ameliorating the spatial concentration of activities import-substituting industrialisation policies had led to. The Echeverría government (1970-76) considered creating growth poles to encourage industrial development away from the traditional sites. The southern region of Veracruz (Figure 2.1) is a rather illustrative example of such state-led development (Blanco 1981, Snoeck 1986).

Figure 2.1 Location of the Veracruz petrochemical cluster



Source: Adapted from Sistema de Información Geográfica de PEMEX (SICORI n.d.).

Our case study is in the south of the state of Veracruz, which is geographically situated in the north of the Tehuantepec Isthmus[13], a region that represents the shortest distance

[13] At its narrowest point, the Isthmus of Tehuantepec covers a distance of 220 km (Encyclopaedia Britannica n.d.)

between the Gulf of Mexico and the Pacific Ocean. The relative importance of the locality, which is formed by the municipalities of Coatzacoalcos, Minatitlán, and Cosoleacaque, also rests on the fact that it is strategically positioned. A few kilometres to the south of the Veracruz cluster, the motorway and railway[14] network that connects the south-eastern states, the southern Pacific coast, and the central highlands converges. Additionally, the locality borders the Gulf of Mexico where petrochemical firms have access by means of a specialised port infrastructure. The point to address here is that such a location and the existing transport infrastructure not only facilitate the supply of local production to user firms in the more industrialised states in the highlands and northern Mexico, it also favours access to hydrocarbon inputs from the energy-rich southern states[15].

Another noteworthy characteristic of the locality is that it houses the two largest urban centres of southern Veracruz and the Isthmus of Tehuantepec. The city of Coatzacoalcos ranks first with an estimated population of 235,983[16], according to INEGI, the national office of statistics, while the city of Minatitlán ranks second with an urban population of 159,545 inhabitants[17]. With a population of 22,454[18] as of 2010, Cosoleacaque is the smallest of the three urban centres (INEGI n.d.). Needless to say, Coatzacoalcos is the epicentre of the locality in many respects and the city not only possesses a thriving service sector that dwarfs those of Minatitlán and Cosoleacaque, it is also home to the headquarters of PEMEX-Petrochemicals, three state-owned petrochemical firms (Cangrejera, Pajaritos, and Morelos), several private

[14] The Veracruz cluster lies just a few kilometres from the Compañía de Ferrocarriles Chiapas – Mayab crossing, which connects the southern states, Ferrocarriles del Istmo de Tehuantepec, which runs south to the Pacific coast, and Ferrosur, the company that links the former and the latter with the rest of the country, as indicated by the Ministry of Communications and Transport (SCT 2009).

[15] With respect to natural gas and crude, the states to the south of Veracruz and the territorial waters bordering these states accounted for 63.89 and 96.34 percent of the overall production of PEMEX, respectively (PEMEX 2010a).

[16] This figure refers to the population of the city of Coatzacoalcos. The population of the entire municipality, which encompasses several communities, stands at 305,260 inhabitants according to the 2010 General Census of Population and Housing (INEGI n.d.).

[17] The city of Minatitlán has expanded beyond its political boundaries. Of these 159,545 inhabitants, 47,499 live in areas corresponding to the municipality of Cosoleacaque. Without taking into account this number, the aggregate population of the municipality of Minatitlán, which includes outlying communities, is 157,840 inhabitants, according to the 2010 General Census of Population and Housing (INEGI n.d.).

[18] However, most of the population of the municipality of Cosoleacaque, which totals 117,725 inhabitants, live in outlying communities. 47,499 residents, for example, live in the metropolitan area of Minatitlán (INEGI n.d.).

petrochemicals firms, and a port infrastructure specialising in the handling of bulk cargo and petrochemical products[19].

The scope of transactional linkages of the Veracruz cluster

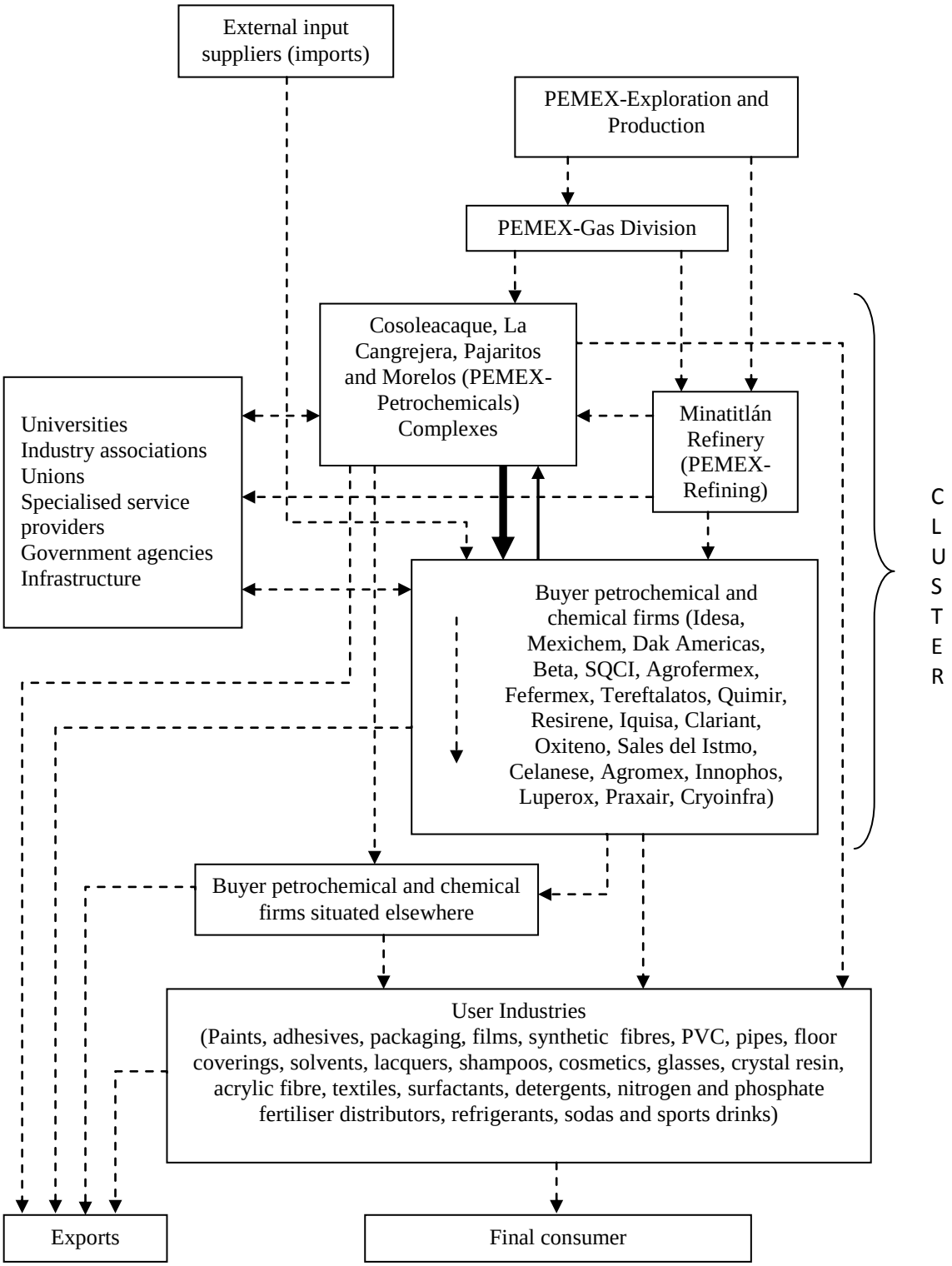
Even though the Veracruz cluster includes a number of actors, two of these are central to this thesis, namely state-owned firms and the pool of private petrochemical companies. The first group of firms refers to the complexes of Cosoleacaque, Cangrejera, Pajaritos, and Morelos, which constitute the petrochemical division of PEMEX and represent over 90 percent of the installed capacity and output of the subsidiary, as previously indicated. The second group includes twenty private firms which are clustered around these complexes and further process the inputs yielded by the first group[20].

The Veracruz cluster is embedded in a broader network of backward and forward linkages that indicates the range of industries fed by local firms. Figure 2.2 illustrates how actors inside and outside the cluster are linked. To begin with, attention must be paid to the different divisions of PEMEX situated in the first nodes of the input-output scheme shown.

Backward linkages, for instance, refer to the players that supply the precursors (naphthas and natural gas) of petrochemical value chains. The role of the different divisions of PEMEX[21], situated in the first nodes of the input-output scheme described, are central in this respect (Figure 2.2). The process begins with the extraction of crude and natural gas by PEMEX-Exploration and Production (PEP). After that stage, PEMEX-Refining (PR) and PEMEX-Gas (PG) perform further processing activities for both inputs. Crude, for example, is not only processed into fuels such as gasoline and diesel, it is also used to yield other by-products such as sulphur and naphthas. The Minatitlán refinery, which belongs to the refining division of PEMEX, supplies sulphur to local firms for the making of fertilisers. Naphthas, which is one of the main value chain precursors in the locality, is supplied by the Minatitlán refinery to the complex of

[19] Information obtained from fieldwork interviews and the Coatzacoalcos port authority website (APICOATZA n.d.).
[20] For 2008, it is reported that economic activities associated with the production of petrochemicals and fertilisers in the three municipalities employed 16,037 workers. If the number of workers at the Minatitlán refinery is taken into consideration, the figure stands at 19,772 (INEGI 2009).
[21] Since 1992 PEMEX has been organised into a central holding with four subsidiaries (Chapter 6).

Figure 2.2 The structure of the Veracruz cluster and linkages



Source: The author's database.
Note: Bold arrows indicate linkages central to this thesis. Dashed arrows denote secondary links that lie outside our analysis. The vertical dashed arrow to the left of buyer firms refers to transaction relationships within this group of companies.

La Cangrejera[22] for the making of aromatics[23] - one of the most commercially important families of compounds in the petrochemical industry (Burdick and Leffler 1990: 12). With regards to natural gas, once this is extracted by PEMEX- Exploration and Production, it is necessary to separate the different associated compounds. This process is carried out by PEMEX-Gas, which subsequently distributes the input to the different subsidiaries of PEMEX and other users for their own industrial processes. Once natural gas and naphthas reach the petrochemical complexes of Cosoleacaque, La Cangrejera, Morelos, and Pajaritos, both inputs are then turned into petrochemical building blocks such as ethylene, styrene, ammonia, and aromatics.

Figure 2.2 also illustrates the backward linkages that local buyer firms establish with external suppliers. At times, as discussed in Chapter 8, PEMEX-Petrochemicals fails to supply certain inputs demanded locally and buyers have no alternative but to find providers abroad. The Tereftalatos company, which uses paraxylene to produce terephthalic acid in the municipality of Cosoleacaque, is a case in point. As PEMEX-Petrochemicals ceased production of paraxylene, this input is sourced in the United States. Fefermex faces a similar situation since PEMEX has also ceased production of cumene and drastically reduced that of acrylonitrile, forcing Fefermex to devise a scheme to import these compounds for the making of acetone phenol. This issue is further contextualised in Chapter 8.

Vertical linkages in the locality, which are one of the two building blocks of this thesis, reflect the way value-adding activities are organised. Put simply, the state-owned petrochemical complexes produce (supply) the basic inputs that local private firms (buyers) use to yield intermediate petrochemical inputs. Even though private firms at times supply inputs to PEMEX petrochemical firms, it is worth reiterating that this scheme occurs to a lesser extent. Figure 2.2 in fact depicts the prevailing pattern of the organisation of production in the Veracruz cluster. One of the features that the bold, solid arrow pointing towards private firms indicates is that the state-owned firms usually play the role of producer (supplier). The point to emphasise here is that the way

[22] It is worth pointing out that the Minatitlán refinery is not the only supplier of naphthas to La Cangrejera.
[23] Benzene, toluene, and xylenes are among the most representative compounds of the aromatics family (Burdick and Leffler 1990).

production is organised in the Veracruz cluster is rooted in the regulations that previous governments laid down during the infant stages of the industry.

In the interests of developing the petrochemical industry, the government had to distinguish the scope of public interest from that of the private sector. The presidential regimes of Ruiz Cortinez (1952-58) and López Mateos (1958-1964) gave PEMEX the exclusive right to produce basic petrochemicals, while allowing private firms to transform these primary inputs into both intermediate inputs and final products (Snoeck 1986). Regulations ensured the state was entitled to produce basic industrial raw materials, which are derived from 'petrochemical processes based on the first important chemical transformation of hydrocarbon resources and its sub-products', while those 'products derived from subsequent petrochemical processes (secondary petrochemical products) are subject to being indistinctly produced by either the state or private participants' (DOF 25/08/1959) [24].

In the subsequent decades, the expansion of the petrochemical industry, particularly in the Veracruz cluster, was in line with these government stipulations; state-owned firms are devoted to producing and supplying the basic petrochemical inputs that clustered private companies use in their own production processes.

In this vertical relationship, the most pervasive characteristic is that state-owned firms wield a disproportionate amount of authority over transactional relationships with local private firms. In this sense, the regulations introduced by market-friendly governments in the 1980s and 1990s, the fact that state-owned complexes are the only producers and hence domestic suppliers of several inputs, the state-owned nature of the producer, the hazardous nature of petrochemical inputs, and the capabilities on the buying end have reinforced the leading position of PEMEX-Petrochemicals. The bold, solid arrow in Figure 2.2 also illustrates the dominant role of PEMEX-Petrochemicals in relationships with buyers.

It is also important to underline that this scenario has turned local private firms into *captive* buyers. Despite the extent of trade liberalisation in the country and the existence of competitive suppliers at the other end of the Gulf of Mexico, buyers appear to favour

[24] DOF stands for Diario Oficial de la Federación, the official gazette in which government stipulations and decrees are made public.

sourcing inputs locally. In addition to the logistical capabilities that the import of materials demands, the concerns that also seem to lock buyers into *captive* relationships are spatial proximity in relation to suppliers and the hazardous nature of petrochemical inputs (the fact that inputs are transported over distances where risks can be minimised and supply delivered promptly).

In addition to these factors, it is important to make a parenthesis to reiterate that analysis of vertical linkages in the Veracruz cluster must be situated in the context of the political economy of Mexico. In doing so, this thesis embeds the use of GVC ideas in a set of economic, political, and institutional factors associated with both the path of development Mexico has followed and the crossroads at which the country has found itself in recent decades. It is certain that the trajectory of the Veracruz cluster would be difficult to understand without discussion of subjects such as the wider implications of market-orientated policies and the sectoral regulatory framework that Mexican policy makers have implemented since the 1980s. In this context, however, the issues that also deserve attention are i) the significance of the Mexican hydrocarbon industry for the United States energy security strategy, with this being related to oil dependency on (OPEC) volatile suppliers and the vertical integration of U.S. oil firms, and ii) the repercussions of the 1994 peso crisis for the petrochemical industry. This is to say that *governance* and *upgrading* prospects in the Veracruz cluster are strongly determined by *sectoral*, *national*, and *supranational* drivers[25].

Back to the discussion on linkages, local firms also engage in transactional relationships with downstream players. While these are beyond the concerns of this thesis, I believe it is relevant to shed light on two features of the Veracruz cluster in this sense. First, most local firms are predominantly geared towards the domestic market and generally began operations in the locality with the aim of encouraging the development of associated domestic industries (national value chains). This feature is in line with the industrial policy that prevailed in the 1960s and 1970s when the government sought to promote the development of infant industrial sectors (orientated to meet domestic demand) by providing subsidised petrochemical inputs (Chapter 5). In recent times, as the size of the Mexican petrochemical market has outstripped local output, firms in the cluster appear

[25] These 'external determinants of local governance' are schematised in Chapter 3.

to have little incentive to engage in export activities and hence tend to market their products locally.

Second, the extent of fragmentation of the petrochemical industry is considerable. A certain number of basic inputs (PEMEX-Petrochemicals) may be transformed into a much wider number of intermediate raw materials (local buyer firms) that at the same time feed a rather broad spectrum of industrial sectors (value chains).

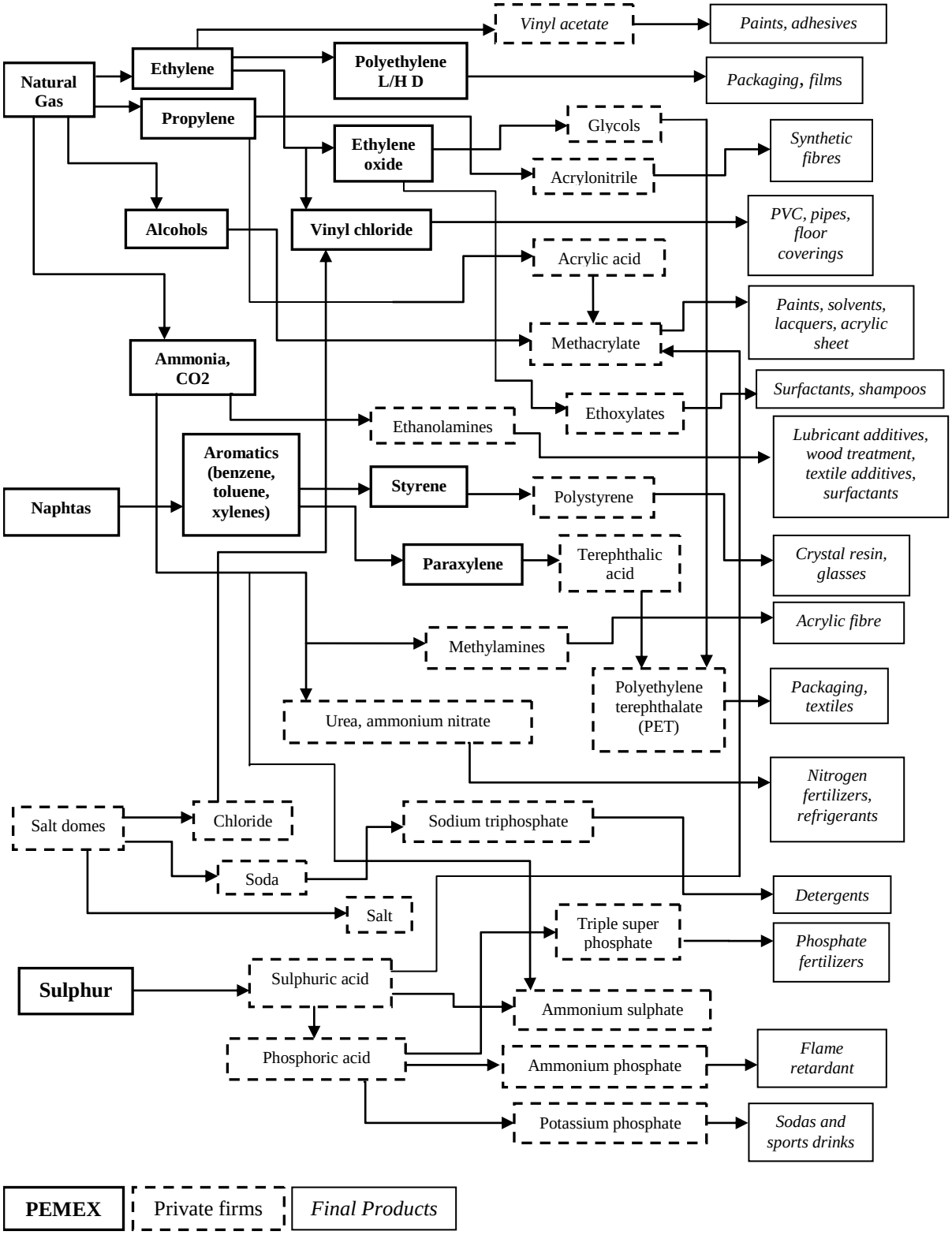
At phases further downstream it is indicated that firms situated elsewhere use the intermediate inputs yielded in the Veracruz cluster to produce either further intermediate inputs or final goods. The assortment of user industries linked to local petrochemical output stretches from fertilisers and plastics to textiles and consumer goods (Figure 2.3). This means that local firms, apart from those dedicated to the production of fertilisers, which are regarded as final products, carry out well-defined value-adding activities associated with the early sequences of such value chains. As shown in Figure 2.3, a large number of value chains are represented in the Veracruz cluster.

To sum up the information provided by Figure 2.3, the state is heavily involved in upstream activities with bold squares (and Figure 2.2) indicating that the scope of PEMEX extends from crude and natural gas extraction to the production of basic petrochemical inputs.

At this stage it should be noted that the latter is in keeping with Gereffi's claims (1994: 101) that 'the role of the state at the point of production tends to be more interventionist in producer-driven chains' and the indications are that this is the role of the Mexican government with respect to transactional linkages in the Veracruz cluster.

Local private firms, on the other hand, indicated with dashed squares in Figure 2.3, process basic petrochemical inputs into either intermediate raw materials or fertilisers. Firms outside the locality, depicted by the squares to the extreme right of the scheme, are devoted to the making of further intermediate inputs and the manufacture of final goods.

Figure 2.3 Main basic and intermediate inputs yielded at the Veracruz petrochemical cluster and final applications



Source: Adapted from Cervantes Polanco (2005) and the author's database.

Similarly, with regard to the different value chains of petrochemical origin shown in Figure 2.3, it is also possible to identify a pattern for the location of private firms with those firms transforming primary inputs into secondary ones (local private petrochemical firms) being situated close to the source of raw materials, clustered around PEMEX-Petrochemicals. Firms turning intermediate inputs into either further raw materials or final goods (forward linkages that are beyond the concerns of this thesis) are situated close to the largest consumer markets.

CONCLUDING REMARKS

This chapter has demonstrated that research methods were at the centre of the process of gathering relevant data for the construction of legitimate arguments in this thesis. Fieldwork activities, as has been noted, were crucial to distinguishing the pre-conceptions held at the time of designing the present research which failed to capture the range of dynamics occurring among firms in the Veracruz cluster, and this turned out to be one of the most important empirical findings that served to indicate the path of analysis that should be pursued in this work. In that respect, the use of semi-structured interviews was what permitted me to discern that the link between the petrochemical industry in southern Veracruz and the extent of economic expansion the locality had been experiencing up to that moment was not as apparent as I had at first assumed. It was the flexibility of this kind of interviews that eventually brought to light empirical evidence of greater weight, namely, the nature and importance of transactional relationships between supplier and buyers of petrochemical inputs and the complex, aggregate (political, economic, and institutional) context in which these relationships were embedded.

This chapter also went on to explore the fundamental characteristics of the case study, revealing the degree to which firms are connected to one another within the cluster and how local companies are at the same time engaged in backward and forward external linkages. The aim was to illustrate how processing activities are organised in the locality - as depicted in Figure 2.2 - and that state-owned and private petrochemical firms situated in southern Veracruz play a critical role in the composition of a wide range of value chains – an argument elucidated in Figure 2.3.

3

CONCEPTUALISING LOCAL GOVERNANCE

Producer-buyer linkages in the Veracruz cluster

INTRODUCTION

Why is it necessary to analyse the Veracruz cluster from the perspective of vertical inter-firm linkages? Firms in the Veracruz cluster, more specifically the pool of private petrochemical companies, are concerned about their prospects for attaining higher degrees of productivity in a globalised economy. Even though it is recognised that the majority of firms in the locality are heavily involved in national value chains, the economic liberalisation Mexico has experienced since the 1980s has not only established new regulations, it has also permitted the involvement of foreign firms through imports. This is to say that companies in the Veracruz cluster participate in the petrochemical domestic market as part of a globalised setting. Firms from throughout the world also face the same predicament concerning productivity and profitability; first and foremost those inserted in the global circuits of production, distribution, and exchange. In attempting to discover what helps firms enhance performance, it is claimed (Porter 1990, Kaplinsky 2000, cited in Humphrey and Schmitz 2002: 1017) that a fundamental avenue for achieving this is by means of upgrading. In other words, 'to make better products, make them more efficiently, or move into more skilled activities', as Humphrey and Schmitz put it (2002: 1017). The answer to the initial question therefore lies in the fact that the main local driver for buyer firms to enhance performance is related to the quality of their transactional linkages with PEMEX-Petrochemicals.

With regard to the co-ordination of inter-firm relationships, an influential stream of literature has emerged in recent years. The global value chain approach[26] has

[26] Gereffi (1994) in his influential paper on how U.S. retailers shape overseas production networks uses the term global commodity chains. At a workshop in Bellagio, Italy, in September 2000, scholars

considerably widened our understanding as to what triggers (or limits) upgrading across firms, with particular reference to those situated in less advanced economies (Gereffi 1999, Dolan and Humphrey 2000, Schmitz and Knorringa 2000, Fleury and Fleury 2001). For the GVC approach, the main focus of analysis, and arguably the most important empirical foundation, is the cross-national transactional linkages that firms in industrialised economies establish with their counterparts in the developing world. Using this view, a considerable number of studies have been devoted to analysing value chains in which the first group of firms (buyers in industrialised economies) tend to set the parameters for other participants in the chain (suppliers in developing countries) (Schmitz 2004).

How does the study of intra-cluster vertical linkages fit into this body of literature? Given the complexity and the multi-dimensional character of the context in which the Veracruz cluster is embedded, which local firms wield no influence over, I believe that the most important local determinant for enhancing competitiveness, at least for buyers, is the quality of relationships these firms have with PEMEX-Petrochemicals, the local supplier of inputs. The type of vertical relationship in the locality affects the competitive performance of firms. As the GVC approach provides the conceptual underpinnings to study the governance of transactional linkages between producers and buyers, at the international level, I contend that this line of reasoning offers an important framework for addressing the empirical evidence provided by the Veracruz cluster.

It is of great importance to remember that the development of the Veracruz cluster is embedded in the context of the complex political economy of Mexico. This environment, formed by a range of intertwined policies and economic junctures I label "external drivers of local governance"[27], has shaped not only the character of vertical linkages in the locality but also affects the upgrading possibilities for the entire cluster. That is to say, the prospects for state-owned and private petrochemical firms to boost competitiveness are rooted in the complex external setting. This statement serves to reiterate that this thesis focuses on analysing the trajectory of the Veracruz cluster and

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interested in the study of transnational production systems agreed to use the term global value chains (Gereffi et al. 2001). I will therefore use this term throughout the thesis.

[27] Such determinants are schematised in subsequent sections of this chapter.

the nature of local transactional relationships through the lens of the peculiar political economy of Mexico on the one hand and the global value chain approach on the other.

The aim of the present chapter is to therefore propose a framework based on key conceptual underpinnings of GVC theory in order to examine the transactional dynamics between PEMEX-Petrochemicals and the pool of local buyer firms. In so doing, it is necessary to bear in mind the role of *external* drivers in shaping governance in the locality. As to the operationalisation of the global value chain approach, the point to underline here is that this body of literature must not be underestimated with respect to determining the governance of vertical linkages in clusters that are not predominantly engaged in cross-national and/or buyer-driven relationships.

Even though the conceptual approach used in this thesis focuses on GVC ideas, it is important to concisely describe alternative schools of thought. The organisation of the chapter is as follows. It begins with a review on the competing approaches to industrial clustering such as the Marshallian industrial district, the growth pole concept, the new economic geography, industrial districts, and business studies. Here the intention is to illustrate the conceptual evolution of the topic over time. The discussion continues throwing light on a string of theories in which the role of the firm is central. The literature around networks of value, global production networks, local production systems, varieties of capitalism, and local governance serves to elucidate alternative views on how firms relate with each other and with associated institutions. The rest of the chapter concentrates on explaining the drivers behind the emergence of the GVC approach, core concepts of this school of thought, and how this is associated with the empirical evidence found in the Veracruz cluster.

INDUSTRIAL CLUSTERING IN THE LITERATURE

Scholars in the fields of geography, development studies, economics, business strategy, and regional science are increasingly interested in studying the geographical distribution of production. This academic trend is believed to have gained popularity as a result of globalisation of the world economy – a phenomenon that has led to firms and countries interacting in a competitive global environment. In the realms of scholarship and policymaking, the search for more effective mechanisms to shore up economic growth

and productivity soon became apparent. In this respect, the notion of industrial clusters represents a fascinating opportunity to reflect on the forces underlying competitiveness.

Nevertheless, the concept of industrial clustering is not recent and its origins can be traced back to Alfred Marshall's *Principles of Economics*[28], in which the author examined 'the concentration of specialised industries in particular localities' (Marshall 1959: 222). In reviewing the existing literature, it is evident that the work of Marshall is considered the first documented effort to explore the character of industrial agglomerations – an endeavour undertaken towards the end of the nineteenth century in England.

It is not until the 1950s that there was a noticeable increase in academic production on the subject, a process that has become even more pronounced over the course of the last two decades. Perroux (1955), Becattini (1990), Porter (1990), and Krugman (1991a, 1991b) are just some of the authors who have studied the factors leading to the clustering of economic agents in specific geographic areas. In all of these cases, the authors have adopted distinctive approaches that clearly respond to the economic circumstances prevailing at given times, leading to the emergence of an array of theories such as growth poles (Perroux 1955), industrial districts (Becattini 1990, 2004, Pyke and Sengenberger 1992), industrial clusters (Porter 1990), and new economic geography (Krugman 1991a).

At this point it is necessary to briefly describe these schools of thought in order not only to elucidate the theoretical and analytical evolution of the topic over time, but also to link particular characteristics of the Veracruz cluster to these ideas:

- The Marshallian industrial district

  Alfred Marshall, a British economist, first introduced the term industrial district in the tenth chapter of his *Principles of Economics*, in which the author discusses patterns of industrial organisation in nineteenth century England. Much of Marshall's interest was linked to the economic drivers of industrial districts with his analysis focusing on the 'fortunes of groups of skilled workers who are gathered within the narrow boundaries of a manufacturing town or thickly peopled industrial

[28] The *Principles of Economics* was first published in 1890.

district' (Marshall 1959: 225). Note that the author makes use of the term industrial district and associates it with the existence of a local system where the local community is at the core leading to the idea that economic determinants are as important as social contexts. On the one hand, this interaction demonstrates that both workers and firms are mutually beneficial since industrial districts are in a better position to compete with rivals by having access to a skilful workforce, which is determinant in attracting more firms into the locality. Workers also benefit as firms offer a constant market for their skills. On the other hand, the social component of the industrial district also implies that the local community includes channels that allow the dissemination of information. In view of this, ideas and values prevailing in the district may be reproduced and upgraded by community members (Marshall 1959).

That said, an industrial district is not only an agent that encourages the reproduction of capital, productive specialisation, and the division of labour; it also fosters the construction of social spaces in which individuals coexist and exchange information. However, one of Marshall's most significant contributions was to study the process of industrial clustering from a spatial approach, being aware of the fact that certain economic activities lie within the confines of bounded geographical areas containing a pool of skilful individuals (Marshall 1959). To a significant degree, this viewpoint continues to be valuable in contemporary debates.

- The growth pole concept

The growth pole concept is attributed to Alfred Perroux, a prominent figure in the French school of spatial economics. His paper *Note sur la notion de pole de croissance*[29] (1955) proved to be influential since it stimulated discussion on both sides of the Atlantic with regard to industrial organisation in the decades that followed (Lausen 1969: 137). The rationale of the growth pole was to interpret the nature of growth in a national economy from a local viewpoint. Perroux insists that industrial output is the force behind growth, which is at the same time associated with the performance of what he calls propulsive industries. Output from these industries is understood to expand at a faster pace and is capable of sending growth

[29] Note on the concept of growth poles.

waves across a broader economic landscape, that is, the national economy. Much of the allure of the growth pole concept lies in the fact that economic gains are transmitted through intra-firm input-output schemes, where the propulsive industry, by increasing its own output, has the capacity to foster output expansions in related sectors (Perroux 1955).

Despite the pioneering character of the growth pole concept, it was similarly recognised as being plagued by imprecision. For example, Perroux disregards the geographical sense of economic growth, but at the same time he appears to be aware of the spatial nature of productive activities (Semple et al. 1972). Lausen (1969: 13) underlines how the definitions of core concepts offered by Perroux are both imprecise and incomplete. Notwithstanding the conceptual shortcomings of Perroux, a considerable number of social scientists (Boudeville 1966, 1972, Lausen 1971, Penouil 1972, Petrella 1972, Parr 1965, 1973, Kuklinsky 1970, 1972, Buttler 1975, Paelinck 1975) sought to moderate the elusiveness of the theoretical guidelines of the French school of space economics and the concept of growth poles set the tone of the debate on spatial planning in the 1960s and 1970s.

- New economic geography

Even though the location of production is a pervasive feature of the world economy, economists overlooked the subject at least until the early 1990s. Krugman (1991a, 1991b), who attributed the latter to analytical gaps, created a collection of quantitative instruments based on the notions of increasing returns, imperfect competition, and transport costs. This set of analytical tools for the study of industrial agglomerations proved to be important in many respects. On the one hand, it offered a window of opportunity for the emergence of a genre of research commonly referred to as new economic geography (Krugman 1998). It also prompted a heated debate among geographers as to the scope of the discipline and the direction it was heading (Brulhart 1998, Amin and Thrift 2000, Martin and Sunley 2001, Yeung 2001). On the other hand, Krugman's analytical approach was well received by economists working on spatial topics to the point that the transport cost function is now standard practice in most new economic geography models (Eckey and Kosfeld 2004, Neary 2001, McCann 2005).

- Industrial districts

The literature on industrial districts is associated with the pattern of development that emerged in the centre-northeast provinces of Italy, where clustered small- and medium-sized companies comprise the main driver of the local economies. To a great extent, this form of industrial organisation drew the attention of scholars for two fundamental reasons. First, these regions helped Italy counterbalance the slowdown in economic growth experienced by other large capitalist countries for much of the last quarter of the twentieth century. Second, this slowdown in growth was thought to be rooted in the crisis of the Fordist industrial model. Consequently, the district concept was viewed as an 'alternative to this system of mass production and a way out of the crisis of Fordism' (Dunford 2006a: 5-6).

Becattini, an Italian political economist, was one of the early researchers who sought to formulate the theoretical underpinnings of the district. The author defines industrial districts as 'a socioterritorial entity which is characterised by the active presence of both a community of people and a population of firms in one naturally and historically bounded area' (Becattini 2004: 19). In a similar way to Marshall's nineteenth century remarks, Becattini also argues that firms are embedded in a geographical space where the local community is central. The existing literature regards the local community, and the cohesion of its constituents (people and institutions), as an important asset. The local community is viewed as the channel that facilitates the dissemination of values, which refers to widespread beliefs that individuals put into practice in all the main aspects of their lives such as work and the family. These value systems are perceived as 'one of the preliminary requirements for the development of a district, and of the essential conditions of its reproduction' (Becattini 2004: 20). In the absence of these beliefs, it is concluded that the district and the local community could be interpreted as two diminished, divergent entities revealing an area of socioeconomic stagnation (Becattini 2004: 20).

Regarding the social context in which industrial districts are embedded, Dunford (2006b: 28) argues that this factor has recently received substantial attention and has

'opened the way to a large literature dealing with the social, cultural, political and institutional foundations of the district mode'[30].

- Business studies

The issue of industrial clustering has also gained importance in the field of business studies. In addressing what makes particular countries (and firms) more competitive than others on the international scene, Porter (1990) argues that industrial clusters, which are defined as geographic concentrations of interconnected economic agents (companies, specialised suppliers, service providers, and associated institutions), constitute the driving force behind such phenomenon. The author developed an analytical framework claiming that local factors, that is, rivalry, demand, physical endowments, and supply networks, determine the extent of the competitive advantage of clustered firms (Humphrey and Schmitz 2000).

To varying degrees, the Veracruz petrochemical cluster possesses particular characteristics that may be associated with the above mentioned arguments. In clear reference to Becattini's remarks, for example, our case study is embedded in a system of values embraced by workers and union leaders as well as a sizeable proportion of the local community. This tends to be more prominent in the state-owned wing of the cluster where individuals have established mechanisms and strong links to protect each other's status quo. Union leaders have, for example, maintained their positions in the different constituencies of the oil workers' union and the local political scene despite claims of wrongdoing and lack of accountability. Likewise, certain workers' privileges and practices that could be subject to scrutiny continue to be widely tolerated. Nevertheless, the local system of values does have a more positive side as it has also fostered reproduction of the cluster. The emergence of specialised service providers is attributed to entrepreneurs whose technical skills, in many cases, were acquired in the cluster. All this suggests that the social notion of the industrial district concept is an attribute that may be present in industrial agglomerations regardless of the size of firms.

Furthermore, analysis of the dynamics leading to the establishment of the petrochemical industry in the 1960s and 1970s (Snoeck, 1986: 46) suggests that policy makers may

[30] For a more detailed discussion of industrial clusters, see, for example, Pyke et al. (1990), Pyke et al. (1992), Becattini et al. (2003).

have established petrochemical complexes in southern Veracruz on the basis of the concept of growth poles[31]. Additionally, if one considers the output-input scheme depicted in Figure 2.2, it is possible to link the assumptions of Perroux to empirical evidence concerning the Veracruz cluster. One basic correlation is the forward linkages between local firms and user industries located elsewhere. Given that the petrochemical industry yields value chain precursors, it can be concluded that the Veracruz cluster possesses the capacity to generate output growth waves throughout an extensive economic hinterland.

When reviewing the evidence for this case study it becomes clear that it possesses many of the attributes of industrial cluster theory. Nevertheless, the question remains as to why this body of literature does not form the cornerstone of the conceptual framework being constructed in the present chapter. There are two fundamental reasons why this approach is not used. First, it is claimed that 'the combination of rivalry and co-operation between local enterprises and the partnership of public agencies and private organisations in supporting local enterprises' are factors that help strengthen the competitive advantages of localities (Schmitz 2004: 2) and there is widespread consensus in scholarly circles on this point, as the contributions of Bazan and Navas-Alemán (2003), Pietrobelli and Rabelloti (2006), and Gomes (2006) illustrate. It therefore becomes apparent that the theory of clusters places a great deal of emphasis on horizontal linkages and does not problematise vertical inter-firm relationships. In relation to the development of the Veracruz cluster, evidence indicates that the weight of vertical co-operation outstrips that of horizontal relationships and that the quality of the former is at best questionable. The second reason to take into consideration is that the work on industrial clusters is much less enthusiastic about theorising the governance structure of output-input transactions in the locality[32] and in fact 'plays down public governance issues', as Humphrey and Schmitz (2000: 7) claim. In reviewing empirical studies of vertical linkages in the existing literature, it turns out that while the emphasis is on how such relationships help firms in developing country clusters respond to structural changes (Rabelloti 1999, Nadvi 1999), little if any attention is paid to the prevailing type of governance structure. Given that this thesis focuses on the co-

[31] During this period, United Nations offshoot offices in Latin America were particularly enthusiastic about the dissemination and study of growth pole policies in the region (Boisier 1974).

[32] While vertical relationships in developing country clusters have been documented, it appears that much of the focus is on inter-firm subcontracting arrangements associated with the production of final goods in labour intensive sectors, as in the work of Nadvi and Schmitz (1994).

ordination of transactional linkages between state-owned petrochemical complexes and local private petrochemical firms, rather than on horizontal relationships, the theory of industrial clusters is unable to provide the theoretical keystones required by the discussion.

In a similar tone, despite the rest of the schools of thought, that is, growth poles, industrial districts, business studies, and new economic geography, have greatly contributed to widening our understanding of industrial agglomerations, what must be pointed out with respect to the Veracruz cluster - and considering the concise descriptions above presented - is that they are unable to provide the conceptual underpinnings for addressing the main empirical feature of our case study: the nature of vertical transactional linkages between suppliers and buyers of industrial inputs. That is why the conceptual framework developed in subsequent sections of this chapter has played down this wealth of literature.

This does not mean that the global value chain approach is not linked to any of the academic works here mentioned. On the contrary, it can be argued that these may overlap when it comes to dealing with industrial clusters dynamics. For example, Humphrey and Schmitz (2000) demonstrate that the notion of industrial clusters is somewhat connected with the global value chain approach since the intersection of both permits to elucidate the ‘interaction of the local and the global in industrial clusters in developing countries (Humphrey and Schmitz 2000: 3). In that respect, some scholars such as Pietrobelli and Rabelloti (2006) have effectively combined concepts of the theory of industrial clusters with arguments of the global value chain approach to determine the prospects of developing country firms to compete globally.

ALTERNATIVE ANALYTICAL APPROACHES

In addition to the conceptual frameworks described above, it is worth reviewing other schools of thought that are in some measure related to the empirical evidence presented in this thesis. For example, the literature around networks of value (Smith et al. 2002) and global production networks (Henderson et al. 2002, Coe et al. 2004) hold certain similarities with respect to the global value chain approach in that both also aim at capturing and elucidating the ways by which globalisation of the world economy has contributed to determining the spatial configuration of production. Furthermore, these

two alternative approaches appear to converge in considering that the set of inter-firm relationships leading to the production of final goods or services is influenced by different economic actors and embedded in a context of multidirectional relationships. Both need further illumination.

In a more specific account, the notion of networks of value aims at exploring how increasing degrees of integration and interdependency within macro-regional economies (North America and Europe) on the one hand and within the world economy on the other have accelerated the appearance of diverging/converging patterns of production and the geographical distribution of value added economic activities (Smith et al. 2002: 41). At the centre of the debate is the notion of flows of value, or rather how value is reproduced, distributed, and appropriated by different actors situated in different locations. A number of scholars consider that, if this question is to be addressed, attention must be paid to those drivers lying behind such processes, that is, state governance, labour organisation, corporate practices, among others. Although this approach acknowledges that 'commodity chains' - understood as a 'network of labour and production processes whose end result is a finished commodity' (Hopkins and Wallerstein 1986: 159) - are instruments through which value can be transmitted, it claims that 'commodity networks' – which encompass the drivers mentioned above – are structures that encapsulate a broader range of instruments allowing for the reproduction, distribution, and appropriation of value. This string of literature therefore claims that by concentrating on networks of value the reconfiguration and (unequal) dispersion of production in macro-regional economies can be better discerned (Smith et al. 2002).

Likewise, the concept of global production networks (GPN) is similarly worth appraising. In addressing the distribution of production within an increasing globalised context of development, this strand of work contends that it is necessary to move beyond a firm-centred analytical approach and embrace a network-focused approach. This fundamentally claims that analysis of production activities must incorporate the set of (horizontal, vertical, and diagonal) relationships that economic actors (firms, governments, consumers, labour and trade unions and so on) establish with one another within different geographical scales (Henderson et al. 2002, Coe et al. 2008). Cross-national value-adding activities, or rather global production networks, are therefore

viewed as being deeply rooted in a broad variety of globally organised 'nexus of interconnected functions and operations by firms and non-firm institutions through which goods and services are produced, distributed and consumed' (Coe et al. 2004). From this perspective, it is maintained that the GPN framework allows for transnational production systems to be analysed in such a way that it captures the degree of complexity, broad geographical scope, and multidirectionality of transnational dynamics among different economic players (Henderson et al. 2002, Coe et al. 2008).

The question that arises is: how industrial clusters are perceived by these both analytical frameworks? In relation to networks of value, industrial clusters can be interpreted as sub-national structures in which economic agents (firms, organised or unorganised labour and supranational, national, and local states) contribute to creating and transmitting value (to a much wider economic hinterland) through participating in macro-regional commodity chains (Smith et al. 2002). The global production networks approach similarly distinguishes such global-local interplay. Coe et al. (2004: 471), for example, assert that 'firm-centred production networks are deeply influenced by the concrete socio-political context within which they are embedded', where industrial clusters are one territorial manifestation of this.

For the purpose of this thesis, these two schools of thought (networks of value and global production networks) carry a limited utility from a spatial and analytical perspective. Both approaches concentrate on the one hand on the global-local interplay of production networks, while the main dimension of analysis in this thesis relates to intra-cluster dynamics between suppliers and buyers, paying significant attention to local drivers that shape governance structures and strengthen transactional dependence. Furthermore, both frameworks consider that articulation of value-adding activities is as important as the networks in which they are embedded, where (horizontal, vertical, and diagonal) relationships between firms and other economic actors are observed. In the case of the Veracruz cluster, however, the weight of horizontal relationships is weakened by the disproportionate degree of power PEMEX-Petrochemicals wields over the rest of the actors.

Additionally, it can be argued that the operationalisation of the global production network paradigm can be rather useful when studying the external linkages of the Veracruz cluster. But the analysis on the nature of relationships that state-owned and

private firms hold with external users lies outside the boundaries of this thesis. This issue was not addressed as it would have demanded more resources (beyond existing capabilities) to investigate the constellation of value chains that local firms serve and the production of final goods (of petrochemical origin) which involves two or more subsequent value-adding activities (located elsewhere) down the chain.

Another body of literature that offers important insights is that of local production systems. This is an approach that pays attention to small- and medium-sized firms (SMEs) embedded in economic activities concentrated on geographical localities. One key concern of this work is to illuminate how changing economic systems in advanced economies, that is, the decline of traditional industries like steel and the emergence of high-tech economic activities like information technologies, influences the behaviour of firms and the way they relate to each other as well as the governance of local economies. Since different responses (summarised in the form in which SMEs are organised: industrial districts, networked firms, empirical agglomerations) have been found across different settings, the point to highlight is that the role of small- and medium-sized firms in production systems continue to be fundamental (Crouch et al. 2004).

Turning now to the arena of comparative political economy, the work on varieties of capitalism deserves particular consideration. This approach served to underline that the market-orientated framework advanced by the United States and other western economies prevailed over the communist ideology championed by the Soviet Union. While some viewed capitalism as the predominant model of economic development, other specialists such as Albert (1991) began to point out the existence of two competing branches of it: ‘a socially co-ordinated [capitalist] model typical of continental Europe and the classical neoliberalised path of the Anglo-American countries’ (Peck and Theodore 2007: 732). A similar interpretation of capitalism was given by Soskice (1990, 1991) who made a distinction between ‘co-ordinated market economies (like Germany, Japan, Sweden, Austria, and Norway) and the liberal market economies (modelled on the USA, but also including the UK, Canada, and Ireland)’ (Peck and Theodore 2007: 736). The traditional perspective of this body of literature concentrates on comparative institutional advantages chiefly in developed economies, or rather on exploring the extent to which varying social and institutional foundations

across developed countries can shape the structure and dynamics of different national models of capitalism and, by extension, determine the specialisation and the trajectory of national economies (Dunford 2011: 24). Almost in parallel, on the American side of the Atlantic a string of ideas on industrial governance materialised under the rubric of varieties of capitalism, shedding light on how the institutional configuration of the U.S. economy influenced the behaviour of firms and the governance of relationships among actors (Campbell et al. 1991, Hollingsworth et al. 1994). In a neo-liberal economy like that of the United States, it comes as no surprise that the government was not accorded a 'privileged economic position' (Lindberg et al. 1991: 31), thus playing an 'outsider role' in the governance arrangements put in place, as illustrated by Peck and Theodore (2007: 767). Conversely, the firm, along with external institutions shaping the organisation of production, is the player situated at the centre of the discussion (Hall and Soskice 2001).

Although this wealth of literature is relevant for the study of inter-firm relationships on the one hand and institutional advantages on the other, the operationalisation of concepts in relation to analysis in this thesis seems to be narrow. First, the work on varieties of capitalism, as widely recognised, seeks to understand how firms and institutions collaborate not only in different globalised settings, but also in contexts of highly developed markets – a perspective that is also characteristic of the concept of local production systems described earlier. The Veracruz cluster, on the contrary, is deeply rooted in and influenced by a complex and fairly adverse developing country setting, as discussed in Chapters 5, 6, and 7 of this thesis. And these empirical features differ from the logic of analysis proposed by these alternative approaches.

As regards industrial governance, two fundamental restrictions are distinguished. The first is that the participation of the state is restricted to the setting of rules for encouraging inward investment and competition among firms so that most of the decisions are made by the firm, or rather market forces. This perspective widely differs from how the state participates in the development of the Veracruz cluster. In the case of the Veracruz cluster, for example, the state is an agent who exercises a disproportionate degree of control over inter-firm relationships through ownership of economic units (PEMEX-Petrochemicals). The second limitation is that even though governance structures are contextualised within 'a matrix of interdependent social exchange relationships that occur among organisations... [...] a wide range of

interdependent actors, including producers and suppliers of raw materials, researchers, manufacturers, distributors, and many others, who must routinely solve various problems, such as raising capital, setting wages, standardising products, and establishing prices in order for economic activity to continue' (Campbell 1991: 6), this body of literature fails to develop the *captive* type of relationships that prevail in southern Veracruz.

Beyond the developing country context in which the Veracruz cluster is embedded, what is seems to be more important in limiting the applicability of arguments here reviewed is the peculiarities of the national economy. While Mexico instrumented policies that allegedly functioned in advanced economies, Mexican policy makers assumed that these could be replicated despite differences in the national (economic, political, and institutional) configuration. The operationalisation of this array of approaches in the case of the Veracruz cluster is, to a significant degree, constrained by the concerns they aim to deal with and the empirical evidence this thesis is concerned about: the trajectory of the Veracruz petrochemical cluster and the governance of vertical transactional relationships.

MAPPING GLOBAL TRANSACTIONAL LINKAGES

In the post World War II period, opposing sets of economic strategies were adopted by a significant number of developing countries. In Latin America, the largest economies accelerated the implementation of inward-looking development policies. This economic model entailed the erection of barriers to trade and the hindering of competition from foreign firms with the aim of fostering the development of infant industries heavily orientated to meeting domestic demand for goods[33]. Several Asian countries, however, opted for a different path to industrial development and created an economic model in which linkages to external markets were at the core.

As several countries either abandoned inward-looking development strategies or further accelerated internationalisation of their productive structures, principally over the last three decades, there was a profound shift in the configuration of the world economy. Not only is the resulting increase in cross-national mobility of goods, individuals, and

[33] As contextualised in Chapter 5, this approach helps to explain why the Veracruz petrochemical cluster, which can be traced back to the 1960s, is at present heavily orientated towards the domestic market.

services one of the many faces of the globalisation of the world economy, the spatial dispersion of manufacturing activities, as a result of the insertion of the economic structures of less advanced countries into global production networks, is similarly one of the most obvious attributes of today's world economy.

The latter did not go unnoticed in academic circles. In the contemporary context of development, the need to understand the globalisation of production led to the emergence of the notion of global value chains which is defined as the sequence of cross-national value adding-activities required to bring a product or service from conception to final consumers and on to recycling (Gereffi et al. 2001, Sturgeon 2000, Kaplinsky 2004). The concept of GVC is based on the contributions of Gereffi (1994), who in his influential paper "The organisation of buyer-driven global commodity chains: how U.S. retailers shape overseas production networks" identified the mechanisms through which large U.S. apparel and marketer firms became a driving force serving to determine production structures in East Asian economies. While the focus of the analysis is on buyer-driven chains, in which brand marketers and retailers from developed countries (the buy end of the chain) tend to determine the parameters of the production process that supplier firms in the developing world must comply with, Gereffi also emphasises that the co-ordination of activities along the chain is a perspective that had attracted little if any attention up until then. The author claims that a fundamental dimension of global value chains is the governance structure; or rather the mechanisms through which such authority and control are exercised by buyer firms (Gereffi 1994: 97).

As it soon became apparent that the manner in which cross-national inter-firm linkages are co-ordinated has repercussions for firms from developing countries, the value chain approach drew the interest of scholars and a sound body of literature promptly emerged. Recent empirical studies on buyer-driven global value chains have considerably broadened our understanding on how gains reaped from engaging in global production and distributions networks are distributed among participants (Kaplinsky 2001) and the extent and nature of the co-ordination of activities in transnational production processes (Gereffi 1999, Dolan and Humphrey 2001, Bazan and Navas-Alemán 2003).

GOVERNANCE IN VALUE CHAINS

Is the value chain approach adequate for the analysis of intra-cluster transactional linkages? This point may be thought-provoking in the strict sense of what the theory stipulates. However, while value chain analysis chiefly focuses on buyer-driven cross-national relationships, within the Veracruz cluster inter-firm relationships are producer-driven and shaped by a complex economic, institutional, and political environment. Even though the operationalisation of the concepts of governance and upgrading may be open to discussion, what is certain is that the GVC approach establishes the guidelines for distinguishing and understanding the type of linkages in the locality and helps identify possible upgrading scenarios in the existing aggregate environment. To this end, it is first necessary to elucidate what governance is and how existing studies link it to the concept of upgrading in developing country clusters.

Core theoretical building blocks of the GVC approach

In the current context of development, in which countries and firms coexist in a more competitive environment, the crafting of more effective mechanisms to shore up productivity and growth is central to policy making (Humphrey and Schmitz 2002). Trade liberalisation, for example, is one fundamental policy through which developing countries have attempted to cope with the challenges and opportunities brought by globalisation of the world economy. Firms from industrialised countries, alternatively, have sought to increase their competitive edge by farming out manufacturing activities to low cost countries. Both trade liberalisation and outsourcing are phenomena that have gained momentum recently, creating strong ties between less advanced countries and the industrialised world. It is increasingly acknowledged that trade is not only bolstered through the transnationalisation of companies since the establishment of transactional cross-border linkages between legally independent firms has also come to play a significant role, as Humphrey and Schmitz (2004: 96) have long asserted.

The mechanisms through which activities along transactional cross-border relationships are co-ordinated, the type of relationships that are formed when firms engage in global production networks, and the implications of these relationships for upgrading in developing country firms are among the main issues the GVC approach seeks to address. All in all, it is the governance structure of such transactional cross-border

linkages that is at the centre of the discussion for, as explained by Gereffi (1994: 97), the notion of governance refers to the 'authority and power relationships that determine how financial, material and human resources are allocated and flow within a chain'.

The question that subsequently arises concerns which player exercises this authority. In this respect, Gereffi (1994: 97) distinguishes two prevalent types of value chains; those driven by producers and those in which buyers rule the transactions. It is maintained that the former is associated with large multinational firms that control the production system[34] and that this is characteristic of capital- and technology- intensive industries such as automobiles and computers. In buyer-driven chains, in contrast, authority is exercised by large retailers, brand-named merchandisers, and trading companies whose role in the chain is to focus on 'the highest value-added segments' such as 'innovation, product design, and marketing' (Gereffi et al. 2005: 79). This type of chain is commonly identified with labour intensive and consumer goods industries (Gereffi, 1994: 97).

A widely acknowledged case that serves to demonstrate both the above mentioned definition and the nature of buyer-driven chains is the influence of UK supermarkets on the structure of the horticultural industry in Kenya and Zimbabwe. Dolan and Humphrey (2001: 147) discovered that large retailers not only possess the authority to indicate the requirements (quality, cost, type of product) to be met by producers, they also decide which producers are allowed to enter the supply chain. To a great extent this case reflects the prevalent pattern of transactional relationships that firms in developing countries establish with their counterparts in advanced economies.

Given that similar conclusions are drawn from a wide range of studies on labour intensive industries, it is evident there is a widespread uncontested consensus claiming that the concept of governance is undoubtedly associated with the manner in which control is exercised over chain participants. This situation raises the question as to what determines the co-ordination of upstream activities, or the role of participants in the chain. Once more, the existing literature appears to agree on this point. It is contended that the lead firm, or buyer, coordinates the different value-adding activities through a set of parameters that essentially determine: i) what is to be produced (product design

[34] In this sense, Humphrey and Schmitz (2001: 22) further elaborate on this idea. The authors conclude that the locus of authority lies in the fact that producers 'control key product and process technologies'.

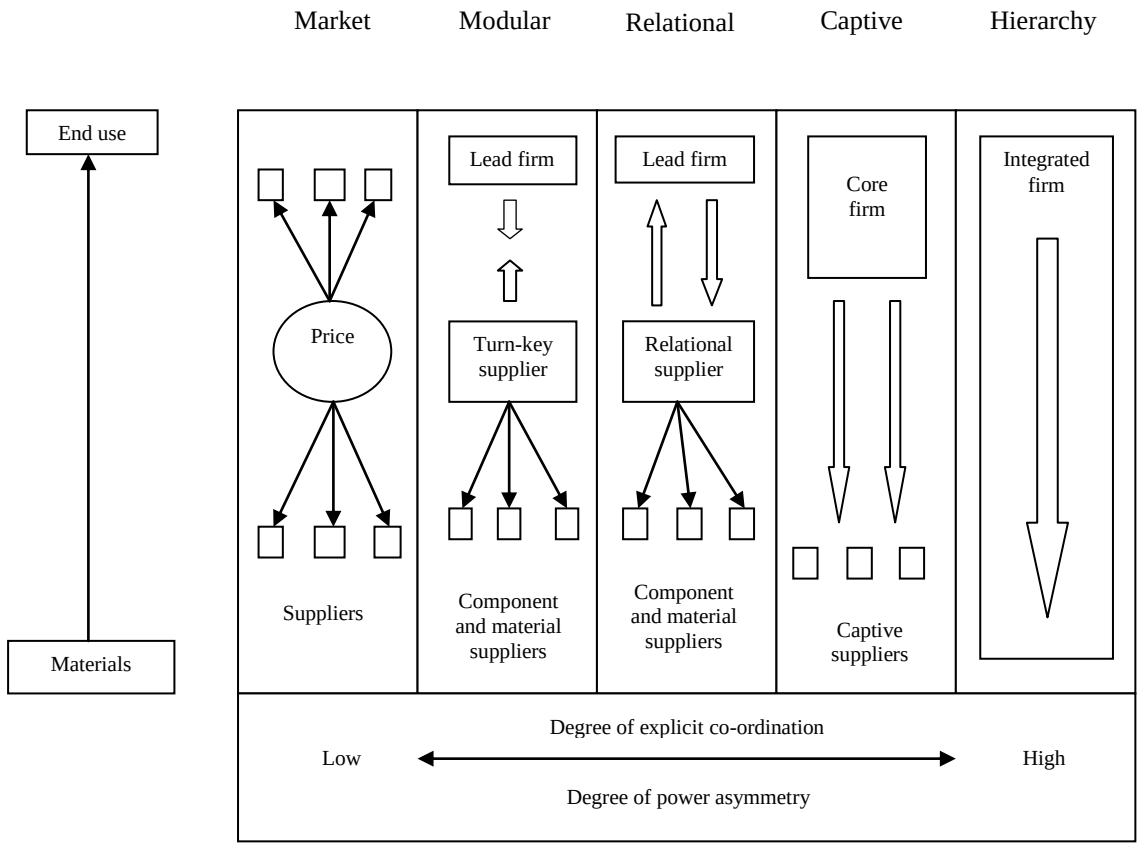
and specifications), ii) how it is to be produced (the technology to be used, the quality systems to be employed, and the labour and environmental standards to be complied with), and iii) how much is to be produced and when (production scheduling and logistics). In this way, governance becomes a concern as the lead firm seeks to enforce compliance with these parameters since they indicate the course of action to be taken by the remaining players in the chain. The conclusion derived from the latter postulation is that governance refers to the quality of relationships between firms in the chain and the mechanisms (practices, values, codes of conduct) that determine the non-market co-ordination of value-adding activities (Humphrey and Schmitz 2001: 21-22).

With respect to the nature of relationships in buyer-driven chains, it is noticeable that this is to some extent influenced by the ability of suppliers to meet the demands set by the lead firm. As these abilities vary from case to case, value chains display different governance structures. In the first instance, Humphrey and Schmitz (2000: 15-16) indicate that governance takes the form of *network* relationships (co-operation between buyer and supplier is on fairly equal terms), *quasi-hierarchy* (the buyer wields a high degree of control over the relationship since the supplier lacks the abilities to meet the requirements of the production process), and *hierarchy*, (operations on the supply end of the chain are owned and controlled by the buyer). But chain governance continued to evolve as indicated by a wealth of empirical studies. In response, Gereffi et al. (2005: 83) crafted an even more comprehensive analytical framework that resulted in the categorisation of five patterns of governance. The contribution of the new conceptualisation was to further specify the different types of network relationships, that is, *modular*, *relational*, and *captive*. *Market* and *hierarchy* governance continued to be at both ends of the spectrum (Figure 3.1).

In constructing this analytical framework, Gereffi et al. (2005: 83-87) incorporated three types of determinants that help outline the possible modes of inter-firm co-ordination. The first is the *complexity of transactions*, which basically refers to the flow of information and knowledge needed to undertake a particular transaction. The second determinant is the *ability to codify transactions*. More specifically, firms can reduce the degree of explicit co-ordination through the design and application of technical and process standards that facilitate the interpretation of product specifications. The third

factor is *capabilities in the supply-base*, which elucidates the competences of suppliers in relation to the requirements of the transaction.

Figure 3.1 Types of governance structure



Source: Taken from Gereffi et al. (2005).

Based on these determinants, the authors conceptualised five types of governance:

- Market: this involves inter-firm relationships mostly associated with the production of standardised products, where the cost for firms to switch partners remains low. This type of governance arises when product specifications are easily codified and the supplier is able to meet the requirements placed by the lead firm.
- Modular: as products become more sophisticated, the complexity of the transaction increases. The supplier, however, possesses the capabilities to interpret product and process specifications with little if any explicit co-ordination with the buyer. In this form of governance, the supplier is also

capable of providing 'turn-key services', which greatly reduce the need for monitoring by the buyer. The cost of switching is low for both players.

- Relational: as the high capabilities of the supplier problematise the development of technical and process standards, the relationship with the buyer tends to be complex. The exchange of tacit information implies high degrees of explicit co-ordination and asset specificity, which at the same time leads to mutual dependence. For instance, the cost of switching partners is viewed as high.
- Captive: a high level of transactional dependence characterises this type of inter-firm co-ordination. As the supplier firm lacks the capabilities to interpret the complex codification of process and product instructions, a great deal of intervention on the part of the lead firm is needed. Since the buyer invests to help the supplier enhance competences, the latter is locked into relationships that significantly increase the cost of exiting the chain. The degree of power asymmetry is high.
- Hierarchy: given that products are highly sophisticated, competent suppliers are not found. The firm is therefore compelled to develop in-house capabilities. This type of governance fundamentally refers to vertically integrated firms.

All things considered, it is important to point out that the form of inter-firm co-ordination this thesis mostly focuses on is that of *captive*. Local buyer firms in the Veracruz cluster are locked into transactional relationships that greatly discourage the switching of suppliers. Nonetheless, before attempting to operationalise the captive mode of inter-firm co-ordination in relation to the vertical linkages in the locality, it is necessary to demonstrate how governance structures and upgrading are linked. In doing so, a brief review of the literature on developing country clusters is given below.

Governance and upgrading in developing country clusters

The point to underline in this section is that the way cross-national linkages are co-ordinated is an issue deeply intertwined with the prospects for firms to upgrade, particularly in the case of suppliers (Bazan and Navas-Alemán 2003: 3). Humphrey and Schmitz (2002: 1020) acknowledge that there are three main approaches to upgrading, namely: *process* (firms transform inputs into outputs in more efficient manners), *product* (moving into more sophisticated product lines), and *functional* (firms move downstream to carry out higher value added activities such as design and marketing.

In a book edited by Pietrobelli and Rabelloti (2006), several studies on clusters and value chains in Latin America further illustrate how the upgrading prospects for firms are associated with the type of relationship (governance) that determines the participation of firms in value chains. Artola and Parrilli (2006), for example, examine a dairy products cluster in Nicaragua and the authors contend that small- and medium producers have managed to upgrade *production processes* and *move into more profitable activities* as a result of engaging in cross-national value chains. Similarly, Maggi (2006) studies the development of the salmon cluster in southern Chile which offers an example of how globalisation serves to encourage different types of upgrading for firms. While during the first two stages of development of the cluster (initial learning and maturation) upgrading was the result of co-operation with local public institutions and joint action, respectively, in the third phase of development, in which salmon producers became more orientated to serve external markets, upgrading materialised in the form of undertaking *more sophisticated value-adding activities*.

Furthermore, studies such as that conducted by Bair and Gereffi (2001) in the Torreon blue jeans cluster exemplifies the evolution that local productive structures undergo as a result of engaging in value chains of cross-national dimensions. The authors examine the evolution of an industry whose external linkages were limited at a time when trade between Mexico and the United States faced restrictions. As the two countries, along with Canada, signed the North American Free Trade Agreement (NAFTA) in 1994, the cluster drew the interest of U.S. lead firms. The paper argues that one of the features that best describes the evolution of the Torreon cluster is precisely the linkages that local companies established with U.S. brand marketers (Levi's, Wrangler, Polo, Calvin Klein, Liz Claiborne, Old Navy, Donna Karan, Guess, Chaps, among others) and retailers (Gap, K-Mart, Wal-Mart, JC Penney, Sears, Target, etc.) in the wake of trade liberalisation. Upgrading at the local level occurred as suppliers introduced production standards enforced by U.S. firms, which at that time 'began to change their sourcing and production networks to take advantage of new activities gradually liberalised under NAFTA' (Bair and Gereffi 2001: 1894). According to the authors, this led Torreon firms to move *from assembly activities* to *more value added ones*.

A study that also claims the scale of upgrading is determined by the type of relationship firms are engaged in is that of the Sinos Valley footwear cluster in Brazil. Bazan and

Navas-Alemán (2003) analyse the value chains in which local firms participate and how particular governance structures encourage (and limit) certain upgrading patterns. Relationships with U.S. buyers, for example, fall into the category of *quasi-hierarchy*, which favours high degrees of *process* and *product* upgrading but holds back the prospects of firms to perform other chain functions (*functional* upgrading). In the case of European buyers, who are also identified as chain governors, the evidence indicates that the form of co-ordination tends to be less hierarchical in comparison to the U.S. chain, thereby broadening the spectrum for upgrading. Local firms also feed into domestic and Latin American chains where relationships are *market-based*. Local firms in these chains undertake more value-added functions such as marketing, design, and branding (*functional* upgrading); although quality gains derived from *process* and *product* upgrading tend to be outperformed by those in more hierarchical linkages.

Drawing on these empirical studies, there is no doubt that the way inter-firm transactions are governed greatly influences the upgrading prospects of firms. At the same time, one can also incorporate the roles played by the capabilities of the supply end and the demands of the buyer. Concerning the latter, the Veracruz cluster poses fundamental questions. Do buyer requirements drive the performance of producers and the supply of inputs? Do producers contribute to enhancing capabilities on the buyer end? The following section responds to these questions.

GOVERNANCE IN THE VERACRUZ CLUSTER

It has previously been underlined that one of the two central subjects of discussion in this thesis is the nature of vertical linkages between PEMEX-Petrochemicals and local buyer firms. In this section, I attempt to relate the *captive* type of governance that GVC literature sets out to the characteristics of vertical transactional relationships in the locality. In doing so, I explain the extent to which local buyer firms are transactionally dependent on state-owned petrochemical complexes.

The other central subject of analysis in this thesis is the complex, multi-dimensional, aggregate context that has shaped the development of the Veracruz cluster in recent decades. This section is therefore also devoted to mapping out the external determinants of local governance.

Captive governance - transactional dependence in the locality

The evidence embodied by this case study indicates that buyer firms are locked into *captive* relationships with producers. This form of local inter-firm co-ordination, however, may not fully address what the GVC literature claims with regard to *the complexity of transactions, the ability to codify transactions, and the capabilities in the supply-base.* Instead, it highlights that buyers are *captive* due to a number of factors rarely contemplated in value chain analysis. Of these, the regulations established by market-friendly governments in the 1980s and 1990s, the fact that PEMEX-Petrochemicals is the only producer and supplier of several inputs, the state-owned nature of the producer, the hazardous nature of petrochemical inputs, and the capabilities on the buy end stand out. For instance, I must briefly contextualise the nature of the relationships between PEMEX-Petrochemicals and local buyer firms.

Up to the mid-1980s, the policy framework with regard to hydrocarbon resources favoured industrialisation under the tutelage of the state. PEMEX was therefore granted the exclusive right to produce and market a large number of value chain precursors. With the liberalisation of the economy in the 1980s and 1990s, the government decided to deregulate the sector and permitted the participation of the private sector in the production of those basic petrochemical inputs that were once reserved for the state. This policy failed as private firms did not establish new production facilities and output fell. As a result, PEMEX-Petrochemicals continues to be the only domestic supplier of a sizeable number of inputs. Drawing on data provided by the Asociación Nacional de la Industria Química (ANIQ 2008), the association that brings together most of the chemical and petrochemical firms in Mexico, and fieldwork findings, PEMEX-Petrochemicals is the only domestic producer of ammonia, ethylene, ethylene oxide, vinyl chloride, methanol, styrene, paraxylene, acrylic nitrile, high-density polyethylene, and low-density polyethylene, among other compounds. All of these feed the industrial processes carried out by local buyer firms. Therefore, one of the most detrimental consequences of this situation is that most private firms in the Veracruz cluster are heavily transactionally dependent on PEMEX-Petrochemicals.

The predicament of limited sourcing alternatives in the Veracruz cluster is exacerbated by the fact that the role of PEMEX-Petrochemicals as a reliable supplier is questionable. First, it is widely recognised in the locality that prices of inputs supplied by state-owned

firms are not competitive and that the quality is considered standard. Second, the erratic supply of inputs is further aggravated as the production of certain raw materials has ceased over the course of the last decade or so. Environmental regulations, the lack of national demand, and the alleged obsolescence of industrial processes are arguments used by policy makers to justify such divisive decisions (Rey Roman 1996). In these circumstances, buyer firms are forced to source inputs elsewhere. Third, buyer firms tend to schedule maintenance works in parallel to those at state-owned petrochemical plants. The problem arises when the completion of works at PEMEX takes longer than initially estimated – a common problem. As supply is interrupted for longer periods, buyer firms are obliged to either remain shut until production on the supply end restarts or import raw materials. Fourth, using a much broader perspective, the availability of primary inputs is also influenced by the constitution of the energy matrix of the country and the international price of crude. In recent years, the use of natural gas to generate electricity has sharply increased. With respect to crude, the government favours exports with the intention to capitalise on high prices. As the amount of natural gas and naphthas (crude) destined to be processed at state-owned petrochemical plants is put at risk in the light of these scenarios, the production of certain petrochemicals is hampered.

By and large, these circumstances lead us to reflect on the rigidity of vertical relationships between participants in the Veracruz cluster. Building on the arguments presented by Gereffi and other scholars (2005), the rigidity of output-input linkages in the locality is associated with the ease for local buyer firms to switch suppliers. Given the shortcomings on the supply side, it can be deduced that private firms in the Veracruz cluster may seek suppliers elsewhere. Given the extent of trade liberalisation of the national economy and the spatial proximity to the northern coast of the Gulf of Mexico, where ‘the largest, most modern and most successful collection of petrochemical plants of the world’ is situated (Gilmer et al. 1999), the logical alternative would be to import raw materials from Texas and/or Louisiana. It is worth mentioning that this is generally the case for buyer firms that have been affected by the cessation of specific production lines at PEMEX-Petrochemicals, as noted above. But the allure of sourcing raw materials from abroad weakens when these can be obtained locally since to a certain extent local buyers find it more convenient to maintain PEMEX-Petrochemicals as their supplier. So, what prevents buyer firms from switching suppliers? The answer lies in the

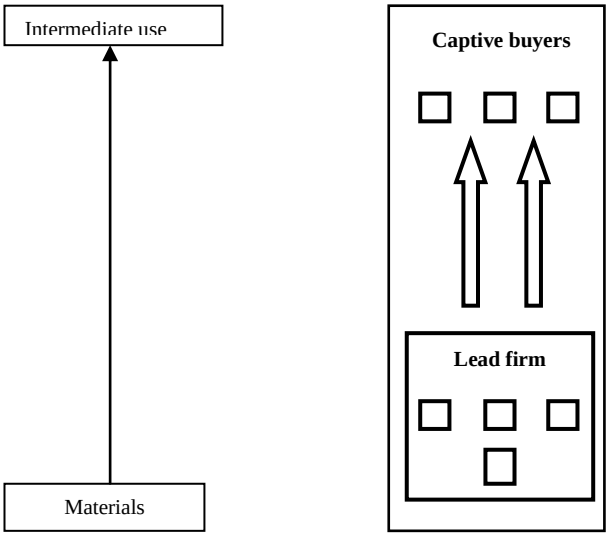
hazardous nature of petrochemical inputs and the capabilities on the buy end. In addition to PEMEX-Petrochemicals being state-owned, these determinants help us understand why transactional linkages in the Veracruz cluster are producer-driven as well as the *captive* nature of buyers.

If a buyer firm decides to source inputs from abroad, it is expected to possess certain capabilities to undertake the activities that the import of hazardous materials involves. The import of petrochemical inputs requires firms to consider transport logistics and the organisation of a consumption schedule. How much of a particular imported input is needed to feed the production process of the buyer firm throughout an estimated period of time? To make the import of inputs economically viable the firm must take into consideration, for example, that the amount imported (normally transported by sea) is sufficient to guarantee the running of the firm's plants for a given period. This is a concern that must be addressed carefully. The planning of how much is imported and how much is consumed is usually less complex when the firm possesses storage facilities since cargo can be offloaded and transported to the firm. However, when the buyer lacks storage infrastructure the alternative is to charter storage facilities at the port of Coatzacoalcos and devise a consumption program in conjunction with the service provider. This entails transporting a certain quantity of the imported input from the service provider storage facility at Coatzacoalcos to the firm's plants in accordance with a pre-determined consumption program. It is worth pointing out that most buyer firms in the locality do not own storage facilities due to the fact that when investors established plants in the locality PEMEX-Petrochemicals was a more trustworthy supplier and the idea was for PEMEX to provide inputs over short distances through the use of pipelines, rail, or specialised road transport. Since the company was able to guarantee a consistent supply, buyer firms did not consider investing in storage infrastructure. However, bearing in mind that PEMEX has become a less trustworthy supplier, the point to highlight is that the import of inputs is at times more appealing for the buyer firm than sourcing raw materials from PEMEX-Petrochemicals despite the logistical implications since U.S. suppliers offer price concessions based on how much is shipped while PEMEX-Petrochemicals fails to extend such benefits to local buyers. All in all, what must be underlined is that price is not necessarily the most important determinant since firms also take into consideration the hazardous nature of petrochemical inputs. The transport of petrochemical inputs entails a risk not only for

the buyer firm and the carrier, but also for the communities the input is transported through and the individuals associated with the procedure, not to mention the environmental risks in the case of an industrial disaster. Together, these factors force buyer firms to insure cargo and, even when prices in the locality are arguably less competitive than those offered by U.S. suppliers and the quality of local inputs is considered standard, buyer firms are keen to source inputs from PEMEX-Petrochemicals. At first glance, one may infer that the rigidity of linkages between state-owned petrochemical complexes and local private petrochemical firms may be loosened by the price factor. However, what in the end appears to shape the scope of transactional dependency, in addition to PEMEX being the only domestic supplier, is spatial proximity (the fact that inputs are transported over a distance for which risks can be minimised and supply delivered promptly), capabilities on the buy end (the lack of storage facilities), and the hazardous nature of petrochemical inputs.

It is in the latter setting that the prevailing form of governance in the Veracruz cluster can be conceptualised as *captive.* Nonetheless, distinctions must be made. While the analytical framework set out by Gereffi et al. (2005) draws on cross-national buyer-driven linkages, the empirical evidence given above indicates that local relationships are supplier-driven. Figure 3.2 situates the lead firm at the bottom of the square, in clear contrast to Figure 3.1 where the buyer is found at the top. In the case of the captive agent of the relationship, the supplier plays that role, according to the GVC approach. For the Veracruz cluster Figure 3.2 - which is drawn on the types of governance structures developed by Gereffi et al. (2005) - also illustrates that the *captive* player is the buyer.

Figure 3.2 Governance of transactional relationships in the Veracruz cluster



So, is this the main governance structure of vertical linkages in the Veracruz cluster? It is the case for those firms that source basic inputs from PEMEX-Petrochemicals, especially when this is the only national supplier. Nevertheless, it is important to note that not every private firm in the locality is supplied by state-owned petrochemical complexes. As PEMEX ceased the production of certain inputs, firms were forced to develop other sources of supply[35]. The type of governance in that relationship, however, lies outside the concerns of the debate detailed here.

Another relationship that is also contextualised in Chapter 8 is that of local firms playing the role of supplier. However, when such transactional pattern arises, PEMEX-Petrochemicals continues to dominate the relationship since the supplier is transactionally dependent. In this case, captive buyer-driven chains are similar to those indicated in GVC literature (Figure 3.1).

Returning to the discussion of the prevailing form of governance in the locality, another important line of discussion is that related to upgrading prospects for firms. In this respect, it is clear that the quality of transactional linkages hinders the performance of buyer firms. For instance, it is worth considering the possible upgrading scenarios for the Veracruz cluster in terms of what is described in GVC literature.

The scope of each local firm for upgrading is variable, not only due to the competences and power of PEMEX-Petrochemicals, but also due to factors such as the different value chains firms feed into. At this point it is also important to remember that buyer firms take in inputs that are transformed into an even larger number of intermediate products that either serve different industries or have specific applications (Figure 2.3).

In the wake of the intra-cluster *captive* linkages contextualised above, *process* upgrading may be pursued in relation to the efficient use of energy since it is recognised that the running of petrochemical plants is energy-intensive. According to interviewees, the cost of energy in the country is believed to be one of the factors that inhibit the competitiveness of firms on the domestic market and this creates a gloomy scenario for IDESA, a firm that uses ethylene oxide to produce glycols. The company operates at roughly 50 percent of its installed capacity as PEMEX output is insufficient to meet its requirements. This hampers the firm's competitiveness given that the amount of energy

[35] There is also discussion of this topic in Chapter 8.

the plant consumes is constant regardless of the rate of capacity utilisation and the energy cost per tonne increases as utilised capacity drops (Chapter 8).

As for *product* upgrading, value chain literature states this is achieved by installing more sophisticated production lines (Humphrey and Schmitz 2002: 1020). In relation to the Veracruz cluster, for firms this would entail production of petrochemical products that have specific industrial applications and Petroquímica BETA is an example of this. The company set up production lines that have specific applications for the cosmetic, detergent, metallurgy, textile, and agricultural sectors (Chapter 8).

The interpretation of *functional* upgrading, in the strict sense of the term, would imply a push for downstream or upstream vertical integration for petrochemical firms producing intermediate goods. Mexichem, a conglomerate that owns facilities for the making of caustic soda and chlorine in Coatzacoalcos, has embarked on an aggressive crusade to integrate operations vertically. In order to merge the upstream links of the value chain, it acquired a company in the neighbouring city of Jaltipán with deposits of sodium chloride – the input that feeds its main production lines. Another example is Alpek, the petrochemical holding that controls Tereftalatos, a firm situated in Cosoleacaque. Alpek bought DAK Americas, a firm also situated in the area and which processes Tereftalatos' terephthalic acid into polyethylene terephthalate.

Figure 3.3 encapsulates these examples of upgrading as defined by the literature. The column to the right, on the other hand, also shows what upgrading means for firms in the locality. The characteristics the Veracruz cluster embodies lead us to identify this approach to upgrading.

The literature on value chains assumes that the supply of inputs is driven by the requirements of the buyer. In other words, the flow of inputs to the buyer firm is taken for granted. However, one of the features that distinguishes the Veracruz cluster is that input supply is at times erratic so a major upgrading, if not the most important upgrading, at the local level would be a more consistent and adequate supply of basic raw materials for the pool of private petrochemical firms. Without a doubt, this would significantly boost both the quality of transactional linkages and the performance of firms.

Figure 3.3 What does upgrading mean for local firms?

	Global value chains	Veracruz petrochemical cluster
Process upgrading	To transform inputs into output more efficiently by re-organising the production system or introducing superior technology	Energy efficiency Technical overhauls Increase output and/or installed capacity
Product upgrading	To move into more sophisticated product lines	To enhance the quality of the inputs and yield intermediate petrochemicals with specific applications in order to reach more sophisticated users and markets
Functional upgrading	To acquire new functions in the chain (design, marketing)	Acquisition of user firms (downstream vertical integration)
The quality of transactional relationships	Categorised Driven by the capabilities of the producer and the demands of the buyer	To regulate the relationship with local input suppliers Price factor Driven by the capabilities of the producer Demands of the buyer are frequently played down Better timing co-ordination with respect to maintenance works

Source: Based on Humphrey and Schmitz (2002: 1020) and the author's findings.

Nonetheless, the quality of the relationship between supplier and buyer is not only restricted to a more reliable provision of raw materials, it is also related to the particularities of the relationship that PEMEX-Petrochemicals holds with each local firm (Chapter 8). In the end, clearer, fairer rules, practices, and transactional mechanisms are badly needed to reduce the degree of uncertainty resulting from the questionable role of PEMEX-Petrochemicals as supplier.

External determinants of local governance

In a paper that links industrial cluster and value chain research, Humphrey and Schmitz (2000: 15) argue that both schools of thought tend to 'underplay the limits to upgrading'. Hence, the question asked by the authors is: 'if upgrading is so easy, why is not pervasive in developing countries?' Drawing on our case study, I contend that the answer may lie in the complexity of the economic, political, and institutional context in which firms operate.

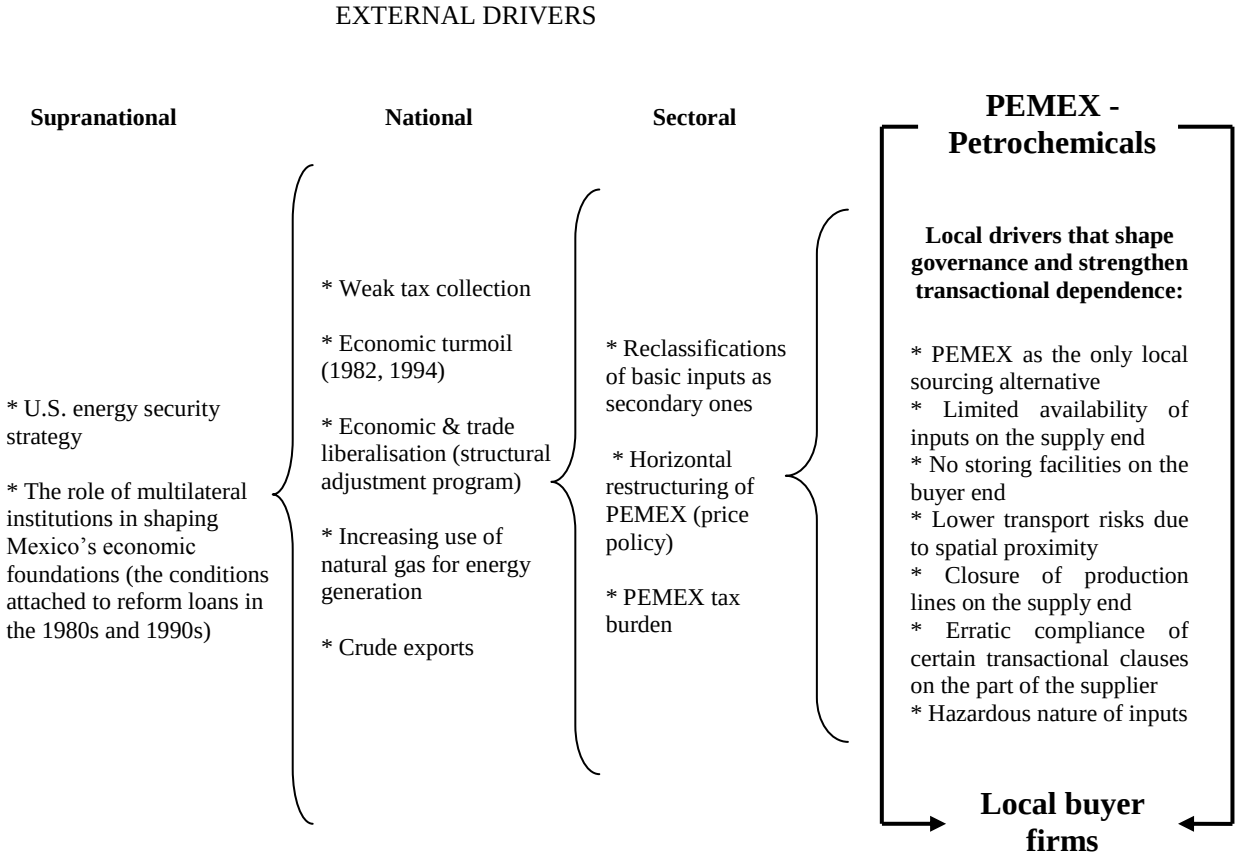
Before attempting to briefly describe the complex political economy of Mexico, it is important to establish how the locality is associated with it. State-owned petrochemical complexes are the bond that links the locality with the larger setting with the Cosoleacaque, La Cangrejera, Pajaritos, and Morelos complexes making up the

petrochemical division of PEMEX. The importance of PEMEX, at the same time, lies in the fact that its revenues finance a third of government spending. PEMEX is managed with a fiscal-driven approach that seeks to compensate the resources the government is unable to collect from other sectors of the economy. As PEMEX is treated as the country's cash cow, upgrading at the company's subsidiaries has long been compromised.

Figure 3.4 demonstrates the extent of this multifaceted setting. In analysing the external environment, I distinguish three dimensions with the first referring to the determinants inherent to the sector. The opening up of the petrochemical industry in the 1980s and 1990s required trimming the number of basic inputs reserved for the state. The government took several petrochemical products off the list and reclassified them as secondary products – a move aimed at allowing private participation. A second aspect of this dimension is the heavy tax burden for PEMEX, as mentioned above. Likewise, the policy of pricing inputs should be mentioned. In line with the horizontal restructuration of PEMEX decreed by the government in 1992, policy makers introduced pricing mechanisms that compelled subsidiaries to trade inputs (natural gas) between them at international prices – an approach that overlooked the comparative advantages of PEMEX in terms of production costs.

The second dimension of the external environment is determined by a number of national determinants. The economic setting of the country in the 1980s, for example, led to the institutionalisation of a development model in which the role of the state is limited and the above mentioned sectoral policies are to a great extent rooted in this context. Similarly, the collapse of the peso in the mid-1990s is believed to be responsible for the fall in output suffered by PEMEX-Petrochemicals during the second half of the decade. The escalating use of natural gas for energy generation and the priority given to crude exports are also factors to be considered since both have placed the availability of the most important precursors of industrial processes in the Veracruz cluster at stake. Another aspect is the national tax system for since the government is unable to capture a larger share of GDP in the form of taxes, PEMEX is used to cover this shortfall and its revenues finance a third of government spending.

Figure 3.4 Determinants of governance in the Veracruz cluster



Source: the author's database.

The third dimension of the aggregate setting is related to supranational determinants. For much of the 1980s and 1990s, international organisations such as the World Bank and the International Monetary Fund played a significant role in shaping Mexico's economic and institutional foundations as the implementation of market-orientated policies occurred under the tutelage of both institutions. A second determinant to consider is the energy security of the United States since a barrel of oil (naphthas) processed at petrochemical plants in Mexico can be interpreted in the following ways: it is a barrel that does not feed the industrial apparatus of the United States; it is a barrel that is not turned into petrochemical inputs and/or refined products that could later serve the growing Mexican market; and it is a barrel that the U.S. would probably have to source from volatile regions. As a result, Mexico has become a mere supplier of crude oil to the U.S., while becoming a net importer of refined and petrochemical products.

By and large, this adverse multi-dimensional context has a number of implications. For the Veracruz cluster, not only a severe drop in output and productive investment at the four petrochemical complexes over the past two decades is worthy of mention, it has also contributed to a deterioration in the quality of local vertical relationships (and hence the development of value chains of petrochemical origin). Transactional linkages between PEMEX-Petrochemicals and local buyer firms are governed by questionable practices and mechanisms rooted in a lack of capabilities at the supply end. Ultimately, there is no doubt that all of the above is associated with the complex context in which the Veracruz cluster, or rather the petrochemical industry, is embedded.

CONCLUDING REMARKS

The analysis presented here claims that arguments used to examine the co-ordination of transactional linkages that firms in developed countries establish with their counterparts in less advanced economies provide an important framework for addressing the empirical evidence embodied by the Veracruz cluster. In that respect, one of the aims of this chapter was to apply the global value chain approach to the type of inter-firm relationships prevailing between PEMEX-Petrochemicals and local buyer firms. To do so, it was first necessary to discuss the rationale behind distinguishing the governance structure of cross-national inter-firm linkages, elucidate the core conceptual underpinnings of this school of thought, and briefly illustrate how the quality of transactional linkages helps enhance performance in firms from developing countries.

On the other hand, the discussion also shed light on the way local governance, in this case study, is greatly influenced by external determinants that in one way or another are associated with the petrochemical industry. In that respect, the point to underline is that GVC literature tends to overlook the role of the aggregate (economic, institutional and political) environment with respect to the governance structure of inter-firm relationships. Even though the discussion in the present chapter was centred on conceptualising the predominant form of governance in the Veracruz cluster, it also emphasised that the analysis proposed in this thesis must pay a great deal of attention to the (aggregate setting) political economy of Mexico. The subsequent chapters will do precisely that.

4

NOTES ON THE ORIGINS OF PEMEX

The rise of economic nationalism

INTRODUCTION

This thesis analyses how the development of the Veracruz cluster is shaped by the complex political economy of Mexico. Since the role of PEMEX and its petrochemical division are central to that end, it is important to expose historical events that not only led to the expropriation of the oil industry and creation of PEMEX in 1938, but also laid down the ideological, political, and economic foundations that validated the instrumentation of a state-led industrial development after World War II – period in which the establishment of the petrochemical industry took place. With respect to the period depicted in this chapter, it is also important to note the degree of economic nationalism that permeated the social and political scene at a time foreign capital dominated several productive sectors of the economy.

One of the attitudes that best describes the idiosyncrasy of the Mexican society is in fact the extent of its nationalist character. The position adopted by various groups towards the exploitation of natural resources, specifically hydrocarbon resources, is perhaps the most outstanding example of this. In this respect, PEMEX, the state-owned oil and natural gas firm, is considered the instrument that made possible both the Mexican nation itself and the country's social and economic progress over the course of the last century. The company symbolises emancipation from foreign interests - a perception shared by both broad social factions and political syndicates. The contemporary economic history of Mexico is for the most part therefore coupled with that of PEMEX. Much of the social and economic progress the country has accomplished over the last seven decades or so is widely attributed to the enormous revenues Petróleos Mexicanos has handed over to the Ministry of Finance. The making of modern Mexico is inconceivable without the wealth yielded by the exploitation of hydrocarbon resources.

Nonetheless, as discussed in subsequent chapters, the standing of PEMEX and its subsidiaries has dramatically deteriorated over the last two decades. In the wake of this deterioration, some argue that the participation of private capital is desperately needed and that the company must focus on specific areas of the industry. Even though these statements have provoked heated debates on both extremes of the political and social spectrum, recent administrations have acted in accordance with market-orientated policies. In the 1990s, for example, the government of Ernesto Zedillo (1992-2000) attempted to privatise a large share of the petrochemical assets of the company – allegedly the most significant link in the hydrocarbon chain in terms of value added to inputs. Unsurprisingly, the affair became highly politicised and controversial. Political and social opposition brought the plan to a halt, making government officials desist. The point to underline here is that when it comes to PEMEX, a large dose of economic nationalism permeates both the political debate and the decision making process. The questions raised by this situation include: Is economic nationalism what prevented the privatisation of PEMEX-Petrochemicals in the 1990s? Where does economic nationalism come from? Did the context in which PEMEX was created establish the conditions for state-led industrial development in the following decades? To address these questions it is necessary to examine the critical developments that led to the birth of Petróleos Mexicanos in 1938.

This chapter seeks to elucidate the developments that marked i) the origins of the national oil industry, ii) the circumstances that led to the instrumentation of a state-led development in the following decades, and iii) the rise of economic nationalism in Mexico. It is necessary to focus on both the economic and political contexts prevailing through much of the first half of the 20th century and the historical background behind the conception of PEMEX - the parent company of the sector studied. The organisation of the chapter is as follows. It begins by describing the importance of foreign capital in encouraging economic development. Here it is necessary to illustrate the context that drew the attention of foreign oil companies in the times of Porfirio Díaz, the long-term dictator of Mexico until 1910, when links between the political elite and U.S. and European entrepreneurs determined the economic fate of the country. The latter is a factor that has long marked the way in which capitalism became institutionalised in Mexico. The discussion continues by throwing light on the inclination of the Díaz administration to find a manner to counterbalance the disproportionate influence

exercised by the U.S. over the country. To that end, Díaz resolved to invite British businessmen, who turned out to play a distinguished role in the early development of the oil sector in Mexico. The overriding participation of foreign firms in a wide range of economic sectors, along with the detrimental living conditions of a large section of the population, progressively fuelled nationalistic attitudes in social groups. The analysis therefore continues with an examination of the episodes that provoked the rise of economic nationalism and eventually led to nationalisation of the oil industry.

FOREIGN CAPITAL IN THE TIMES OF PORFIRIO DIAZ

At the end of the 19th and beginning of the 20th centuries, Mexico was ruled by a dictatorial regime led by Porfirio Díaz, a high-ranking army officer who came to power in 1876. His leadership persisted over a period of three decades, coming to an end in 1911 in the wake of social and political discontent. This period of Mexican history is known as the *Porfiriato*, a controversial regime that allegedly brought a certain degree of economic prosperity and political stability to the country under authoritarian practices. During this period, it is acknowledged that key sectors of the economy such as mining, the railways, oil and public services attained a certain degree of development due to Diaz's determination to modernise the country, a task largely associated with the participation of foreign capitals (Brandenburg 1964, Meyer 1985a, Vázquez 1985).

Throughout the Porfiriato, U.S. and European firms perceived Mexico as an attractive place to invest. This is understood as the outcome of a number of domestic factors. The forceful control Díaz exerted over most of the country's affairs resulted in a professed internal stability - a context which helped build a perception in the international scene that Mexico offered a favourable business climate. Also, as the economic strategy of the regime critically relied on foreign capital, the ruling elite took advantage of weak legal enforcement to favour the interests of foreign firms, permitting the manipulation of markets towards the maximization of benefits. In the light of these circumstances, U.S. and British entrepreneurs, mainly, eventually acquired a very privileged position in political circles on the one hand and assumed a prominent role in an array of economic sectors on the other (Brandenburg 1964, Brown 1987)

The success of U.S. and British businessmen in Mexico is not only attributed to the aforementioned factors. The decisive factor was the political shelter provided by Díaz.

As the national environment was highly politicised, the business elite easily took advantage of this situation by cultivating close dealings with high ranking government officials as a means to expand their interests. In reality, the key determinant for foreign entrepreneurs to do extremely well in Mexico was to have a foot firmly planted in politics (Wasserman 1985, Brown 1987). Such a practice, in retrospect, has had long-lasting consequences for the manner in which capitalism has become established in Mexico.

The presence of foreign capital proved beneficial to Diaz's interests. By and large, both social stability and economic progress were perceived by many Mexicans as achievements of his administration, an impression that suited his political aspirations. In this regard, the partnership between Mexican government officials and foreign businessmen was opportune as it came to serve the objectives of both sides. Nonetheless, it presented a downside that worried Díaz. In spite of the need for foreign investment, Mexican politicians were sceptical about the dominant position of U.S. capital in sectors such as the railways and mining (Brown 1987). In 1911, towards the end of the Díaz administration, U.S. capital accounted for 38 percent of total foreign investment in the country. With respect to railroads and mining, U.S. firms were responsible for 47.3 percent and 61.7 percent, respectively, of the total foreign capital invested (Meyer 1985a).

Mexico perceived the U.S. as an imperialist power. To both Díaz and the ruling elite, the significant influence of United States capital in the country and its expansionist history represented a national security concern. The regime interpreted such factors as jeopardising not only its own status quo, but also national sovereignty. Due to these concerns, national security affairs were part of the rationale used by the Díaz administration to pursue economic development (Díaz Duffo 1918). For historical reasons the regime could not afford to be solely dependent on the United States and this led President Díaz to reflect on the appropriateness of diminishing the weight of U.S. interests and encouraging the participation of European businessmen in key areas of the economy (Brown 1987). In 1911, for example, British interests accounted for 35.5% of the total investments in railways, second only to the United States. With regards to mining, French capital represented 21.8 percent of foreign interests (Meyer 1985a).

In the same year, at the time the Porfiriato came to an end, it is claimed that government efforts to attract foreign investment began to pay off. Direct foreign investment and loans stood at an estimated $1.7 billion, while income per capita is calculated to have grown at an annual rate of 2.3% from 1877 to 1910, recovering its pre-independence levels. All this suggests that the partnership between the regime and U.S. and British companies drove economic progress and, more importantly, delivered long-term consequences with respect to the subsequent development of the abovementioned economic sectors (Brown 1987). In that sense, it is in the interest of this academic work to highlight in a few words the legacy of British capital in relation to the emergence of the oil industry - a sector that largely explains the making of modern Mexico.

BRITISH INTERESTS IN THE MEXICAN OIL SECTOR

Towards the end of the 19th century and during the first decade of the 20th century, Standard Oil stood as the most prominent oil firm in the United States with the power to shape the structure of the U.S. oil industry through monopolistic practices[36]. In the same fashion Standard Oil, along with its Texas-based subsidiary the Waters-Pierce Oil Company, dominated the marketing of oil-related products in Mexico, constituting a monopoly that did not benefit the political interests of President Díaz. It has been mentioned that many sectors of the Mexican economy through the Porfiriato were controlled by U.S. firms. Leading figures of the ruling elite considered it inconvenient to permit U.S. businessmen to gain further prominence in the country's economic affairs. Accordingly, European capital represented a window of opportunity for Díaz to counterbalance U.S. influence (Brown 1987, Skirius 2003, Meyer 1985a).

As the rationale of this stage is to shed light on both the origins of Petróleos Mexicanos and on the role of foreign firms in its conception, particularly British capital, a case in point is Sir Weetman Pearson, a British engineer whose firm S. Pearson & Sons was of great economic and political importance for the Díaz regime. The firm attracted the attention of the government as it had long-standing expertise in the construction of rail lines, docks, harbours, and drainage systems throughout the world. President Díaz in

[36] For a more detailed account of this matter see, for example, Tarbell, I. M. And Chalmers, D. M. (2003) *The History of the Standard Oil Company: Briefer Version.* Dover Publications, New York. See also Montague, C. H. (2005) *The Rise and Progress of the Standard Oil Company.* Kessinger Publishing. Bringhurst, B. (1979) *Antitrust and the Oil Monopoly: the Standard Oil Cases, 1890-1911.* Issue 8 of Contributions in Legal Studies. Greenwood Press.

fact sent emissaries to New York in 1889 to meet Pearson and persuade him to come to the country to conclude the construction of the Mexico City drainage system, a project that had been abandoned by a U.S. firm. As Pearson eventually completed the project he found himself in an enviable position as he had direct access to Díaz. This situation prompted the government to partner with Pearson in succeeding projects, with the latter providing the financing and the former the engineering (Brown 1987).

Over the years, S. Pearson & Sons assembled a competent staff in Mexico and firmed up its association with the regime to expand its holdings in the country. It is in this spirit that Díaz appealed to Pearson once again in 1898 to intervene in the upgrading of the Tehuantepec[37] railway, a major infrastructure project whose concession was granted to another British firm. Although the railway had been completed, it presented serious technical flaws that prevented it entering into operation. The overhaul entailed construction works throughout a vast region. In the end, 'a new roadbed, a flood control system, extensive bridging and breakwaters and docks at the Pacific terminus of Salina Cruz, and dredging and dockwork at the Gulf terminus of Coatzacoalcos' were erected, allowing the firm to accumulate extensive knowledge of the Tehuantepec region – knowledge that turned out to be decisive with regard to the interests of Sir Weetman Pearson in the oil industry (Brown 1987: 398-399).

In 1901, on a trip from Mexico to New York, Pearson spent a night in Laredo, close to the Texas Gulf Coast, one of the epicentres of U.S. oil fever. Once there, Pearson 'made inquiries about this new oil business and learned that prospectors had been attracted to Spindletop[38] by the same kind of tar pools that his staff had found along the route of the Tehuantepec railway'. In the light of such evidence, it is reported that Pearson wired his staff in Mexico to secure rights on land along the railway and elsewhere. By the end of the year, his firm had men exploring the Tehuantepec Isthmus and the adjacent state of Tabasco under the expertise of Anthony Lucas, the engineer responsible for the first successful oil well at Spindletop (Brown 1987, Clark et al. 2000).

Even though Pearson bought and leased vast tracts of land, hired workers with oil drilling experience, and created a favourable political climate for his enterprises, the

[37] The Tehuantepec area lays between the states of Veracruz, on the Gulf of Mexico coast, and Oaxaca, which is situated on the southern Pacific coast.
[38] Spindletop is an oil field situated in Beaumont, Texas. As a result of the beginning of oil production in 1901, Beaumont became one of the first boomtowns in the U.S. (Clark 2000).

technical requirements of the oil industry along with the lack of a major oil discovery challenged the success he was accustomed to. Nevertheless, expectations remained high. In 1905, the British engineering firm began the construction of a 3,000 barrel per day refinery at Minatitlán, and a year later, Pearson's close relationship with the regime paid off as his firm 'received the biggest oil concession the government had to offer, a fifty-year contract covering all national land, lakes and lagoons in the state of Veracruz' (Brown 1987: 402). By 1908, after a fire damaged the Minatitlán refinery, he decided to expand it to process 40,000 barrels a day. In spite of all this, as of 1908 S. Pearson & Sons was not making any profits. The lack of a major oil discovery prevented the British company from stocking up the Mexican market of refined products, which was monopolised by the Waters-Pierce Oil Company from the U.S. To secure the supply of oil for its refinery, Pearson approached other entrepreneurs, however, negotiations were never gratifying as potential providers were either involved in legal disputes (Standard Oil) or limited by a sort of oil Pearson's refinery could not process. Pearson then realised he had to change his strategy in order to compete against the monopoly of refined products in Mexico. By April 1909 he had set up the Compañía Mexicana de Petróleo "El Águila", whose structure on the one hand 'provided Pearson with the political resources to attack the Waters-Pierce monopoly' and on the other its "national" character 'met the political goals of the Díaz regime' (Brown 1987: 408-409).

As a "national" company, the government sought to protect the interests of El Águila in the domestic market by increasing import tariffs, which came to directly affect the leading position of Waters-Pierce. In addition, Pearson's friends in high government positions guaranteed for El Águila a contract to supply one-third of the National Railways' requirements for lubricating oils. Previously, Waters-Pierce had been the sole supplier. What is more, the government granted contracts for the exploration and operation of deposits in several Mexican states, including Veracruz. As the facts suggest, the expansion and formation of El Águila occurred under a form of political shelter provided by the Díaz government, breaking the U.S.-led monopoly and eventually capturing half of Mexico's oil market (Brown 1987, Skirius 2003).

Nonetheless, as late as 1910, El Águila still relied on imported oil from Texas to meet its requirements. Having hired geologists from the United States and formed skilled drilling crews, Pearson felt confident that his company would soon discover domestic

sources of crude to substitute imports. On 27 December 1910, after conducting extensive exploratory work at a hacienda called Potrero del Llano in the state of Veracruz, El Águila drilled a well that helped increased Mexico's oil output fourfold, from 3,634,080 barrels in 1910 to 12,552,788 barrels the following year. Along with the production of U.S. firms, Pearson helped make Mexico a net exporter of hydrocarbons in 1911 and turned the Anglo-Mexican company of El Águila into the largest oil producer in the country. However, it was precisely at this time that President Díaz faced social and political turmoil that compelled him to step down and flee into European exile (Brown 1987).

THE RISE OF ECONOMIC NATIONALISM

The expropriation of the oil industry in 1938 is not only attributed to a given set of circumstances prevailing at the time, it is also believed to be the result of the nationalist sentiment that lingered after the Mexican Revolution. The goal of this chapter is not to determine the extent to which both factors contributed to the nationalisation of foreign oil assets, but to briefly depict the context in which nationalism rose.

For these purposes it is necessary to take the Porfiriato into account since this is a period of Mexican history that allegedly brought in a certain degree of progress in terms of industrialisation and modernisation at the expense of the impoverished majority. The international bourgeoisie resident in Mexico greatly benefitted from the conditions created by the Díaz administration, constituting a privileged class that fuelled nationalist attitudes throughout the working class, peasants and the like (Hart 1997). In the same way, what also nourished nationalism was the widespread economic penetration of foreign capital in the country's domestic affairs, a situation perceived by government and society as menacing.

The abovementioned scenario fed perceptions that a change in power was needed, although Díaz had something rather different in mind. He ran for his seventh presidential term in 1910 - a move that increased political restlessness among regional elites and rival political groups (Hart 1997). When Díaz proclaimed himself victor in the 1910 presidential elections in the midst of widespread perception of electoral fraud, Francisco I. Madero, the opposition candidate, headed an uprising that unleashed the Mexican Revolution (1910-1920), an armed confrontation involving numerous factions

whose ultimate interest was to reverse the disadvantageous conditions suffered by the most vulnerable sectors of the population during the presidency of Porfirio Díaz.

Madero (1911-1913) became Mexico's President a year after Díaz was ousted. The constant struggle for power amidst rival factions condemned his presidency to be short lived and precarious. In a similar fashion, the subsequent administrations of Victoriano Huerta (1913-1914) and Venustiano Carranza (1914-1920) were usually challenged by both rebel political groups seeking to further different social causes and by foreign investors in the hunt for endorsing the party that best served their interests (Hart 1997). It is important to observe that Madero, Huerta and Carranza became president not only through their own belligerent actions since it is also claimed they benefited from the indirect support of British and U.S. investors. Although there is no sound evidence that international businessmen were directly involved in the conflict, it is clear that some actions undertaken by competing groups of businessmen were intended to favour one or another revolutionary leader in order to gain future economic rewards (Meyer and Morales 1990, Skirius 2003). This is believed to have 'contributed significantly to the attitudes in official Mexican circles that led to the railroad and oil nationalisation in 1937 and 1938' (Skirius 2003: 51).

With regard to the oil industry during the Porfiriato, it is worth noting that its development was at a very early stage. Mexico's potential as an oil producer came with the discovery of major oil fields in 1911 since these would substantially boost the importance of the oil industry in subsequent years. Nevertheless, the importance of the oil industry for much of the first two decades of the 20th century was dwarfed by that of the railroads which, in sharp contrast, embodied a far more strategic character since they represented a valuable instrument for Díaz and subsequent revolutionary governments in terms of economic prosperity, national security, and political and social control. For instance, the character of the railroad in the rise of nationalist sentiments by the time of the Revolution is critical and worth reviewing.

In view of U.S. expansionist history and economic influence, the railroad was seen as a means to strengthen territorial cohesion. The loss of half of the country's territory in the preceding century had not been forgotten or forgiven so it was a top priority for the government to wield greater political control over remote regions and to make the displacement of troops throughout the country possible. For this purpose the railroad

proved decisive. Furthermore, by connecting outlying states to one another and to Mexico City the government promoted trade and economic dynamism throughout the country (Grunstein 1996). Nevertheless, the fact that most railroad employees were of U.S. origin appeared to jeopardise government targets with Díaz, for instance, so displeased with the situation that he considered it vital to bring the railroads under the control of his administration (Quirk 1981).

Bearing in mind the implications of being in command of the railroad, Porfirio Díaz constituted the National Railways of Mexico by merging the Mexican Central Railroad, owned by Henry Pierce[39], and the National Railroad, controlled by the Speyers[40] of New York and London. This new Mexican company represented fifty five percent -or 6,987 miles - of the existing mileage of railways in operation in the country in 1909. Full control, however, was not attained since Henry Clay Pierce, who also had noteworthy interests in oil, retained half of the bonds of the new firm and the right to appoint members of the board of Directors. But what is worth pointing out is that Díaz took a step towards establishing a major government role in the railroads. Diaz's decision illustrates that economic nationalism during his term was driven by the need to shield the country's sovereignty as fears of a U.S. intervention persisted. Similarly, in the final years of the Porfiriato and beyond, the disadvantageous living conditions of the majority of the population are also believed to have contributed to this (Skirius 2003)

There was therefore significant pressure on revolutionary governments to Mexicanise the railroads. In the U.S., leading voices pushed for military intervention south of the border, raising concerns in Mexico. It was perceived that in the case of a U.S. invasion – such as that of April 1914 - U.S. railroad managers would be keen to support their fellow countrymen. This panorama prompted Madero and Huerta to plead for a major number of Mexicans at railroad companies while removing foreign personnel. In this sense, it was Carranza, the third revolutionary president, who took the toughest measures. Upon entering Mexico City in August 1914, his forces occupied the offices of

[39] Henry Pierce was the owner of Waters-Pierce, the company that held the monopoly for distributing oil products imported from the United States.

[40] The Speyer family had interests in U.S. and British railroads, as reported by the press of the time. Speyer Unites London Lines (1912, November 20) *New York Times.* London Traction Merger Arranged. Sir Edgar Speyer combines general omnibus and underground electric companies (1912, January 19) *New York Times.*

the National Railways of Mexico, seizing the company at the expense of Pierce share holdings (Skirius 2003).

As can be seen, given the circumstances the country faced the railroad represented the most strategic asset for revolutionary governments. Similarly, with regard to oil, the importance of this sector increased as output soared towards the end of the civil war, as did the clashes between authorities and foreign firms. This corroborates the idea that both society and political elites adopted a more nationalist approach towards economic assets, without this creating a sense that a nation was in the making. It was therefore essential to convert that impetus into a framework that both placed the national interest first and delivered a sense of nationhood. It was the Constitution of 1917, put into force by President Carranza, which embodied all the Mexican Revolution stood for (Meyer 1985c).

The Constitution of 1917 embraced a nationalist nature which was unsurprisingly interpreted as anti-capitalist, raising concerns in business and political circles in the United States given that it laid the legal foundations for further government intervention. More specifically, the Constitution epitomised the legal precept of expropriation in article 27, stipulating that 'private property may be nationalised on account of public utilities and through indemnification' (Thomson 1938). By that time, Mexico's oil output represented 25 percent of the world's supply, the second largest producer after the U.S. (Haber et al. 2003). The new Constitution was therefore set to change the rules, albeit the government found itself powerless in enforcing its observance. As a result, foreign oil firms continued to operate as if there were no changes to the law, a condition favoured by the fact that subsequent administrations sought the recognition of the U.S. government (Macmahon and Dittmar 1942a).

Since it was widely acknowledged that the oil sector lacked regulation and that the government had little to say with regard to output, exploration and other matters, the Mexican authorities took tentative steps towards playing a more active role in the sector. In 1925 the government established the Control de Administración del Petróleo Nacional, an agency allegedly entrusted with broad power over the national oil, reserves and concessions. In 1933, a mixed company called Sociedad de Petróleos de Mexico was formed, and dissolved in 1937 in order to set up the Administración General del Petróleo Nacional, an agency with an entrepreneurial-orientated character. In the end, it

is rather unclear to what extent the government exerted more control on the sector through these initiatives, but the implementation clearly signalled an increasing interest. As yet, the creation of the aforesaid agencies was not aimed at seeking nationalisation of foreign oil assets. Instead, what is believed to have prompted President Lázaro Cárdenas (1934-1940) to expropriate oil holdings was a development of a somewhat different nature; a legal dispute between employees and firms in relation to wages and working conditions (Macmahon and Dittmar 1942a, Woolsey 1932).

THE ROAD TO EXPROPRIATION

By the time expropriation occurred in 1938, Lázaro Cárdenas had become President of Mexico and the political landscape seemed to encompass values that had arisen during the civil war two decades earlier. His administration was characterised by furthering two of the causes of the Revolution: agrarian reform and workers' rights. The instrument that smoothed the institutionalisation of these policies was the National Revolutionary Party, funded in 1929 and whose main objective was to hold in line the factions constituting the new regime (Portes Gil 1954, Meyer 1985b). At that time, the government itself 'began large-scale expropriations of rural property and actively supported the workers' organisation'. In response to this renewed nationalist spirit, one of the developments that stands out is the creation of the Union of Oil Workers of the Mexican Republic (STPRM), an organisation that increased the bargaining power of Mexican oil workers and their leaders (Meyer 1985b).

In 1936, one of the first actions taken by the newly formed STPRM was to present a set of demands for discussion with oil companies. Workers claimed higher wages and benefits amounting to 65 million pesos a year and firms strongly disagreed with the figure, offering just a fraction of this amount. This dispute was set to be solved through negotiations, but these failed and the union struck in May 1937. The government of Cárdenas was aware of the devastating effects an oil strike would have for the economy and mediated to call it off. From that moment onwards, the government became more involved in the quarrel and decided to carry out a financial analysis to determine the amount the companies were able to afford without putting at risk their financial viability. The report concluded that they could offer wage and benefit increases totalling 26 million pesos, which was more than they were willing to offer. The verdict was

accepted by the union but rejected by the companies, who took the case to the courts (Macmahon and Dittmar 1942a, Meyer 1985b).

On March 1, 1938, the Supreme Court ruled in favour of workers and granted the companies seven days to comply with the resolution. Shortly after, the U.S., British and Dutch governments expressed their concern about the situation and began to lobby Mexican authorities. On March 16 the oil companies agreed to pay the 26 million but President Cárdenas had already made a decision: 'on 18 March, he announced to an astonished world his determination to seize virtually all the foreign oil holdings in Mexico' (Meyer 1985b: 149).

With the expropriation the Mexican oil industry stumbled as firms and their respective governments protested. Standard Oil of New Jersey and El Águila, for example, questioned the legality of the presidential decree and rejected the conditions of compensation payments. With respect to countries, Britain adopted a more radical posture than that of the United States by suspending diplomatic relations with Mexico. The government of Roosevelt, on the other hand, recognised the right of Mexico to nationalise the oil industry, but highlighted the need to compensate U.S. firms accordingly. The commercialisation of inputs was another concern. In addition to the inherent limited technical capabilities of the Mexican oil industry, what also made access to international markets problematical was that in retaliation the U.S. and Britain imposed restrictions. The outbreak of the Second World War in late 1939, however, benefitted Mexico in that respect since it became a supplier of crude oil to the Axis countries, although crude exports to Germany and Italy were marginal. By then, Mexico's output was not considerable and much of the production was in fact absorbed by a growing domestic market. But the most important consequence of the world conflict was that it also helped appease the pressure wielded by the U.S. government. National security concerns topped the priorities of the economic and political agenda of policy makers north of the border. It soon became clear that the menace posed by the Axis countries would demand close co-ordination with Latin American countries - and this was an issue far more important than any legal suits presented by expropriated firms (Meyer 1985b). All in all, the 1938 expropriation is seen as 'the culmination of Mexican revolutionary nationalism' as it not only brought to an end the long standing control that foreign firms wielded over the most important natural resource of the

country, it also paved the way for the subsequent creation of Petróleos Mexicanos (PEMEX) (Meyer 1985b: 149).

CONCLUDING REMARKS

The extent of foreign participation in key sectors of the Mexican economy at the beginning of the 20th century was viewed with scepticism by factions within the political elite and the general public. The political order that emerged from the civil war and the subsequent enactment of the 1917 Constitution laid the groundwork for the state to participate more actively in the economic development of the country in the years ahead. To that end, the hydrocarbon industry, mostly in the hands of U.S. and British firms, was destined to be a key instrument. Post-revolutionary governments encouraged the dissemination of nationalistic values through the establishment of an array of labour and social organisations and this political scaffolding has persisted to the present day. The dispute between workers and foreign oil firms over wages erupted in the midst of a climate permeated by the rise of economic nationalism. For the Mexican government, the conflict not only represented the perfect opportunity to expropriate oil assets in 1938. It also signalled the path of development that political elites were to embrace – one in which the state is the most important regulator and supporter of economic activities. To a significant extent, the context that led to the creation of Petróleos Mexicanos (PEMEX) helps us understand the rationale behind the industrial development strategy that the country followed in the subsequent decades – period in which the establishment and rise of the petrochemical industry took place.

5

THE RISE OF THE PUBLIC PETROCHEMICAL INDUSTRY

An overview of the national context in the post-World War II period

INTRODUCTION

In the decades following the end of World War II, many countries in the developing world embraced inward-looking strategies in pursuit of social and economic progress. Contrary to the outward-looking policies instigated in Asian countries, Mexico introduced a series of measures for expanding the national industrial base through the substitution of imports – a strategy that entailed imposing high barriers to trade. Even though this approach succeeded in accelerating economic growth for a period of over two decades, the model itself began to present certain flaws by the 1970s. In the light of the relative deterioration of the economic climate throughout the first half of that decade, policy makers wondered whether import-substitution strategies would enable Mexico to continue in the right direction. Nevertheless, there were no changes to economic policies in the second half of the 1970s. The oil boom experienced during this period fuelled the belief that hydrocarbon resources would contribute to an expansion of the domestic industrial apparatus – an approach that broadened and deepened the extent of prevailing policies. In this context, the government envisaged the processing of natural gas and crude into basic industrial inputs as pivotal. Since these basic inputs would encourage development of the privately-owned secondary petrochemical industry, while simultaneously stimulating production of a broader range of consumer goods, the government allocated substantial resources for the construction of PEMEX petrochemical facilities. The downside to such a strategy is that the magnitude of the required investments largely contributed to the widening of public financial imbalances, which along with the deterioration of the external economic environment sent the country into economic turmoil in 1982.

In the present chapter, even though the main focus of the discussion is on the establishment and rise of the petrochemical industry in the 1960s and 1970s, attention is also paid to political economy issues associated with this development. It is difficult to understand what drove the construction of petrochemical facilities in the Veracruz cluster and elsewhere without discussion of the wider economic context. The import-substituting industrialisation (ISI) that Mexico followed from the 1950s is therefore discussed. Another development that deserves particular consideration is the oil boom the country experienced towards the end of the 1970s. Apart from encouraging industrial expansion, the growth of hydrocarbon reserves also played a role in worsening public imbalances. If one believes that the economic model at that time along with the oil boom help to explain the rapid expansion of the state-owned petrochemical company's installed capacity, the collapse of the economy in 1982 is equally of great weight with respect to understanding the development of the sector in subsequent decades. For instance, a brief yet concise discussion of what such economic turmoil entailed is also given.

THE GOLDEN YEARS OF THE MEXICAN ECONOMY

Although the genesis of import-substituting industrialisation (ISI) in Mexico is traced back to the administration of Lázaro Cárdenas (1934-1940), the president who nationalised the oil industry in 1938, it is not until after World War II that such a development strategy became a calculated policy tool (Ángeles Cornejo 2001, Baer 1972). In the relevant literature it is widely acknowledged that the 1950s and 1960s represented the golden age of ISI – a phase during which the country's economy expanded at an average rate of more than 6 percent annually (Figure 5.1). Such prosperity was accompanied by other equally alluring economic indicators: inflation remained under control, prices rose at an annual rate below 5 percent from 1940 to 1976, and industrial output expanded at an even faster pace towards the end of the period. From 1960 to 1972 the sector grew by more than 7 percent per annum. Furthermore, what also contributed to this economic strength was the fixed exchange rate for the peso against the dollar with the value of the national currency pegged at 12.5 pesos to the U.S. dollar from 1954 to 1976 (Ramírez 1986).

The political stability experienced by Mexico from the mid 1930s onwards played an important role in the country's outstanding performance. At the core of the country's

political system was the Institutional Revolutionary Party (PRI), founded in 1929, which brought together the most important social, political and economic forces that survived the Mexican Revolution. Given the strict control the PRI eventually wielded over different spheres and the fact that other ideological groups held little power, post-conflict Mexico emerged as a one-party democracy that assured both the transfer of command from one president to another in peaceful terms and the continuation of economic policies (Domínguez 1982).

Mexico's favourable economic and political scenario under ISI was coupled with an expanding domestic market. In 1970 the Mexican population reached 50.7 million, up from 20.2 million in 1940 (Alba and Porter 1986), with annual growth of over 3 percent throughout the period. A social phenomenon that characterised the ISI model is that the population tended to migrate from rural to urban areas in search of jobs and better living conditions. The population living in urban centres of more than 2,500 inhabitants grew from 42.6 percent in 1950 to 58.7 percent in 1970 – a trend that accelerated the shift of employment from agriculture to the service and industrial sectors (Lustig 1981, 1998). This sizeable domestic demand, coupled with increasing income, is believed to have prompted policy makers to intensify the implementation of protective measures.

Figure 5.1 Mexico's main economic variables, 1950-1972
(Real average annual growth rates, 1960=100)

	1950-55	1955-60	1960-66	1966-72
GDP	6.1	6.2	6.3	6.4
Population	3.1	3.2	3.4	3.4
Per Capita Product	3.0	3.0	2.9	3
Industrial Output	4.4	6.2	7.3	7.9
Agricultural Output	5.7	3.0	4.3	2.4
Price Index for Mexico City	7.5	3.9	1.8	3.5

Source: Taken from Ramírez (1986).

With regard to the prevailing policy framework in the 1950s and 1960s, both accelerated growth and industrial expansion were made possible thanks to the imposition of high trade barriers and other quantitative and qualitative restrictions on imports. Towards the end of the 1940s, the government had introduced an import permit system. As the aim was to protect domestic infant industries from foreign competition, import tariffs on consumer goods were fixed at 50 percent - a rather high rate to

discourage consumers from purchasing imported goods. On the other hand, policy makers were also interested in 'establishing domestic production facilities to manufacture goods that were formerly imported' (Baer 1972: 95). The permit system taxed machinery and raw materials, which were regarded as vital inputs for industrial expansion, at 5 percent and 10-15 percent respectively – a much lower rate in comparison to consumer goods. In the years to come, under pressure from industrialists, Mexican authorities imposed quantitative restrictions on a larger number of goods (Reynolds 1970). In addition to tariffs, the government also contemplated licensing requirements for imports. Calva (2000), for example, notes that the value of imports subject to licensing requirements in the 1950s and 1960s averaged 57.2 percent, while a decade later the share had escalated to 74.1 percent. While Villarreal (1977) offers a similar judgment, he nonetheless estimates that 80 percent of imports required a license to enter the country by 1970.

The role of the state went far beyond regulation as it was determined to be heavily involved in the expansion of the industrial base. To do so, it carried out a crusade to "Mexicanise" several productive sectors. 'In 1961 the government decreed that foreign mining companies had to sell majority stakes to Mexican investors. In 1962 López Mateos, Mexico's president from 1958-64, moved to limit foreign ownership in the automobile parts industry to 40 percent. In 1966 President Gustavo Díaz Ordaz (1964-70) ordered that the banking industry had to be domestically owned. In 1967 he limited foreign ownership in the sulphur industry to 34 percent. Three years later, Díaz Ordaz declared his intention to "Mexicanise" the steel, cement, glass, fertiliser, paper, and aluminium industries'[41] (Haber et al. 2008: 47). There is no doubt that the intervention of the state was determinant in the rapid industrialisation experienced by Mexico during the 1950s and 1960s, with the setting up of the petrochemical industry in this period being a case in point.

[41] For a more detailed discussion of the role of the Mexican state in the organisation of the aforementioned industries see Bernstein (1964) and Izquierdo (1995).

THE ESTABLISHMENT OF THE PETROCHEMICAL INDUSTRY IN MEXICO

In the 1950s Mexico embarked on a process of industrialisation through the implementation of import-substituting measures. In line with such an approach, the processing of hydrocarbon resources into a wide range of industrial raw materials, which at subsequent production stages are transformed into an even broader array of consumer goods, was deemed by policy makers to be a critical component in accelerating expansion of the domestic industrial apparatus – an objective central to the prevailing economic model. In other words, by turning crude and natural gas into industrial inputs, what the government contemplated was a strengthening of the vertical configuration of associated value chains. The establishment and later expansion of the petrochemical industry became one of the top priorities of policy makers.

The government took the first steps towards setting up petrochemical facilities in 1951 when PEMEX commenced operation of a plant for the production of sulphur, an input used in the production of fertilisers, at the Poza Rica refinery in the state of Veracruz. Later, in 1959, the government completed construction of facilities at the Mexico City refinery for the making of dodecylbenzene, an important raw material employed in the detergent industry. During this period development of the petrochemical industry in terms of output and installed capacity was constrained by a number of factors and PEMEX was unable to finance construction of the petrochemical plants contemplated by the government. A key element in the industrial policy institutionalised by the Mexican government during the ISI era was the commercialisation of products and services provided by state-owned firms at subsided prices. The goal was to encourage the development of associated private sectors. It is believed that industrial expansion occurred elsewhere[42] and at the expense of the financial standing of PEMEX. To make matters worse, the existing regulatory framework of the oil industry did not clarify demarcation between basic and secondary petrochemical products and this lack of a clear definition led to a high degree of uncertainty among government officials with regard to the extent of the involvement of public and private actors in the industry. These factors prompted a heated debate in political circles in relation to determining the regulatory framework for the petrochemical industry (Snoeck 1986). As a result, on 29

[42] For a more detailed discussion of the growth of the secondary petrochemical industry in the 1960s, see a report by the Instituto Mexicano del Petróleo (1973).

November 1958 President Ruiz Cortinez (1952-58) decreed an amendment to the Petroleum Law of Article 27 of the Constitution, which included the legal precepts serving to regulate the oil industry in Mexico. The aim of the amendment was to hand PEMEX the exclusive right to produce basic petrochemicals, while allowing private firms to transform these basic inputs into intermediate and final products[43]. But the classification of inputs proved complex to interpret. On 25 August 1959 President López Mateos (1958-1964) decreed the Regulations of the Petroleum Law of Article 27 of the Constitution with the aim of further defining basic and secondary petrochemical products[44]. These Regulations ensured the State's entitlement to produce basic industrial raw materials, which are derived from 'petrochemical processes based on the first important chemical transformation of hydrocarbon resources and its by-products', while those 'products derived from subsequent petrochemical processes (secondary petrochemical products) are subject to being indistinctly produced by either state-owned or private companies'[45]. Since this set of regulations gave PEMEX the responsibility of supplying basic inputs to those industries the government was seeking to develop under ISI, the expansion of output and installed capacity was a matter of fundamental importance (Snoeck 1986). At the same time, President López Mateos (1958-64) sought to alleviate the financial situation of PEMEX by authorising a rise in the subsided price of oil-derived products[46]. The latter course of action, along with the regulations of the sector that established which petrochemical inputs fell within the scope of government or private investors, allowed PEMEX to undertake more ambitious plans (Dovalí Jaime 1971, Snoeck 1986). Throughout the presidency of López Mateos, the number of petrochemical inputs processed by PEMEX grew from 4 in 1960 to 13 in 1964. Output followed suit by swelling from 56,000 to 397,000 tonnes during the same period, as Figure 5.2 depicts.

[43] See the Official Gazette of the Federation (DOF) of November 29, 1958.

[44] In the case of a product whose definition as basic or secondary is not clear, it is stated in Article 29 of the Regulations (DOF 1958) that the President would make a decision based on a report prepared by PEMEX, the Ministry of National Assets (SEPANAL) and the Ministry of Trade and Industry (SIC).

[45] See the Official Gazette of the Federation (DOF) of August 25, 1959. In the case of conflicts derived from the interpretation of basic and secondary petrochemical inputs, the President would issue a final decision based on a report previously prepared by PEMEX.

[46] It is important to remember that a component of industrial policy during this period was commercialisation of hydrocarbon-derived products at subsided prices, which tended to be lower than those in the U.S.

Figure 5.2 Evolution of PEMEX petrochemical output, 1960-1977
(Thousands of tonnes)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Alkilarilo	3	8	13	9	11	16	8	10	10	7	6	5	7	5	4	6	6	6
Sulphur	34	52	47	44	37	47	34	48	53	58	60	65	62	64	64	90	96	146
Dodecylbenzene	10	20	27	21	26	36	42	48	46	45	49	48	53	49	60	72	63	62
Tetramers	9	19	27	10	25	35	41	47	49	43	35	37	41	35	37	41	50	38
Ammonium sulfide		0.1	0.2	0.2	0.4	0.1	0.02											
Ammonia			57	103	124	121	140	132	163	391	454	460	505	530	525	801	865	944
Carbon dioxide			66	126	149	91	171	161	254	551	631	677	746	751	813	1,092	1,156	1,263
Heavy aromatics					0.7	6	17	26	53	49	38	42	44	52	58	42	34	42
Benzene					7	31	37	52	80	82	77	75	62	82	97	90	99	74
Heptane					0.3	3	3	2	3	3	5	4	4	5	6	7	5	5
Orthoxylene					0.6	5	10	14	15	14	14	14	14	14	17	15	19	14
Hexane					0.8	6	9	7	10	12	14	15	19	20	25	26	30	30
Toluene					15	65	92	88	99	97	89	93	84	101	119	116	132	116
Ethylbenzene						3	7	8	11	13	15	25	28	30	38	27	34	32
Metaxylene and paraxylene						19	34	41	49	44	42	44	40	49	57	52	66	62
Polyethylene							6	16	23	27	26	36	65	87	89	99	94	95
Muriatic acid								1	16	19	42	46	40	40	11	9	13	13
Vinyl chloride								0.7	8	10	19	21	16	16	50	44	60	56
Dichloroethano								3	20	23	39	42	38	40	98	90	104	98
Styrene								10	24	25	28	31	32	33	30	27	35	36
Ethylene							8	24	41	53	60	69	83	166	178	213	228	230
Ethane							15	41	65	84	106	112	159	247	271	324	352	416
Propylene							51	58	62	54	46	71	83	95	92	93	114	137
Acetaldehyde									2	10	17	20	31	26	26	32	47	44
Cyclohexane									0.7	2	0.4	1	5	28	42	35	43	38
Methanol										5	19	17	22	26	30	32	32	33
Isopropanol											3	9	7	8	12	8	4	4
Acrylonitrile												11	17	19	22	20	22	19
Ammonium sulphate												5	8	6	15	15	15	12
Hydrogen cyanide												2	3	3	4	3	4	3
Ethylene oxide													5	13	23	27	25	27
Petrochemical specialities														2	2	2	3	2
Paraxylene														5	33	32	39	35
Hydrochloride acid															30	26	35	38
Aromine																3	4	3
Butadiene																22	19	23
Perchloroethylene																		3
Total	56	99	237	313	397	484	725	838	1,157	1,721	1,934	2,097	2,323	2,647	2,978	3,633	3,947	4,199

Source: PEMEX (1978).

With respect to the stipulations described lines above, it is appropriate to make a parenthesis to indicate that the manner in which petrochemical value-adding activities are currently organised in the Veracruz cluster are rooted in the context of state intervention at that point of time: PEMEX-Petrochemicals produce and supply raw materials that private firms use to yield intermediate (or final) inputs.

Back to the discussion, in the second half of the 1960s the government continued subsidising the growth of associated industries by imposing price controls for PEMEX products. It is alleged that the price index of basic petrochemicals fell from 100 in 1960 to 96.5 in 1966 and to 89.5 in 1972, whereas price indexes for other economic sectors such as agriculture and construction jumped from 120.9 and 130.7 in 1965 to 149.4 and 175.5 in 1972, respectively (Gutiérrez 1975). In the specific case of agriculture, the government paid special attention to this sector. Figure 5.2 demonstrates that the production of ammonia, the main input for the making of fertilisers, substantially increased towards the end of the 1960s. Output skyrocketed from 57,000 tonnes in 1962 to 454,000 tonnes in 1970. Overall, and in spite of the financial restrictions PEMEX endured in the 1960s, output firmly established an upward drift, jumping from 397,000 tonnes in 1964 to 1,934,000 tonnes in 1970 – a figure 34.5 times larger than that in 1960 and 4.9 times that of 1964. Concerning the number of products, the figure reached 26 by 1970 – up from 4 in 1960 and 13 in 1964, the last year of the previous presidential term. These numbers illustrate both the extent of state intervention and, more importantly, the strategic significance of the sector with regard to import substitution. In this respect, PEMEX (1971) reported that import substitution during the 1964-70 presidential term was 5.6 times greater than during the 1958-1964 administration. In the ensuing years, indications were that despite deterioration of the economic climate prospects for the petrochemical sector looked promising.

The 1970s – the waning of the economic model

The involvement of the state, along with trade barriers and rising domestic demand, contributed greatly to the growth of gross domestic product at a rate of 6.4 percent from 1966 to 1972. This upward trend was also mirrored by industrial output, which grew by almost 8 percent annually throughout the same period - more than three times the average growth of the agricultural sector (Figure 5.1). Up to that point, the Mexican economy had performed remarkably well, but the situation was about to take a less

fortunate turn as there was evidence indicating that macroeconomic stability was at risk. Protectionist measures created industrial sectors that grew larger under oligopolistic structures and that had no incentives to export since the domestic market yielded significant returns. In order to grow, this domestic industrial base relied strongly on imported raw materials and machinery for the manufacture of consumer goods. The combination of both these factors led to imports ballooning at a faster rate than exports, thereby widening the deficit of the balance of payments current account (Figure 5.3). While in 1950 Mexico's exports totalled $826 million[47], the value of services and products marketed abroad had reached $6,305 million by 1975. An even more pronounced drift is observed with regard to imports, which in 1950 stood at $768 million. By 1975 imports had skyrocketed to almost $10 billion, resulting in a trade deficit of $3.692 billion in the same year (Ramírez 1986). In many respects, it is thought that what also contributed to holding back the rise of exports was the fixed exchange rate for the peso. The value of the dollar was set at 12.5 pesos from 1954 to 1976 and this policy delivered mixed results, stabilising prices for capital goods demanded by industrialists but also eroding the competitiveness of Mexico's products in international markets (Haber et al. 2008).

Figure 5.3 Mexico's exports and imports, 1940-1975

	1940	1950	1960	1970	1975
	Millions of U.S. Dollars				
Exports of Goods and Services	213.9	826.7	1371.8	2933.1	6305.5
Imports of Goods and Services	191.3	768.0	1672.3	3879.0	9998.4
Balance on Current Account	22.6	58.7	-300.5	-945.9	-3692.9
	Shares %				
Exports/GDP	6.3	9.7	6.1	4.3	4.3
Imports/GDP	8.8	11.8	9.8	7.8	10.0
	Growth Rates (Average annual rates, %)				
		1940-50	1950-60	1960-70	1970-75
Exports of Goods and Services		12.3	4.5	6.7	12.7
Imports of Goods and Services		8.2	6.0	8.7	15.9

Source: Adapted from Ramírez (1986).

[47] Figures in this thesis are expressed in US dollars.

Furthermore, during the first half of the 1970s the government conducted a more aggressive form of interventionism by further encouraging import substitution in the capital goods sector along with public spending (Solís 1982). There is reason to believe that this course of action was driven by the mild economic slowdown the country experienced, which was to some extent attributed to the oil crisis of 1973. Additionally, the administration of President Echeverría (1970-76) believed that greater state intervention was in the interests of economic, social, and political stability. Policy makers were certain that the government had to wield a sizeable deal of control over industrial ownership, investment, and price-setting mechanisms. According to this line of thinking, it was taken for granted that the country 'would be more prosperous, equitable, and less vulnerable to the political pressures of the business sector at home and abroad' (Lustig 1998: 18).

But the interventionist role of the state came at a high price with public finances being rapidly debilitated. Lustig (1998: 19), for example, explains that the 'fiscal deficit rose from 2.5 percent of GDP in 1971 to 10 percent in 1975'. To finance public spending, the government had to borrow heavily from international markets. 'During the same period the foreign public debt rose from $6.7 billion to $15.7 billion', which according to Ramírez (1986) corresponded to 24.4 percent of the GDP in 1975. In addition, 'the inflation rate, Mexico's pride in the previous two decades, reached chronic two-digit levels, rising from 3.4 percent in 1969 to an average of 17 percent in 1973-75'[48] (Lustig 1998: 19). Another significant indication of the deterioration of public finances is the country's external financial solvency. In the 1960s debt service payments, as a percentage of the current value of exports of goods and services, represented 21.5 percent. By 1975 the financial solvency of Mexico worsened to a further 26 percent (IDB 1982).

In the face of these adverse economic events, the Mexican government had no option but to devalue the national currency for the first time in more than two decades. The exchange rate jumped from 12.5 to 19.7 pesos per dollar. Given the extent of the turbulence, the Mexican government commenced negotiations with the International Monetary Fund (IMF) in order to design a program that would alleviate financial imbalances. The IMF called for the implementation of austerity measures that entailed

[48] For a more extensive discussion of the deterioration of Mexico's public finances see Zedillo (1985, 1986).

scaling back public sector employment, reducing the deficit, adjusting the exchange rate, and adjusting prices for goods and services produced by state-owned firms. In 1978, however, the economic circumstances that compelled Mexico to implement this course of action were to take a dramatic turn in the near future. PEMEX announced the discovery of oil fields that converted Mexico into an energy powerhouse almost overnight (Ramírez 1986).

The oil boom

The austerity measures the IMF recommended for Mexico were put on hold. The country's economic perspectives changed as its oil and natural gas reserves climbed from 6,338 million barrels in 1975 to 40,194 million barrels three years later and then to 72,008 million barrels in 1981 (Figure 5.4). In a scenario where world oil supply was not guaranteed, the new energy wealth of Mexico was praised in financial and political circles of the industrialised world, particularly in the United States, a country that had suffered the boycott of Arab oil-producing countries in the early 1970s.

Figure 5.4 Proven reserves and production of oil and natural gas, 1970-1981

Year	Proven Reserves (Million barrels)	Annual Production	Years of Reserves
1970	5,567.50	310.6	18
1971	5,428.40	306	18
1972	5,387.80	326.9	16
1973	5,431.70	335.6	16
1974	5,773.40	402	14
1975	6,338.40	464.8	14
1976	11,160.90	500	22
1977	16,001.70	545.6	29
1978	40,194.00	672.2	60
1979	45,803.40	803.6	57
1980	60,126.40	1,039.10	58
1981	72,008.40	1,228.80	57

Source: Taken from Ramírez (1986).

Although it is not within the scope of this chapter to shed light on the strategic importance of Mexican oil in relation to the energy vulnerability of the United States, it is worth pointing out that Mexico was seen as a more reliable source of supply since it did not belong to the Organisation of Petroleum Exporting Countries (OPEC) (Grayson 1981) - a syndicate that exerted a great deal of control over world oil prices. The

possession of massive hydrocarbon holdings, as Grayson puts it (1979: 431), 'lofts a country's standing within the community of nations, improves its position with the World Bank and other financial agencies... (and) also expands (its) leverage in negotiations with the United States'. To a major extent, this quote clearly demonstrates Mexico's experience during this period.

As these large hydrocarbon reserves needed to be developed, Mexico's demand for foreign borrowing increased and this occurred in the context of a favourable external environment. During this period the price of oil remained high as a result of market intervention by OPEC countries in the wake of the 1973 embargo (Smith 1992), yielding large returns for oil producers. A large proportion of such returns were deposited in the banks of oil-importing countries, which swelled the availability of capital throughout the international financial system. International banks therefore sought to channel these funds into profitable projects, and Mexico, in many respects, was regarded at the time as an attractive option (Haber et al. 2008). As oil output mushroomed from 672.2 million barrels in 1977 to 1,228.8 million barrels in 1981, Mexican authorities managed to obtain low interest rates from foreign lenders (Grayson 1979, Meyer and Morales 1990).

Figure 5.5 Mexico's economic evolution, 1976-1981

	1976	1977	1978	1979	1980	1981
Gross domestic product (annual percentage change)	4.2	3.4	8.2	9.2	8.3	7.9
Annual average inflation (annual percentage change, 1978=100)	15.8	29.1	17.5	18.2	26.3	27.9
Fiscal Deficit as % of GDP	9.9	6.7	6.7	7.6	7.5	14.1
Total external debt (billions of U.S. dollars)	27.5	30.9	34.6	40.3	50.7	74.9
Total public debt (billions of U.S. dollars)	20.8	22.9	26.3	29.8	33.8	53.0
Oil exports as a % of total exports	15.4	22.3	30.7	45.1	67.3	72.5
Current account balance (billions of U.S. dollars)	-3.7	-1.6	-2.7	-4.9	-10.7	-16.2

Source: Adapted from Lustig (1998).

On the domestic front, despite the economic boom – Mexico's economy expanded at a rate of over 8 percent from 1978 to 1981 – there were some warning signs that government officials appeared to overlook (Figure 5.5). A rather alarming drift was the fact that the expansion of exports mostly came from larger oil output. While oil exports accounted for $3.9 billion in 1979, the amount had increased to $14.5 billion in 1981 – representing almost 75 percent of the total value of exports (Nacional Financiera 1984).

Furthermore, a system of low taxation coupled with increasing levels of government spending greatly contributed to an increase in the public deficit. In 1981 the public deficit represented 14 percent of gross domestic product, up from 7.5 percent a year earlier. To ameliorate the problem, the government sought to increase the money supply in the economy, but this measure only led to higher rates of inflation. Consumer prices rose from 15.8 percent in 1976 to 27.9 percent in 1981. As can be noted, the financial concerns of the Mexican government were associated with an increasing public deficit - partially fuelled by PEMEX and the development of oil fields which absorbed 45 percent of the country's borrowing from 1974 to 1981 (Haber et al. 2008). Even though oil output skyrocketed from 500 million barrels in 1976 to 1,228.8 million barrels in 1981 (Figure 5.4) as a result, the country's public finances sharply worsened at the same time.

THE RISE OF THE PETROCHEMICAL INDUSTRY IN MEXICO (1970-1982)

At the beginning of the 1970s there was no doubt concerning the strategic nature of the petrochemical industry with regard to import substitution. While in the 1960s the aim was to industrialise hydrocarbon resources and encourage the development of associated value chains, in the 1970s the objective was to make Mexico self-sufficient in the production of basic inputs demanded by the secondary petrochemical industry and other sectors. As a result, the state-owned basic petrochemical industry tended to be more orientated towards meeting domestic needs – a situation that has continued to the present. For the rest of the 1970s, and the early years of the 1980s, even when output grew at a faster pace than that of the previous decade, PEMEX was unable to cope with increased demand. Whether the latter objective was achieved or not is beyond the scope of this analysis, however, it is necessary to address the fact that output in 1982 was five times greater than that of 1970 (Figure 5.6), according to official estimates (Snoeck 1986).

It has been mentioned in preceding sections that the first half of the 1970-1982 period was marked by an erratic economic environment (1970-76) and that the second half (1977-82) was characterised by both the discovery of oil fields, rapid economic expansion, and serious public financial imbalances. To a great extent, the development of the state-owned petrochemical sector throughout this period is similarly phased.

During the presidency of Luis Echeverría (1970-76), growth perspectives for the sector were constrained by a number of factors. Firstly, a central concern of the government was the establishment of a clearer set of guidelines for while previous administrations had attempted to demarcate the sphere of action for public and private interests, the definition of basic and secondary petrochemical products frequently led to conflicting interpretations – an ambiguity that made private firms hesitant concerning investment plans. President Echeverría tried to solve this problem by introducing legal definitions of what the petrochemical industry is and by further clarifying the scope of action of the government and the private sector[49]. Simultaneously, the government established the Mexican Petrochemical Commission - the regulatory body for the sector with responsibilities including technical enquiries and the interpretation of which products either PEMEX or private firms were allowed to produce. From that moment on, the intention of policy makers was for petrochemical projects to be undertaken in accordance with legal, technical, and economic criteria (DOF 9/2/1971, Rey Romay 1996).

[49] Amendments to the Regulations of the Petroleum Law of Article 27 of the Constitution on February 9, 1971, stipulate that the petrochemical industry consists of the performance of either chemical or physical processes for the making of compounds derived from oil natural hydrocarbons, or from hydrocarbons that are products or by-products of refining operations. Amendments also state that the Mexican government, through PEMEX or associated subsidiaries, is entitled to participate in the production of petrochemical compounds that can be used as basic industrial raw materials resulting from either the first important chemical transformation or the first important physical process of products or by-products derived from refining processes or oil natural hydrocarbons. The new legal precepts also granted exclusive production rights to PEMEX and other state-owned firms for those products that represent a fundamental economic and social interest. To do so, the newly-created Mexican Petrochemical Commission, along with the Ministry of National Assets, determines the strategic character of those inputs in question. In relation to petrochemical inputs resulting from subsequent processes, the amendments pointed out that these may be produced by either state-owned firms or by private firms. With regard to the participation of Mexican nationals in the social capital of private petrochemical firms, this must stand at 60 percent, which at the same time indicates that the participation of foreign investors in the secondary petrochemical sector cannot be higher than 40 percent (DOF 9/2/1971).

If the financial constraints of PEMEX[50] weren't enough in themselves, what also cast a shadow over petrochemical prospects was the complex co-ordination entailed by backward and forward linkages. The construction of proposed state-owned petrochemical plants was not only determined by the availability of inputs (natural gas and naphthas), but also by the existence of firms demanding that specific group of products. Bottlenecks with regard to engineering and input supply estimates along with the cancellation of projects by private investors are similarly said to have contributed to slowing down the expansion of petrochemical output by PEMEX (Snoeck 1986).

In addition to the above mentioned factors, it could be initially inferred that the relatively adverse economic climate of the first half of the 1970s may have also prevented the petrochemical industry from expanding. However, in general terms this was not the case. Output climbed from 1,934 thousand tonnes in 1970 to 2,978 thousand tonnes in 1974. All in all, what is critical to emphasise is that the growth rate under these circumstances was slower than that for ensuing years. The perspectives of the petrochemical industry began to change in the final two years of the Echeverría term. The 1973 oil embargo, the discovery of hydrocarbon fields in southern Mexico (Grayson 1979, Smith 1992), and an authorised increase in subsided prices for basic inputs allowed PEMEX to accelerate the construction of plants. By 1976 PEMEX had put into operation seventeen new plants (PEMEX 1983) that added 2,690 thousand tonnes to the overall installed capacity, which in that year reached 5,039 thousand tonnes. This additional capacity led to PEMEX output totalling 3,947 thousand tonnes in 1976 – 1.32 times larger than that of 1974 and more than twice the figure for 1970. During this entire period, the pace at which output grew stood at 12.7 percent annually (Figure 5.6).

At this point it is pertinent to go back to the discussion of the industrial policy introduced by the government during this period. It is widely accepted that in addition to financial imbalances, ISI accentuated both the spatial concentration of economic activities and social inequality (Blanco 1981). In an attempt to alleviate these shortcomings, the Echeverría administration considered the creation of growth poles - peripheral regions embodying certain features that encourage industrial development (Snoeck 1986). The construction of state-owned petrochemical plants was central to this

[50] It is important to remember that PEMEX output was supplied to domestic user firms at subsided prices – a government decision that prevented PEMEX from expanding capacity in line with demand.

purpose as the availability of basic inputs in a particular locality would lead to a clustering of user firms. A case in point is the petrochemical cluster in southern Veracruz – a region that eventually became home to the largest agglomeration of industrial firms in southern Mexico. In this respect, NAFIN (1976), for example, estimated that the state of Veracruz accounted for 49.4 percent of total investment by the private secondary petrochemical sector in 1973.

Within the period examined in the present section, the second phase of development of the petrochemical industry runs in parallel to the *sexenio*[51] of López Portillo, Mexico's president from 1976 to 1982. As one can observe in Figure 5.6, PEMEX petrochemical output escalated from 3,974 thousand tonnes in 1976 to 10,590 thousand tonnes in 1982, with this being primarily the result of putting into operation fifty seven plants (PEMEX 1983). The aggregated production capacity during this period reached 9,844 thousand tonnes – 3.66 times greater than the figure reported for the previous presidential term. The explanation for such accelerated growth is the fact that the presidency of López Portillo was distinguished by a favourable economic setting. High rates of economic growth coupled with huge hydrocarbons reserves discovered off the Campeche coast in south-eastern Mexico and low interest rates abroad (Ramírez 1986) favoured the reaching of PEMEX targets. On the policy making front, what also contributed to this was that the government still considered the sector pivotal with regard to the industrialisation of crude and natural gas and the geographical organisation of production. In this way, the state-owned petrochemical industry, along with another eight economic activities was given priority by government officials in terms of public spending (De Oteyza 1977).

As to PEMEX investment during the 1976-82 *sexenio*, it is worth considering the establishment of ammonia plants at the Cosoleacaque petrochemical complex and the construction of La Cangrejera petrochemical complex in Coatzacoalcos – projects that ballooned PEMEX output at the time. In the first case, what led PEMEX to expand the installed capacity for ammonia was the importance of this input for overhauling agricultural productivity, an issue of great concern for Mexico's government in terms of food self-sufficiency, and the increasing availability of natural gas[52] in southern

[51] It refers to the six-year presidential period in Mexico.
[52] Natural gas is the input used to produce ammonia, which at the same time is used in the making of fertilisers.

Veracruz where adequate infrastructure already existed. From 1977 to 1981 PEMEX brought 5 plants into operation with the capacity to yield 2,080 thousand tonnes of ammonia and 2,616 thousand tonnes of carbon dioxide. As a result, ammonia output rose from 864 thousand tonnes in 1976 to 2,469 thousand tonnes in 1982 – representing 23.5 percent and 23.3 percent of PEMEX overall output for the same years, respectively. As for carbon dioxide, output jumped from 1,156 thousand tonnes in 1976 to 3,552 thousand tonnes in 1982 - representing 29.2 percent and 33 percent of PEMEX output for each of the years mentioned. A more sound indication of the importance of these inputs is the fact that both accounted for 51.2 percent of PEMEX petrochemical output in 1976 and a further 57 percent in 1982 (PEMEX 1983, 1989). In this context it is necessary to highlight the fact that four of these plants, which represented 85 percent of the recently added ammonia and carbon dioxide production capacity, were situated at the Cosoleacaque petrochemical complex. This is to say that the southern region of the state of Veracruz, and in particular the city of Coatzacoalcos, was considered fundamental to the industrial decentralisation policy envisioned by the government (Snoeck 1986).

Figure 5.6 PEMEX petrochemical output and installed capacity, 1970-1982
(Thousands of tonnes)

	Installed capacity	Annual change (%)	Output	Annual change (%)	Capacity utilisation (%)
1970	2,349	-	1,934	-	82.33
1971	2,494	6.17	2,097	8.43	84.08
1972	2,990	19.89	2,323	10.78	77.69
1973	3,299	10.33	2,647	13.95	80.24
1974	4,059	23.04	2,978	12.50	73.37
1975	4,409	8.62	3,633	21.99	82.40
1976	5,039	14.29	3,947	8.64	78.33
1977	6,384	26.69	4,199	6.38	65.77
1978	7,659	19.97	5,788	37.84	75.57
1979	7,840	2.36	6,345	9.62	80.93
1980	8,886	13.34	7,224	13.85	81.30
1981	11,676	31.40	9,160	26.80	78.45
1982	14,883	27.47	10,590	15.61	71.16

Source: PEMEX (1978, 1991), Snoeck (1986).

Parallel to the expansion of Cosoleacaque, PEMEX carried out an even more ambitious project in Coatzacoalcos. The aim was to establish twenty-two plants at La Cangrejera complex[53]. Although construction commenced in 1974, the adverse economic climate of the mid 1970s and early 1980s, along with the precarious financial standing of PEMEX, meant that La Cangrejera did not become fully operational until 1984 (Snoeck 1986). In spite of the financial and technical difficulties faced, which are beyond the scope of this thesis, it is necessary to address the fact that La Cangrejera further boosted the position of southern Veracruz in the national petrochemical spectrum. By 1982, the year in which twelve of the projected plants began producing, it is estimated that the state of Veracruz was home to 70 percent of PEMEX overall installed capacity, while the share in 1970 was 62 percent (PEMEX 1971, 1983). In absolute terms, the latter means that petrochemical installed capacity in Veracruz stood at 8,683 thousand tonnes in 1982 – of a total of 10,590 thousand tonnes nationwide. Furthermore, in the case of the secondary petrochemical industry, users of the basic inputs produced by PEMEX, 21.4 percent of the country's installed capacity was reported to be located in the state of Veracruz (IEPES 1982).

In view of the evidence, there is no doubt that the construction of petrochemical plants in southern Veracruz was at the core of the PEMEX strategy with respect to installed capacity expansion in the second half of the 1970s and early 1980s. Much of this remarkable development of the public petrochemical industry not only occurred in the midst of the oil boom (Figure 5.6), it also materialised in spite of a declining economic climate. The crisis that erupted in 1982 set the tone for the development of the sector in the decades ahead.

THE 1982 DEBT CRISIS

As demonstrated in the previous two sections, public finances were seriously weakened towards the end of the 1970s and more so in the early 1980s. Public external debt climbed from $23 billion in 1977 to $53 billion in 1981, and to a further $60 billion in 1982 (Haber et al. 2008, Hamilton 1984, Lustig 2001). If the external debt of the private sector is added, the number soars from $30.9 in 1977 to $74.9 billion in 1981 (Figure

[53] The installed capacity of La Cangrejera was projected at 3,500 thousand tonnes a year. Ethylene, ethylene derivatives, and aromatics constitute the main production lines.

5.5). The government sought to finance its growing deficit through external borrowing, which was contracted on the assumption that interest rates would remain low and the price of oil per barrel would continue to be attractive. By 1981, and unfortunately for Mexico, the external panorama took a turn for the worse. The price of oil began a downward drift, interest rates soared, and external credit became increasingly meagre (Lustig 2001, Ramírez 1986). As it was imperative to counteract this emerging disadvantageous scenario, policy makers devised a series of questionable measures. To meet the galloping public financial needs, for example, the government turned to short-term borrowing. By 1981 Mexico's short-term debt escalated to $10.8 billion, up from $1.5 billion a year earlier (Cárdenas 1996). This approach to alleviating public imbalances exacerbated the maturity of the external debt with, according to Lustig (1998), almost half of it requiring repayment or refinancing in 1982.

Given this disadvantageous scenario, it was no longer reasonable to maintain the value of the peso through borrowing so the government decided to devalue the national currency in January 1982. The exchange rate jumped from 27 pesos to 47 pesos per U.S. dollar. It is believed that devaluation of the peso was intended to slow down the flight of capital and the value of imports with the aim of boosting the availability of dollars to the central bank. However, evidence suggests that this measure was counterproductive. It made the burden of public and private external financial obligations even greater as the dollar value of the debt remained unchanged (Lustig 1998).

In addition to this, while the government took steps to prevent citizens from taking dollar-denominated savings out of the country, the long and porous border between Mexico and the United States aggravated the flight of capital. Powerless to prevent the drain of dollars, on August 20, 1982, the government had no alternative but to announce its inability to 'repay $10 billion in short-term debt that would fall due a few days later' (Haber et al. 2008: 64). With that decision, Mexico, 'the world's first and foremost debtor nation at that time, kicked off what would come to be called the debt crisis' (Adler Hellman 1997: 2). To make matters worse, President Jose López Portillo (1976-1982), worried that the private sector would accelerate the flight of capital, decided to take full control of the financial sector to prevent that from occurring. On September 1, 1982, López Portillo decreed the nationalisation of the banking system (Del Angel-Mobarak et al. 2005).

In the face of these events, 1982 is widely marked in the relevant literature as a turning point in Mexico's development strategy. With public external debt of $60 billion, an inflation rate of 98.8 percent, devaluation of the national currency, a drop in GDP of 0.6 percent, an employment rate that jumped to 8 percent, foreign dollar reserves equal to just one month of imports, financial turmoil, higher international interest rates, and a falling oil price, the Mexican economy started out on the bumpy road it would be forced to take over the coming years (Haber et al. 2008, Lustig 1998). Whether the fortunes of the Mexican economy over those years are attributed to adverse external circumstances or economic mismanagement is beyond the scope of this thesis, although it is worth pointing out that Mexico's external debt default, the nationalisation of the banking system, and the prevailing economic conditions seriously damaged the credibility of the government and political elites at home and abroad. Throughout the rest of the decade (and beyond) Mexico embarked on a process of economic liberalisation with far-reaching implications. To a great extent this series of policies created a context that would hinder the development of PEMEX, its petrochemical division, the private firms situated in the Veracruz cluster, and value chains of petrochemical origin.

CONCLUDING REMARKS

The establishment and subsequent growth of the petrochemical industry from the 1950s to the 1970s was not only accompanied by favourable economic circumstances, the approach to industrial development that dominated policy making at that time is also viewed as critical in that respect with the Mexican state acting in the national interest. By expanding output and the installed capacity of basic petrochemical inputs, the government managed to encourage the development of indigenous value chains. Measured in these terms, the intervention of the state delivered positive results with oil boom of the late 1970s also contributing to this perception.

Nonetheless, as noted by Lustig (1998), it is equally important to draw attention to the fact that government officials instigated questionable policies, mainly with respect to financing public expenditure. The administration of López Portillo continued to borrow heavily upon the assumption that international interest rates would remain low and crude prices high. Unfortunately, the hydrocarbon wealth did little to prevent Mexico from economic unrest. The 1982 collapse not only brought economic growth to a halt, the government also abandoned import-substituting industrialisation. In the wake of this

context, the role of PEMEX and its petrochemical industry was set to change in the forthcoming years.

6

MEXICO IN TIMES OF NEOLIBERALISM

Understanding the complex scenario of the petrochemical industry

INTRODUCTION

It has been widely documented that Mexico found itself on the verge of financial collapse in 1982 – the year government officials sent shockwaves through the international community by defaulting on external debt obligations. This decision, along with the gloomy economic imbalances persisting at the time, is widely regarded as having prompted the country to abandon the inward-looking strategies of economic development introduced since the administration of Lázaro Cárdenas (1934-1940). Given that it was imperative for the government to restore economic stability and growth all the indications were that Mexico had no alternative but to set its sights on market-friendly export-driven policies. In the years ahead, under the tutelage of multilateral organisations such as the International Monetary Fund (IMF) and the World Bank (WB), which proceeded in association with the country's creditors, the local political elite pushed Mexico towards a process of economic liberalisation. Under the new economic regime the tendency was for the market to replace state regulation, private ownership to displace public ownership, and competition to replace surrogate protectionism (Lustig 2001).

At first, the dismantling of the state-owned productive apparatus and the opening of the economy to foreign trade and investment were the cornerstone of the program (Ramírez 1995). Such development foundations, however, proved insufficient to reinstate economic stability in the way the government had hoped. After a decade of reforms, policy makers considered it necessary to take neoliberalism to the next level. To some extent, the inroads of the economic liberalisation program of the 1980s eased the institutionalisation of additional market-based policies in the years ahead. The most important of these was the North American Free Trade Agreement (NAFTA) – which

tied the economic structure of Mexico to that of the United States and Canada. NAFTA was the instrument through which Mexican political elites ensured that further instrumentation of neoliberalism 'would survive the pendulum policy shifts of future sexenios' (Dresser 1998: 245).

With respect to the analysis proposed in this thesis, it is argued that the development strategy adopted by Mexico in the 1980s contributed to the eventual creation of a multi-dimensional setting that has hindered not only the development of PEMEX and its petrochemical division, but also that of the Veracruz cluster and associated value chains. With regard to public and private firms in the Veracruz cluster, the problem that arose concerns the nature of the complex context that has allegedly constrained industrial upgrading, collective efficiency, and the quality of vertical linkages in the locality. It is therefore fundamental to situate our case study within a broader empirical background, or rather within the political economy of Mexico. The discussion must follow a timeline that includes the strategy the government adopted to stabilise the economy in the wake of the 1982 debt crisis, the increasing U.S. dependence on imported oil and the role of the Mexican hydrocarbon industry in relation to this dependency. The chapter analyses how these *national* and *supranational determinants* (Figure 3.4) contributed to persuading government officials to minimise the scope of state intervention in the petrochemical industry on the one hand and determine the horizontal restructuring of PEMEX on the other - political decisions understood as a step towards the dismantling of the state-owned petrochemical sector. Last but not least, the chapter also discusses the post-NAFTA era context and the threat of privatisation for PEMEX-Petrochemicals resulting from the 1994 peso crisis.

THE ROAD TO A FREE MARKET ECONOMY

In the two presidential regimes that followed the 1982 economic crisis, the roots of which were briefly discussed in Chapter 5, Mexico underwent a process of profound change. During this period, given the failure of the former development model, there was widespread belief that the state must play a less important role in economic planning (Biersteker 1990). Mexican political elites, which were convinced that the prescriptions of the IMF and the WB would restore economic growth and stability, implemented a series of policies aimed at giving market forces a much greater influence in economic matters. Miguel De La Madrid (1982-1988) took office as Mexico's

president in December 1982 – months after López Portillo, the preceding president, declared a default on the country's external debt and decreed the nationalisation of the banking system (Haber et al. 2008, Del Angel-Mobarak et al. 2005). The new administration inherited an economy in tatters with an external debt of $92.4 billion, a public deficit of 16.9 percent of GDP, rampant inflation, and capital flight and these factors set the tone for the upheaval experienced throughout the 1980s (Lustig 1998). These circumstances indicated it was time for Mexico to distance itself from inward-looking strategies.

Mexico's vulnerable position prompted policy makers to seek the assistance of the IMF and the WB concerning debt restructuring. Needless to say, such assistance came at a price and Mexico was forced to introduce a structural adjustment program (SAP). For the first half of his term, President Miguel De La Madrid envisaged a stabilisation program entailing currency devaluations, restrictions on imports, and deep public spending cuts (Lustig 1998). In the short term, the strategy seemed to work. Non-oil exports rose from approximately $400 million during the first quarter of 1982 to over $600 million in the first quarter of 1983. Imports fell from roughly $2 billion per month in 1981 to less than $600 million during the first months of 1983 (Ten Kate 1992). As to public spending, government officials managed to reduce the deficit from 16.9 percent in 1982 to 8.6 percent of GDP in 1983. Nonetheless, all these measures proved insufficient to counterbalance both persistent financial imbalances and an adverse external environment as the national economy continued to perform poorly. While in 1982 external debt stood at $92.4 billion, the amount jumped to $96.6 billion in 1985 - representing 54.2 percent and 52.4 percent of the country's GDP in each of the years indicated. The international price of oil consistently tumbled throughout the first half of De La Madrid's tenure – from $28.7 per barrel in 1982 to $25.3 in 1985. Furthermore, nominal interest rates in the U.S. remained high. The cost of capital averaged 12 percent from 1982 to 1985 - a rate that obliged Mexico to transfer 6.5 percent of its yearly GDP to international creditors during the same period (Lustig 1998).

Figure 6.1 demonstrates that the De La Madrid administration failed to stabilise the economy. The approach of the IMF and the dogmatic viewpoint of Mexican policy makers overestimated the effectiveness of the measures introduced. The actual performance of inflation, public sector borrowing requirements (PSBR), and real GDP

growth was much worse than first anticipated. The IMF projected that inflation would shrink from 55 percent in 1983 to 18 percent in 1985. In point of fact, prices skyrocketed at a rate of 80.8 percent in 1983 and 63.7 percent in 1985. The PSBR as a percentage of GDP followed a similar pattern. IMF officials believed that the public deficit would fall from 8.5 percent in 1983 to 3.5 percent in 1985. Unfortunately, the PSBR jumped from 8.6 percent to 9.6 percent during the same period. With regard to GDP, the original IMF projection calculated that the economy would achieve no growth in 1983 and that the rate of expansion would stand at 6 percent in 1985. Instead, GDP collapsed by 4.2 percent in 1983 and attained a rather modest growth rate of 2.6 percent by 1985 (Lustig 1998). The determinants behind such failure are beyond the scope of this chapter, but what is important to note is that the Mexican government was compelled to step up the pace of economic reforms in the years ahead.

Figure 6.1 Key economic variables, 1981-1990

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
GDP (%)	8.8	-0.6	-4.2	3.6	2.6	-3.8	1.7	1.3	3.3	4.5
Public sector borrowing requirement (as % of GDP)	14.1	16.9	8.6	8.5	9.6	15.9	16	12.5	5.6	3.9
Total external debt (billions of U.S. dollars)	74.9	92.4	93.8	96.7	96.6	101.0	107.5	100.4	95.3	104.3
Public sector external debt (billions of U.S. dollars)	53.0	59.7	66.6	69.4	72.1	75.4	81.4	81.0	76.1	77.8
U.S. nominal interest rate (%)	18.9	14.9	10.8	12.0	9.9	8.3	8.2	9.3	10.9	10.0
Interest payments (billions of U.S. dollars)	9.5	12.2	10.1	11.7	10.2	8.3	8.1	8.6	9.3	9.0
External debt as % of GDP	29.9	54.2	63.0	55.0	52.4	77.7	76.5	58.1	46.1	42.7
Debt service as % of GDP	6.26	7.1	6.78	6.65	5.53	6.38	5.76	4.97	4.49	3.68
Export oil price (U.S. dollars per barrel)	33.2	28.7	26.3	26.8	25.3	11.9	16	12.2	15.6	19.2
Oil exports as % of total exports	72.5	77.6	71.8	68.6	68.2	39.3	41.8	32.6	22.4	24.8
Inflation (annual average)	27.9	58.9	101.9	65.4	57.7	86.2	131.8	114.2	20	26.7
Minimum wage (annual percent change)	1.0	-0.1	-21.9	-9.0	-1.2	-10.5	-6.3	-12.7	-6.6	-9.1
Net resource transfers to GDP (%)	n.a.	6.3	7.6	6.8	6.9	4.2	2.9	6.8	1.2	0.4

Source: Taken from Lustig (1998).

Due to this state of affairs, the country once again faced a balance-of-payments crisis in mid-1985. One of the fundamental consequences of the latter was that as the country failed to meet fiscal targets, access to additional external financing was limited in that year and for much of 1986. Policy makers soon realised that fiscal and monetary policies were by no means sufficient to counterbalance public imbalances and that this time the search for economic stabilization needed to be bolstered by trade liberalisation and a less prominent role for the state in economic affairs (Lustig 1998).

In keeping with this rationale the government unilaterally resolved to reduce the share of domestic production protected by import licensing from 92.2 percent in June 1985 to 47.1 percent in December of the same year – a drop of over 45 percent in a span of six months (Figure 6.3). With respect to state intervention, the government sped up the privatisation of state-owned firms. The number of firms turned over to the private sector soared from 7 in the first two years of the sexenio to 32 in the year 1985 (Presidencia de la República 1982-2003). With this decision the government sought to persuade multilateral organisations and potential domestic and foreign investors of the government's determination to perform comprehensive structural reforms (Ten Kate 1992, Rodrik 1989).

On the international front, the economic situation in Mexico raised concerns throughout the financial system. Since U.S. commercial banks were largely exposed not only to Mexican debt but also to that of several other indebted developing countries. This situation jeopardised the stability of the U.S. banking system (Monteagudo 1994). James Baker, U.S. Secretary of the Treasury at that time, devised a plan aimed at assisting heavily indebted countries to meet debt obligations (Baker 1985). It is reported that the U.S. government conditioned his mediation between Mexico and creditors to both the implementation of substantial structural reforms and the reaching of a new agreement with the IMF (The Economist 1986). The economic policies proposed by the Baker Plan were thus incorporated by the WB and the IMF as conditions for the financial assistance provided to Mexico (Monteagudo 1994). In 1986, after commercial banks and multilateral institutions agreed on rescheduling the country's external debt, the government was coerced into furthering the structural adjustment program already initiated. The privatisation of state-owned firms (Ramírez 1995, Chong et al. 2005) and

the liberalisation of trade (Ten Kate 1992, Weiss 1992) gained momentum in the second half of the De La Madrid tenure.

It is understood that the most sweeping expression of the structural adjustment program was the reduction of the role of the state in the economy (Ramírez 1995). The adverse circumstances of several developing economies in the 1980s coupled with an inefficient industry resulting from protectionist practices is what led to the emergence of an uncontested consensus among multilateral financial organisations, international banks, U.S. government officials, and scholarly circles that economic planning must shift from state intervention to a greater reliance on market forces (Biersteker 1990). In the case of Mexico, as previously noted, the financing of development was conditioned to either shutting down state-owned firms or turning them over to the private sector. Figure 6.2 reveals that under the De La Madrid government, the number of public firms tumbled from 1,155 at the beginning of the term to 666 in 1988 (Chong et al. 2005).

At present, the fact that expansion of the state-owned petrochemical industry - most of which is situated in southern Veracruz - is no longer a priority for policy makers must be understood in the light of the approach to development embraced during these years. Even though the De La Madrid administration did not contemplate privatisation of the petrochemical industry (as it did with other state-owned sectors), the nature of economic and industrial policies instigated under his leadership set up the foundations that eventually restrained the extent of state intervention in the sector and with that the development of the Veracruz cluster and the quality of local inter-firm linkages.

Figure 6.2 Evolution of Mexico's privatisation program, 1982-2003

State-owned enterprises	1982-88	1989-93	1994-2003
Total at the beginning of the period	1,155	666	258
Creation	59	39	108
Liquidations/shutdowns	294	193	58
Mergers	72	17	16
Transfers	25	11	26
Privatisations	157	226	56
In process			37
Total at the end of the period	666	258	210

Source: Taken from Chong and López-De-Silanes (2005).

Turning now to the issue of trade liberalisation, which primarily consisted of the elimination of import licenses (Figure 6.3), the aim was to increase competition for privatised sectors in the domestic market. Notwithstanding government reduction of domestic production protected by import licensing in 1985, the IMF and the WB remained sceptical in many respects. What contributed to weakening the credibility of the trade policy was that goods not contemplated under such scheme continued to represent almost half of the domestic production and the fact that the average import tariff was increased from 23.5 percent to 28.5 percent in order to compensate import liberalisation. The 20 percent devaluation of the peso in July 1985, which held back the rise of imports, also played a role (Ten Kate 1992). As this credibility was a critical ingredient in the allocation of IMF and WB funds for the financing of the structural adjustment program in Mexico, it was therefore imperative for the government to demonstrate the definitive character of trade reform (Rodrik 1989). Mexico's access to the General Agreement on Tariffs and Trade (GATT) in August 1986 (Story 1986) was clearly a step in this direction. In addition, the subsequent reduction in the proportion of domestic production covered by import licensing, which plunged from 47.1 percent in December 1985 to 21.3 percent in 1988, is also interpreted as a move to shore up the confidence of creditors and potential investors in the government plan (Ten Kate 1992).

Figure 6.3 Domestic production value protected by import licensing

	June 1985	December 1985	December 1986	December 1987	December 1988	December 1989
Oil and Gas	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Petroleum refining	94.3%	87.4%	87.2%	87.2%	87.2%	86.4%
Transport equipment	99.0%	77.0%	64.2%	58.0%	41.4%	41.0%
Total	92.2%	47.1%	39.8%	25.4%	21.3%	19.8%

Source: Taken from Ten Kate (1992).

While the rationale behind Mexico's rapid economic liberalisation in the 1980s is associated with the belief that it would increase efficiency for both the domestic industrial apparatus and the entire economy on the one hand (Ten Kate 1992, Baer 1994), and that it would promote sustained economic growth on the other (Baker 1985), the evidence indicates that the speed at which such reforms were introduced was

fundamentally determined by the state's need for capital inflows to comply with debt servicing. This view is arguably sound if we bear in mind that throughout the second half of the sexenio (1986-88) net capital transfers to the industrialised world accounted for 4.6 percent of GDP (Gurría 1991) – a shocking figure given that economic growth over the same period of time averaged -0.26 percent (Figure 6.1).

In view of IMF and WB prescriptions, government stabilisation measures such as currency devaluations and public spending cuts, and an adverse external economic environment, the economic performance of Mexico continued to languish as late as 1987. The country was marked by a frail economic growth rate of 1.7 percent, public sector borrowing requirements that made up 16 percent of GDP, debt servicing that stood at 5.7 percent of GDP, an annual inflation rate of 131.8 percent, and inflation-adjusted minimum wages that deteriorated at a negative rate of 6.3 percent (Figure 6.1). In a further attempt to ameliorate these impasses, De La Madrid orchestrated an arrangement in which the state, along with labour, agricultural, and business syndicates, teamed up to push for the convergence of policies. The Economic Solidarity Pact (PSE) was launched in the same year. Besides trade liberalisation and privatisation[54], the PSE also relied on fiscal deficit cuts and a comprehensive price and wage control policy. The PSE started to produce moderate positive results in 1988 with the economy growing 1.3 percent, inflation slowing down towards the end of the year, non-oil exports rising by 15.2 percent, foreign reserves jumping from $13.7 to $16 billion, and real wages worsening at a rate lower than that of 1983 (Lustig 1991, 1998). In spite of the fragility of these variables, the subsequent administration was provided with somewhat more solid preconditions to broaden the scope of market-orientated policies.

NEOLIBERALISM RELOADED

The extent to which the array of *sectoral*, *national*, and *supranational determinants* have shaped both the development of the Veracruz petrochemical cluster and *governance* structures prevailing in transactional linkages between PEMEX-Petrochemicals and local private firms is strongly associated with the deepening of trade liberalisation in the early 1990s. In that respect, it is broadly acknowledged that the

[54] The speeding up of privatisation was central to the PSE. The number of public firms turned over to the private sector rose from 22 in 1987 to 66 in 1988 (Presidencia de la República 1983-2003).

signing of the North American Free Trade Agreement is the pinnacle of that process and for that reason is essential to illustrate the political and economic circumstances leading to the inauguration of this agreement between Mexico, the United States, and Canada in 1994.

In the light of the rather harsh economic circumstances endured by Mexicans towards the end of the De La Madrid term, the Revolutionary Institutional Party (PRI), which had held power since 1928, was at risk of losing the 1988 presidential election. After a highly contested ballot vote, Carlos Salinas, the PRI candidate, managed to be sworn in as the country's president in the midst of widespread claims of fraud. The hostile economic conditions, pervasive social discontent, and the lack of confidence shown by domestic and foreign investors in the government urged the new administration to take the market reforms that De La Madrid had inaugurated to the next level (Haber et al. 2008).

By the time Salinas (1988-1994) took office in December 1988, inflation had begun to show signs of slowing. Official estimates indicate that prices increased 1.2 percent a month throughout the second half of the year. On the other hand, economic growth continued to be rather disappointing. It is argued that the enormous net capital transfers Mexico yielded as a result of the external debt burden is what really compromised economic recovery (Lustig 1998, Gurría 1991). It is important to note that what fuelled the extent of capital transfers was the private sector's lack of confidence in the government. Potential domestic and foreign investors remained of the credibility of economic reforms so it was therefore of critical importance to design policies to boost the confidence of private investors in order to increase capital inflows in the form of direct investment and capital repatriation (Lustig 1998).

One of the first measures undertaken by Salinas and his U.S.-educated economic team (Babb 2005, Lindau 1993) was to launch the Pact for Economic Stability and Growth (PECE). The PECE sought to 'underscore the government's commitment to growth without sacrificing price stability' (Lustig 1998: 55). Salinas therefore negotiated restructuring of the external debt with the U.S., the WB, and the IMF as part of the so-called Brady Plan[55]. Even if servicing of the debt decreased by $1 billion a year (Orme

[55] Mexico signed the final Brady Plan agreement in February 1990.

1996), it is claimed that the most important feature of the restructuring was the implicit support given by the U.S. to the Mexican reform program. With respect to foreign investment, Salinas took steps towards the elimination of restrictions on the ownership of manufacturing firms and the purchase of shares in domestic firms (Haber et al. 2008, Clarkson 2002). Following the trend established by De La Madrid, Salinas also concentrated on the divestiture of public assets. The banking system, expropriated in 1982, along with firms ranging from steel plants to airlines and Teléfonos de Mexico (TELMEX), the landline monopoly company, were sold to private investors (Pastor and Wise 2002). During the first three years of the Salinas term, for example, 193 state-owned firms were privatised, while the number during the last three years of the previous sexenio stood at 118 (Presidencia de la República 1982-2003). Figure 6.2 also indicates the pace at which the state-owned productive apparatus was dismantled under Salinas. The number of public firms sank from 666 at the start of the sexenio to 258 by the end of it. Most of the resources these transactions yielded are reported to have contributed to moderate financial imbalances for the government (Pill 2002).

Although debt restructuring did little to reduce the financial burden (Figure 6.1), the fact that negotiations with creditors were accompanied by both the privatisation of state-owned firms and changes to the foreign investment law helped the economy respond favourably and re-established government credibility. Public sector borrowing requirements, for example, dropped from 12.5 percent in 1988 to 3.9 percent in 1990. The economy expanded at a rate of 1.3 and 4.5 percent over the same period and inflation was brought down to 20 and 26.7 percent in 1989 and 1990 – a sizeable plunge since prices soared 114.2 percent in 1988. The government also experienced a certain degree of success with respect to net transfer resources, the ratio of which to GDP plunged sharply from 6.8 percent in 1988 to 0.4 percent in 1990. To a significant extent, such a fall in capital transfers is associated with the rise of capital inflows that occurred soon after the government announced the reprivatisation of banks in May 1990. Nevertheless, much of the capital inflows corresponded to portfolio investment, which in 1991 was reported to have increased fivefold in comparison to 1990 (Lustig 1998).

The most significant shortcoming of the Salinas administration, at least for the first three years, was that, in spite of the policies introduced, foreign direct investment did not significantly vary with respect to the final three years of the De La Madrid term.

What is more, as late as 1993, the fifth year of the sexenio, the ratio of fixed capital formation to GDP continued to stand at its 1988 level. The much expected upsurge in FDI inflows proved harder to materialise and after almost a decade of reforms, it appeared that the Mexican economy was still haunted by the ghosts of state intervention and economic nationalism – factors that helped create the perception among investors that Salinas's structural reforms could be reversed by future administrations and turn the country back to protectionism and nationalisation practices. As economic growth in the short- and medium-term was believed to rely to a significant extent on FDI, it was therefore crucial to eliminate the uncertainty associated with government policies (Haber et al. 2008, Dresser 1998, Orme 1996).

The Mexican government soon understood that a free trade agreement with Canada and the United States, the country's largest source of investment and trading partner, would greatly help in ameliorating the lack of confidence in the economic liberalisation program. The Bush administration and the Canadian government responded favourably to Salinas's proposal and kicked off negotiations in August-November 1991. It is worth mentioning that by that time tariff barriers between Mexico and the United States were already low (Krugman 2008, Maxfield and Shapiro 1998). The trade liberalisation initiated by De La Madrid (Figure 6.3) was extended by Salinas and immediately prior to NAFTA coming into effect, it is reported that just 11 percent of domestic production was still protected by import licensing and that the average import tariff stood at 13 percent. In the case of the United States, import tariffs applied to Mexican goods averaged 3.5 percent. With these figures in mind, it would therefore be imprecise to contend that NAFTA primarily addressed free trade between members since the most significant feature of the deal was that it included a series of non-trade issues intended to establish a framework that would help protect the interests of investors (Haber et al. 2008). In the end, NAFTA is interpreted as the instrument used by the government to more firmly establish market-orientated policies and accelerate social and economic integration with the rest of North America (Dresser 1998). From the U.S. perspective it is certain that NAFTA allowed for the introduction of mechanisms to protect investment, but what is of particular significance is the fact that NAFTA also represented the ideal channel for demanding further liberalisation of the Mexican oil industry - a matter that had long been a main concern in U.S. policy circles. In a scenario where U.S. dependency on oil from volatile regions continued to grow, access

to Mexico's sizeable hydrocarbon reserves was considered an issue of paramount importance for the U.S. energy security strategy (Fagen 1979). In this respect, the vertical integration of PEMEX, to which the petrochemical complexes situated in the state of Veracruz are central, may be interpreted as representing a danger to both the long-term availability of crude intended to feed the industrial apparatus of the U.S. and the prospects of U.S. oil firms to capture a larger share of the Mexican petrochemical market. The dismantling of the Mexican state-owned petrochemical industry (and development of the Veracruz cluster) must therefore also be understood in this context.

U.S. OIL DEPENDENCY AND PEMEX

Before focusing on what economic liberalisation in the 1980s and 1990s entailed for the petrochemical industry, it is of utmost importance to determine how *supranational determinants* such as the United States oil dependency may be associated with the current standing of PEMEX[56] and that of the Veracruz cluster[57].

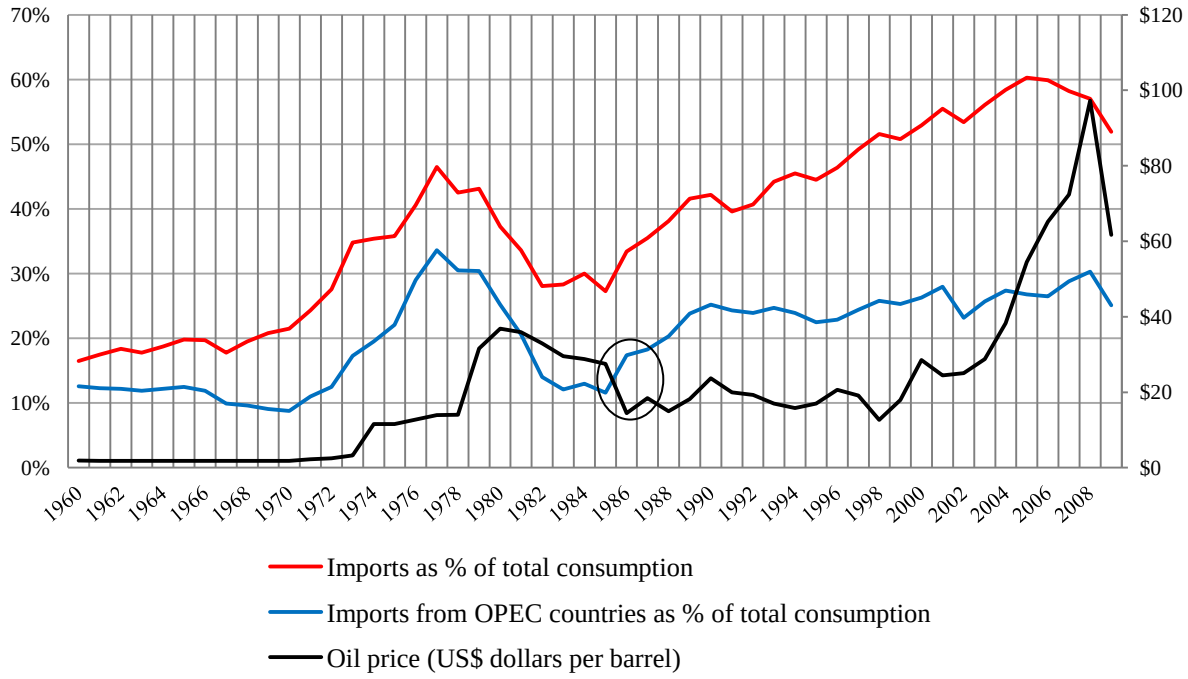
International organisations (WB 1995) and scholars (Smith 1992) have long argued that the state-owned nature of PEMEX is a factor limiting the development of the oil industry in Mexico. The inefficiencies of the company were therefore exacerbated as a means to push for greater deregulation of the sector. Nonetheless, it is worth pointing out that such rhetoric emerges at a time when the U.S. was struggling to reduce its dependency on oil from OPEC countries (Figure 6.4) – a determinant that forced the world's largest energy consumer to develop alternative sources of supply. It can therefore be asserted that the 1973 Arab oil embargo had long-term repercussions with respect to the U.S. energy policy-making process and that reducing dependency on OPEC oil has been central to such policies since that time. In this context, the issue to address is where Mexico's oil industry would be suitable.

The Arab oil embargo of 1973 and the subsequent manipulation of oil prices and supply by OPEC countries demonstrated the extent of U.S. energy vulnerability as well as that of other industrialised economies that relied heavily on imported oil. In response, the U.S., along with the member countries of the Organisation for Economic Co-operation and Development (OECD), created the International Energy Agency (IEA) with a

[56] The standing of PEMEX is discussed further in Chapter 7.
[57] Chapters 7 and 8 analyse the contemporary standing of the Veracruz petrochemical cluster.

mandate to counterbalance OPEC influence over the world oil market. It is contended that 'one of the fundamental policies of the IEA was to stimulate the production and exports of oil' of non-OPEC suppliers such as Mexico, for which financing to develop fields was made available (Ángeles Cornejo 2001: 76).

Figure 6.4 U.S. oil dependency and oil prices, 1960-2009



Source: U.S. Energy Information Administration (2010).

Ironically, in the years that followed the boycott U.S. dependency grew steadily. The Energy Information Administration (2010) estimates that the share of oil imports in overall consumption surged from 34.8 percent in 1973 to 46.5 percent in 1977. Imports from OPEC countries jumped from 19.5 percent to 33.6 percent in the same period (Figure 6.4). These worrying figures raised concerns in U.S. policy circles and provoked a heated debate that not only focused on what needed to be done to reduce this dependency, but also underlined the different possible scenarios if demand continued to expand and output became stretched (Fagen 1979). Since the possibility of another energy crisis persisted, pundits wondered what the repercussions would be for the U.S. and the wider international community and in fact predicted possible scenarios. In this sense, Yergin (1978: 32), an influential expert on energy matters, anticipated that oil prices 'will double or triple, in real terms, within a short time. The standard of living of every American will nosedive. The international monetary system will shudder and

shake. Industrial nations will be pitted against each other in a bruising scramble for oil. The Western alliance could be shattered. In a number of countries, democracy itself might not be able to survive'. Even though this gloomy picture did not materialise, these words did reflect to a significant degree the character of policy dialogue in the U.S. in the aftermath of the oil embargo.

At the same time as this debate was taking place in the U.S., a development of significant proportions unfolded south of the border. In the second half of the 1970s PEMEX discovered major oil fields that served to swell hydrocarbon[58] reserves from 11,160 million barrels in 1976 to 40,194 million barrels in 1978 and to a staggering 72,008 million barrels in 1981 (Figure 5.4). The prospects of the holdings were so enormous that government officials speculated that possible reserves could be as high as 200 billion barrels (Petróleos Mexicanos 1979). This enthusiasm resonated throughout the media[59] and political[60] circles in the U.S. (Fagen 1979, Grayson 1979) with the lead editorial of The New Republic (19 August 1978), for example, reporting that Mexico's oil output, by some estimates, was believed to be as high as 10 million barrels by the mid 1980s – an amount that would have been fundamental in weakening U.S. dependency on OPEC and Arab oil (Fagen 1979: 39).

In retrospect, there is no doubt that possible reserves and output predictions were greatly overstated. But the point is that the strategic importance of Mexico's oil and the country itself, where crude output soared from 803 Mbd in 1976 to 2,748 Mbd in 1981 (PEMEX 1989), grew in status on the international scene. The dimension of the latter is summed up by Fagen (1979: 46), who argued that 'a barrel of Mexican crude oil is not just another barrel on the world market. It is a barrel that softens upward price pressures; it is a barrel (if there are enough of them) that weakens OPEC; it is a barrel that might be available when other barrels are in short supply for either political or economic reasons. It is, in sum, a barrel with a very high political value added. Note that this added

[58] It refers to crude oil, condensates, gas liquids, and natural gas.

[59] Fagen (1979) indicates that U.S. perception of the Mexican oil boom was invigorated by the speculative figures influential magazines and academic journals helped disseminate. *Fortune* (10 April 1978) published that 'optimists on Mexican oil say that the potential reserves come to perhaps 120 billion barrels.' *Business Week* (15 January 1979) similarly echoed the oil boom in Mexico. The author also reported that a Mexican journalist is believed to have said that 'PEMEX thinks it has 700 billion barrels' (quote found in Metz, W. (1978) Mexico: the premier oil discovery in the western hemisphere. *Science*, Vol. 202, 1261-65).

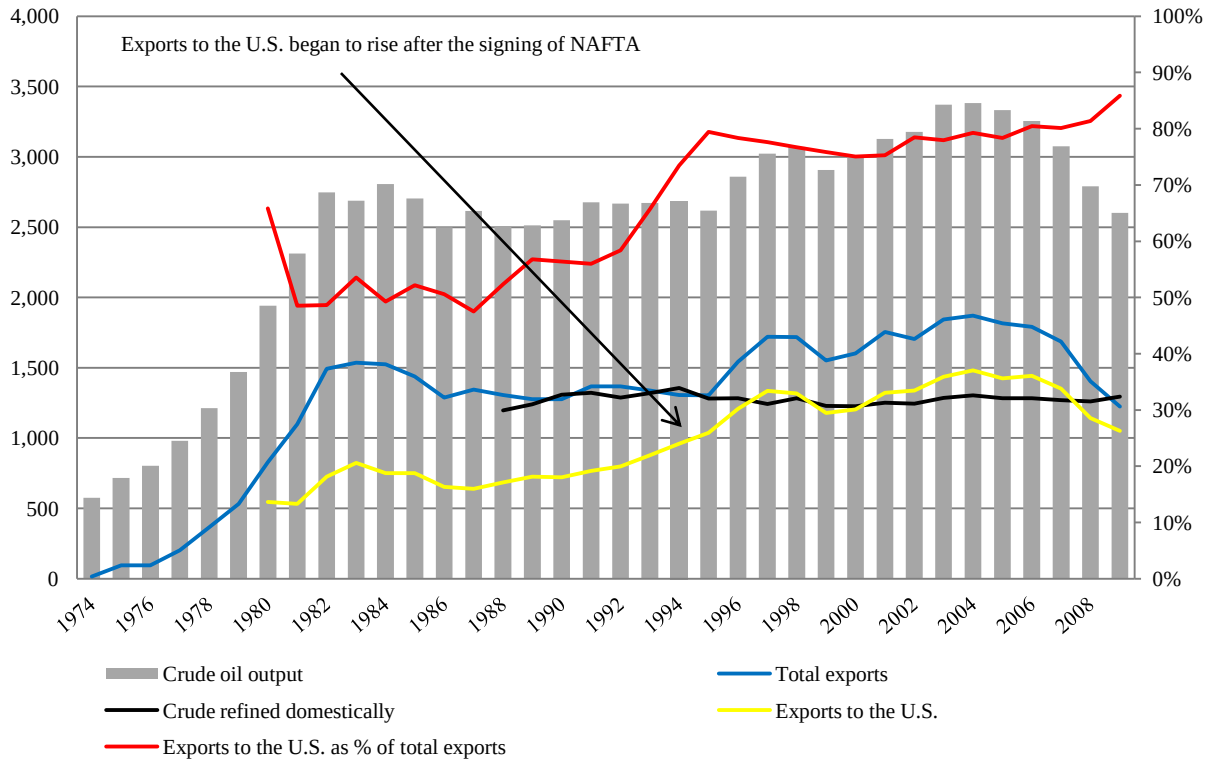
[60] In March 1978 the U.S. Geological Survey informed Senator Edward. M. Kennedy, at that time Chairman of the Subcommittee on Energy of the Joint Economic Committee, that Mexico's oil holdings may be as high as 340 billion barrels (Grayson 1979).

political value of Mexican oil is not necessarily diminished even if the United States is highly successful in limiting energy use – and thus imports. Nor is it diminished even if Mexican oil comprises a relatively modest percentage of U.S. imports during the 1980s. Since the Mexican barrel is thought to be potentially more secure, it is correspondingly – and somewhat ironically – more crucial. When much else may be in doubt, so the logic goes, the United States can surely count on Mexico.'

Another example that illustrates the growing interest of the U.S. in Mexican oil is to be found in the words of President Jimmy Carter, who is quoted (Fagen 1979: 46) as saying during a broadcast address on energy problems (April 17, 1977) that 'now we have a choice. But if we wait, we will constantly live in fear of embargoes. We could endanger our freedom as a sovereign nation to act in foreign affairs. In ten years we would not be able to import enough oil – from any country at any acceptable price'. These two viewpoints clearly signal the position that the Mexican oil industry would come to occupy in the decades that followed the oil boom.

In the decade of the 1980s a combination of domestic factors contributed to eventually articulate the development of PEMEX with both the energy security agenda and the economic interests of the United States. As noted in previous sections, Mexico's economic climate markedly worsened during that time. In order to deal with the enormous burden of external debt and the public deficit (Figure 6.1), the government needed to generate much-needed capital inflows urgently. Given the magnitude of public financial requirements and the limited export capacity of the domestic industrial apparatus, policy makers had no alternative but to urge PEMEX to increase output and therefore exports. Despite the harsh economic conditions, output grew significantly. It jumped from 575 Mbd in 1974, the year after the oil embargo, to 1,936 Mbd in 1980. By 1984 PEMEX production had reached 2,806 Mbd and averaged 2,565 Mbd for the rest of the decade. As a consequence, exports also grew at a fast pace. PEMEX sales abroad rose from the meagre figure of 15 Mbd in 1974 to 827 Mbd in 1980 and to a further 1,537 Mbd in 1983. For the rest of the 1980s exports remained consistently above the mark of 1,300 Mbd. Of all these exports, an average of over 50 percent went to the U.S., whose imports of Mexican oil climbed from 533 Mbd in 1981 to 720 Mbd in 1990 (Figure 6.5).

Figure 6.5 PEMEX output and oil exports to the U.S., 1974-2009
(Thousands of barrels per day)

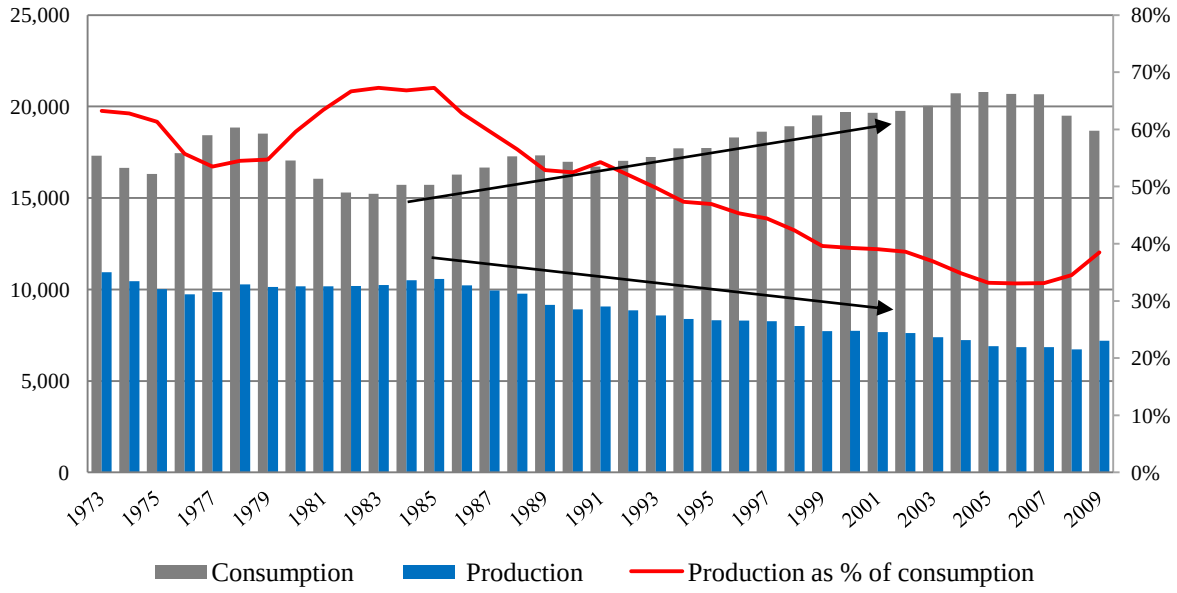


Source: PEMEX (1989, 1990, 2000, 2010a).

With regard to U.S. dependency on OPEC oil, it must be noted that this began to sink at the same time Mexico's output increased (Figure 6.5). Whereas 33.6 percent of U.S. consumption came from OPEC countries in 1977, by 1985 that share had plummeted to 11.6 percent. Nonetheless, from that year onwards U.S. dependency rebounded. The overall ratio of U.S. oil imports to domestic consumption rose from 27.3 percent in 1985 to 33.4 percent in 1986 and to a staggering 42.2 percent in 1990. The share of imported oil supplied by OPEC countries grew from 11.6 percent in 1985 to 17.4 percent in 1986 and to 25.2 percent in 1990 (Figure 6.4). What appears to have driven U.S. oil dependency in the mid-1980s is the fact that domestic consumption, which surged from 15.726 Mbd in 1985 to almost 17 Mbd in 1990, grew at a time when proven reserves and output were dropping slightly but consistently. Proven reserves fell from 36.4 billion barrels in 1985 to 33.8 billion barrels in 1990 (BP 2010). Domestic production, on the other hand, shrank from 10,580 Mbd to 8,914 Mbd over the same period – a drop of 16 percent (Figure 6.6). Furthermore, this conjuncture is embedded in a context of lower international oil prices – at least in comparison with the 1977-1985

period. While the extent to which price levels led to fluctuations in U.S. energy dependency is open to debate, the evidence suggests that it exercises a certain degree of influence. From 1977 to 1985 U.S. oil dependency declined in the midst of relatively high international prices, which averaged $27.91 per barrel. From 1986 to 1990, on the other hand, U.S. oil imports as a percentage of consumption soared while international prices averaged $17.95 per barrel – a drop of 35.7 percent with respect to the previous quote (Figure 6.4)

Figure 6.6 U.S. consumption and production of oil, 1973-2009
(Thousands of barrels)



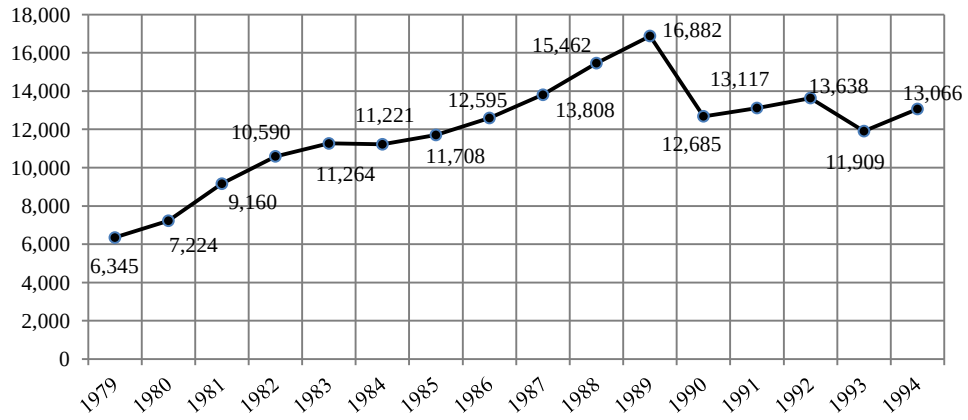
Source: U.S. Energy Information Administration (2010).

Bearing in mind this scenario, in the years preceding the launching of NAFTA negotiations (August-November 1991) the U.S. found itself immersed in a situation where energy dependency continued to grow and showed no signs of slowing down in the near future. So, did energy dependency persuade the U.S. to consider signing a comprehensive agreement with Mexico? Arguably yes. Mexico's hydrocarbon reserves, which stood at 51 billion barrels and represented 1.58 times those of the U.S. in 1991 (BP 2010), appeared on the radar of U.S. policy makers. Apart from the trade and non-trade issues covered by NAFTA, while the Salinas administration regarded the deal as the instrument that would reinforce the economic liberalisation program (Haber et al.

2008), the U.S. weighed it up as the mechanism that would eventually facilitate greater access to Mexico's hydrocarbon wealth.

The articulation of PEMEX with the U.S. energy security strategy became clearer when NAFTA came into effect. Figure 6.5 demonstrates how PEMEX output and exports to the U.S. began an upsurge in 1994. Of the total exports from 1994 to 2000, which accounted for 53.1 percent of overall PEMEX output throughout the period, exports to the world's largest energy consumer averaged 76.64 percent – an explosive jump in comparison to the 1980-93 period when the share of exports to the U.S. averaged 54.41 percent, according to official estimates. On the domestic front, what were the most paradoxical consequences of all this? After NAFTA came into effect, the amount of Mexican crude processed at U.S. refineries was frequently larger than that refined by Mexico itself. From 1988 to 1993 exports to the U.S. accounted for 59 percent of the crude processed by PEMEX. From 1994 to 2000 the proportion soared to 92 percent. These figures further demonstrate the articulation of PEMEX with the U.S. energy security strategy (PEMEX 1989, 1990, 2000, 2010a).

Figure 6.7 PEMEX petrochemical output, 1979-1994
(000' tonnes)



Source: PEMEX (1990, 2001).

Within this equation, it is important to point out that notwithstanding the economic unrest Mexico endured in the 1980s, PEMEX managed to bring into operation petrochemical plants that led to a considerable increase in output. The wave of external borrowing in the late 1970s and early 1980s, which PEMEX channelled towards the industrialisation of hydrocarbon reserves, is what to a certain extent fuelled the

expansion of the state-owned petrochemical industry in the pre-NAFTA era. Figure 5.6 in the previous chapter and Figure 6.7 demonstrate that PEMEX petrochemical output skyrocketed from 1,934 thousand tonnes in 1970 to 6,345 thousand tonnes in 1979 and to a further 16,882 thousand tonnes in 1989.

Such remarkable development, however, appears to have provoked concerns elsewhere. Ocampo Torrea (2006: 124) for example, argues that specialised magazines such as *Hydrocarbon Processing*[61] (1981) revealed that the U.S. National Petrochemical and Refiners Association[62] (NPRA) discussed the growing importance of Mexico as a maker of petrochemicals. In that respect, the author also claims that some even labelled PEMEX a dangerous competitor. To contend that such a view of PEMEX was widespread in the U.S. may arguably be certain. Since the U.S. dependency on imported oil grew larger, a mounting petrochemical output demanding greater amounts of feedstocks in Mexico was viewed as jeopardising both the availability of hydrocarbon inputs to feed the industrial apparatus of the U.S. and, more importantly, the international expansion and vertical integration of U.S. oil firms. The vulnerability of Mexico as a result of the external debt problem represented the perfect means for the U.S. to urge liberalisation of the sector allegedly through conditions attached to WB and IMF financial aid and NAFTA stipulations.

An ongoing economic liberalisation program in Mexico that entailed a much weaker role of the state, coupled with a growing energy dependency north of the border, proved to be of major importance for the public petrochemical industry and the relationships of this with buyer firms in the Veracruz cluster. The following section demonstrates the approach adopted by neoliberal government officials with respect to development of the sector.

DISMANTLING THE PUBLIC PETROCHEMICAL INDUSTRY

How has output at state-owned petrochemical plants plummeted over the last decade and a half? What has driven the upward drift of imports? What lies behind the disarticulation of value chains of petrochemical origin? These questions to a great extent

[61] A monthly magazine offering industry news and technical content for the refining, gas processing, petrochemical/chemical manufacturing and engineer/construction industries. Information obtained from http://www.hydrocarbonprocessing.com/AboutUs.html (Accessed on 12 March 2011).

[62] The NPRA comprises 'virtually all U.S. refiners and petrochemical manufacturers', according to the organisation's official website (22 December 2010).

reflect both the contemporary challenges faced by state-owned and private petrochemical firms situated in the Veracruz cluster and the drawbacks characterising the entire industry in the context of the political economy of Mexico. In order to understand the current status of the Veracruz cluster, it is therefore of critical importance to examine the implementation of *sectoral determinants* such as the reclassification of basic petrochemical inputs and the horizontal restructuring of PEMEX in the wake of the political, economic, and institutional environment of the 1980s and 1990s.

During these decades public petrochemical assets in particular were not off the radar of neoliberal policy makers. In tune with the process of economic liberalisation and given the financial hardship endured by the state[63], Mexican authorities intended to open up the sector to private capital. The different reclassifications of petrochemical inputs, the horizontal restructuring of PEMEX, and changes to the pricing policy of inputs were, among others, the avenues to achieve this. Contrary to what government officials predicted, such guidelines in the end largely contributed to delineating the complex context in which the Veracruz cluster is currently embedded.

The reclassification of basic inputs

First of all, it is necessary to briefly shed light on the legal precepts that regulate the state-owned petrochemical industry. The Regulations of the Petroleum Law of Article 27 of the Mexican Constitution of 1959 and subsequent amendments in 1971 stipulated that the making of hydrocarbon by-products that either 'serve as basic industrial raw materials or embody a fundamental socioeconomic interest for the country' is reserved exclusively to the state. The private sector, on the other hand, is permitted to 'produce those industrial inputs that result from subsequent processes' - provided that foreign investors participate with up to 40 percent of the social capital (DOF 25/08/1959, 09/02/1971). In a more specific manner, private firms are allowed to transform basic industrial raw materials into secondary petrochemical products. Despite the confusion such demarcation provoked, the intention of the government was to differentiate the scope of action reserved for public interest and that reserved for the private sector. Two

[63] It is estimated that Mexico's interest payments amounted to 9.4 percent of GDP in 1990 (Haber et al. 2008).

and a half decades after setting up this regulatory regime, the extent of public concern in the sector was no longer regarded as being in line with the prevailing economic approach.

With respect to the structural adjustment reforms of the 1980s, a fundamental clause worth underlining is that of the reduction of resources allocated to state-owned firms. By doing this, firms belonging to strategic sectors would eventually find themselves in a position to be the subject of additional deregulating measures. PEMEX, the largest source of public revenues, is a case in point. The government consistently downsized the financial resources allocated to PEMEX throughout the sexenio. In 1988, for example, the firm's budget comprised around 50% of that in 1983 – a financial constraint that had wider repercussions within the company structure. It is estimated that PEMEX was therefore unable to produce certain basic petrochemicals demanded by domestic user firms. In August 1986 government officials had no alternative but to authorise private companies to import those basic inputs that were not being supplied by PEMEX. In retrospect, such a course of action may be interpreted as the policy that led to further deregulation of the sector (Ángeles Cornejo 1996).

A couple of months later, in October 1986, President Miguel De La Madrid took the first step towards dismantling the public petrochemical industry. De La Madrid decreed a cut in the list of basic petrochemical products from seventy to thirty four – an arbitrary decision with which the Mexican government handed over the manufacturing of thirty six basic petrochemical inputs to the private sector. The government claimed that this reclassification was intended to help increase productive investments in this industrial branch, expand the production of basic and secondary petrochemical products that the national industry requested, foster the integration of value chains, and encourage the rise of non-oil exports with high added value (DOF 13/10/1986, Ángeles Cornejo 1996).

In an attempt to present such arguments in a more convincing manner, the Ministry of Commerce and Industrial Promotion (SECOFI) published the Integral Program for the Promotion of the Petrochemical Industry (PIDIP) in the same issue of the DOF. The objective of the PIDIP was to establish the policy mechanisms through which the government would force the sector to maintain an output growth rate higher than that of the manufacturing industry, increase the participation of national production in the total supply of petrochemical products, reduce the trade balance deficit, and strengthen the

vertical integration of the basic and secondary petrochemical industry, among others (DOF 13/10/1986). But as we will see in subsequent chapters, these targets proved hard to meet.

The vertical dissolution of PEMEX continued under the administration of Carlos Salinas (1988-1994) as a second reclassification was announced less than a year after he took office. This time the reclassification consisted of listing sixteen basic petrochemical products as secondary products and narrowing down to twenty the number of basic inputs PEMEX was entitled to produce, according to the DOF (15/08/1989). It is contended that what determined such reclassification were the conditions attached to restructuring of the external debt under the Brady Plan in 1989. The Salinas administration pledged to introduce a program aimed at limiting the participation of PEMEX in the sector while encouraging the involvement of private capital (Ángeles Cornejo 1996, Saxe Fernández 2002). The 1989 decree, however, went beyond reclassification. With respect to secondary petrochemical products, it reduced to sixty six the number of industrial inputs requiring production permits – a requisite stipulated in the regulations of the DOF in 1959 and 1971. It also eliminated bureaucratic requisites for the production of 540 tertiary petrochemical products and permitted foreign ownership in the production of more than 700 products (Ángeles Cornejo 1996, Maxfield and Shapiro 1998).

In spite of the extensive deregulation already inflicted, Salinas conceived a third reclassification (DOF 17/08/1992) parallel to NAFTA negotiations in 1992. Despite Mexico's intention to protect its petrochemical industry, the United States pushed for further deregulation. The Mexican negotiation team agreed to make 'limited' concessions. Fourteen primary petrochemical products were declassified and three more were added to the list. The final list of basic petrochemicals hence encompassed just eight products (Maxfield and Shapiro 1998).

With respect to secondary inputs requiring permits, only 12 remained on that list, as stipulated in the DOF (17/08/1992). As to the remaining non-basic inputs, 'including the sixty six secondary petrochemicals, the NAFTA negotiations concluded that these would be open to one hundred percent foreign ownership within a period of three years' (Maxfield and Shapiro 1998: 98). This provision eliminated the previous ceiling of 40 percent concerning foreign ownership.

Figure 6.8 Reclassification of basic inputs[64]

	09 April 1960	13 October 1986	15 August 1989	17 August 1992	13 Nov 1996
1	Ammonia	Acetaldehyde	Ammonia	Butanes	Butanes
2	Benzene	Acetonitrile	Benzene	Ethane	Ethane
3	Butadiene	Acrylonitrile	Butadiene	Heptanes	Heptanes
4	Cumene	Alpha olefins	Dodecylbenzene	Hexane	Hexane
5	Ethylene Dichloride	Ammonia	Ethane	Carbon black	Carbon black
6	Ethyl chloride	Benzene	Ethylene	Naphthas	Methane
7	Dodecylbenzene	Butadiene	Heptanes	Pentanes	Naphthas
8	Styrene	Cyclohexane	Hexane	Propane	Pentanes
9	Ethylene	Vinyl chloride	Carbon black		Propane
10	Isopropanol	Cumene	Methanol		
11	Methanol	Dichloroethane	Methyl tert-butyl ether		
12	HD polyethylene	Dodecylbenzene	N-paraffins		
13	LD polyethylene	Styrene	Ortho-xylene		
14	Propylene	Ethane	Para-xylene		
15	Polypropylene	Ethyl benzene	Pentanes		
16	Toluene	Ethylene	Propylene		
17	Xylenes	Heptanes	Propylene Tetrameter		
18		Hexane	Methyl ter-amyl-ether		
19		Isopropanol	Toluene		
20		Carbon black	Xylenes		
21		Methanol			
22		Methyl tert-butyl ether			
23		N-paraffins			
24		Internal olefins			
25		Ortho-xylene			
26		Para-xylene			
27		Pentanes			
28		HD polyethylene			
29		LD polyethylene			
30		Propylene			
31		Propylene Tetrameter			
32		Toluene			
33		Xylenes			
TOTAL	17	33	20	8	9

Source: Chow Pangtay (2003).

[64] Apart from the reclassification shown in Figure 6.8, the government decreed to take methyl tert-butyl ether off the list of basic petrochemicals on June 7, 1991 and add methane to the list on November 13, 1996 (DOF 7/06/1991 and DOF 13/11/1996).

In reviewing how the petrochemical industry has been regulated over time, it is possible to distinguish fundamental features that demonstrate its evolution. During the import-substituting industrialisation era, for example, differences arising from the categorisation of basic and secondary petrochemical inputs were settled by means of recommendations from a working group formed by several government agencies and PEMEX that were presented to the president (Snoeck 1986). More to the point, it has been suggested that in the Petroleum Law of Article 27 of the Constitution of 1958 and the subsequent amendments in 1959, which represented early attempts to delineate the scope of public interest with respect to petrochemicals, the participation of the legislative branch was determinant. In the context of economic liberalisation, the resolution to reclassify basic inputs was in the hands of the president and a small group of technocrats, leaving political and economic factions traditionally consulted in the state decision-making process out of the debate (Pérez Fernández 1996).

Such an autocratic approach was intended not only to cast doubt over the law-abiding nature of the resolution. Scholars, pundits, and Member of Congress alike (Pérez Fernández 1996, Saxe Fernández 1996, 2002, Ángeles Cornejo 1996, Suárez Guevara 1996, 2008, Ortiz Muñiz 1996, Ocampo Torrea 2006, Nahle García 2008) have pointed out that the reclassification of inputs not only represented the capitulation of the state's role in the petrochemical industry, but that it was in fact unconstitutional.

As Salinas (1988-94) was aware of how contentious would be to reform the Constitution, and given that this was a necessary step if changes to state participation in the oil industry were to be considered, his administration was determined to amend the Regulations of the Petroleum Law of Article 27 of 1996. Amendments to this secondary law not only made it possible to circumvent the mandate expressed in the Constitution, but also to avoid irritating the opposition in Congress and the nationalist wing of his party. By arbitrarily listing basic inputs as secondary Salinas completed what De La Madrid had begun – the handing over of downstream oil activities to private capital at the expense of the vertical integration of PEMEX and the associated industrial base of the country (Suárez Guevara 1996, Ortiz Muñiz 1996, Saxe Fernández 1996). Furthermore, the technical character of what the government considered basic inputs is rather questionable. The nine compounds that Figure 6.8 lists in the 1996 classification are allegedly not even basic petrochemicals, but rather hydrocarbon feedstocks used for

the making of base petrochemicals. A comprehensive interpretation of the Regulations of the Petroleum Law of Article 27, which claims that basic inputs are derived from the first important chemical transformation of hydrocarbon resources, leads to the argument that these reclassifications neither respect the stipulations of the Constitution nor the parameters of chemical nomenclature. All in all, one may conclude that the position of PEMEX within the petrochemical industry has been downgraded and its function was simply to supply inputs naturally found in crude oil and natural gas fields (Cruz Malpica 1996, Manzo 1996, Ocampo Torrea 2006).

The rationale behind these reclassifications, or rather *sectoral determinants*, was that the participation of the private sector would increase investment flows and facilitate articulation of the different actors - basic and secondary input producers as well as user firms manufacturing final goods - across the broad range of petrochemical value chains. Mexican policy makers also expected to promote both national and foreign investment flows (DOF 13/10/1986, 15/08/1989, 17/08/1992). The dogmatic interpretation of neoliberalism in government circles seemed to be shared by some scholars. Maxfield and Shapiro (1998: 98-99), for example, speculated that deregulation of the petrochemical sector 'was the only way Mexico could hope to reverse drastic underinvestment and poor capacity use'. However, it is worth mentioning that underinvestment in the state-owned petrochemical firms was one of the prescriptions of the WB and the IMF in the face of the structural adjustment program instigated in the 1980s and 1990s (Ángeles Cornejo 1996). As the state ceased its investment in the sector so did the private sector. Regardless of what government officials initially claimed, reclassification of basic petrochemical inputs and deregulation of the sector did not generate the expected capital inflows (Ortiz Muñiz 1996, Torres 1999, Morales 2005) – a policy failure that was finally recognised by the government in the 2001-2006 energy sector program (Presidencia de la República 2001). With regard to poor capacity use, Maxfield and Shapiro (1998) similarly misjudged PEMEX performance. The company reports that petrochemical complexes operated at an average rate of 98.68 percent of installed capacity in the four years prior to NAFTA (PEMEX 2000). Taking into consideration the levels of production and capacity use PEMEX attained over those years, it is rather contradictory to argue that the state must withdraw from the sector. Figure 6.7 demonstrates that output at state-owned petrochemical facilities grew

steadily throughout the 1980s and even accomplished record levels by the time reclassifications commenced (PEMEX 1990, 2003).

Another point that challenges government arguments for deregulation is the sector's changing business environment. It is widely acknowledged that under ISI private capital was attracted by the high rates of return on investment that regulatory barriers to entry, subsidised input prices, and import protection yielded. Given that the government also struggled to attract greater investment, anticipating that greater investment would be drawn into the secondary petrochemical industry by a regime that favoured free trade, competition, and the elimination of subsidies on petrochemical inputs produced by PEMEX is at best naive (Kessel and Chong-Sup 1993).

Ultimately, the reclassification of petrochemical inputs not only entailed a judgment that observed the directives of market-orientated policies and the liberalisation of almost 90 percent of the state-owned petrochemical industry (Palacios Solano 2008), it also compromised the articulation of value chains of petrochemical origin in the long run – as in the case of the Veracruz cluster.

The horizontal restructuring of PEMEX and the international context

In April 1992, Guadalajara, the capital city of the western state of Jalisco, suffered one of the most devastating industrial accidents in Mexican industry. Natural gas that had leaked from a PEMEX pipeline into the sewer system of the city caused a blast that reportedly killed more than 200 people. The Salinas administration (1988-1994) used the tragedy to highlight the lack of accountability for PEMEX activities and address the need to restructure the company (Merrill and Miro 1996, Ángeles Cornejo 2001). Three months after the explosion, on July 16 of the same year, Congress enacted the Organic Law of PEMEX and Subsidiary Bodies – a new regulatory regime that abrogated the 1971 Organic Law of PEMEX and reorganised the company into a central holding and four subsidiaries, that is, PEMEX-Exploration and Production, PEMEX-Refining, PEMEX-Gas and Basic Petrochemicals, and PEMEX-Petrochemicals (DOF 16/07/1992).

One of the fundamental amendments was that each subsidiary became a more autonomous entity. Article 4 of the new PEMEX Law stated that 'Petróleos Mexicanos

and its decentralised subsidiaries, according to their own objectives, are allowed to enter into any sort of act, agreement, and contract with individuals and corporations, and subscribe negotiable instruments[65]'. In other words, PEMEX-Petrochemicals, most of the assets of which are situated in the Veracruz cluster, was not only entitled to act independently from the rest of the subsidiaries, it was also granted the right to issue debt. Even if the petrochemical division of PEMEX did not exercise such rights, these changes in the regulatory framework represented the avenue that could lead to further deregulation of the sector in the future (Suárez Guevara 1996, Ángeles Cornejo 2001).

Nonetheless, the most staggering repercussion of the 1992 PEMEX Law was the introduction of the transfer pricing scheme, which indicated that transactions between subsidiaries were no longer determined by production costs, but rather by arm's length prices. This principle established that input transactions between associated entities, as in the case of PEMEX subsidiaries, were subject to determination by market-based prices (OECD 2009). This approach was to a significant extent in line with the price liberalisation policy that the Salinas administration (1988-1994) undertook as part of the Pact for Economic Stabilisation and Growth (PECE), in the wake of NAFTA negotiations in 1991 (Lustig 1998) and as a consequence of the country's joining the OECD in 1994.

But what do market-based prices entail for PEMEX inputs? The concept of opportunity cost has helped government officials address this problem. Rigoberto A. Yepez (2006), former deputy director of economic planning at PEMEX, explains that opportunity cost is understood as 'the amount the provider would receive in the market if the product is sold to the next best alternative. If the provider can obtain a greater amount from the next best alternative', that alternative ought to determine the market price of that particular product. The next best alternative for the commercialisation of PEMEX inputs is the relevant international market which, given the economic integration of the country with the U.S., is situated on the northern coast of the Gulf of Mexico. The prices of ethane and other precursors of petrochemical value chains pertaining to the Veracruz cluster are therefore linked to those prevailing in Texas and other southern states of the

[65] Negotiable instruments are documents by which companies/individuals acquire/recognise debt obligations, according to Mexico's General Law of Negotiable Instruments and Credit Operations (DOF 27/08/1932).

U.S. and allegedly reflect the opportunity cost with respect to those markets (Yepez 2006, fieldwork interviews).

While the government argues that the pricing transfer scheme helps 'maximise the value of the company as a whole, reflects the value created in each division, identifies inefficiencies and opportunities for improvement, and complies with international trade regulations and taxation' (Comisión de Energía de la Cámara de Diputados 2009: 4), others (Ocampo Torrea 2006) contend that such a mechanism simply reflects transactions between U.S. based firms and takes away the comparative advantages of PEMEX.

The argument is that while PEMEX remained vertically organised, the company set input prices according to a policy that both favoured the industrialisation of its own hydrocarbon reserves and took into account production costs. Contrary to this approach, horizontal restructuring introduced by the 1992 PEMEX Law articulated the country's hydrocarbon resources with the energy needs of the United States and paved the way, along with the reclassifications previously discussed, for disincorporation of the petrochemical division (Suárez Guevara 1996, Ángeles Cornejo 2001).

If the path that the output of petrochemical complexes has followed in recent times (Figure 7.7) is studied, the effectiveness of the transfer pricing mechanism can be questioned. This is just one perspective from which the horizontal structure of PEMEX may be placed under scrutiny. Almost in parallel to the reclassifications and the 1992 PEMEX law, a wave of mergers and acquisitions in the U.S. oil industry were observed (Figure 6.9). In 1984, for example, the Standard Oil Corporation of California (currently Chevron) acquired the Gulf Oil Company – a transaction dubbed at that time as the largest in U.S. history. Similarly, Occidental Petroleum (currently Oxy), a California-based firm, purchased a series of energy-related companies throughout the 1980s (Bazan Navarrete and Peña Guevara 2007, Chevron company profile, Oxy corporate history).

Despite the number of mergers occurring in the 1980s and early 1990s and what these represented, Mexican policy makers were reluctant to anticipate that the trend in the

world oil industry was in the direction of vertical operational integration[66]. This is the strategy that in fact determined the expansion of oil firms in the years to come, as Shields has put it (2005). Figures 6.9 and Figure 6.10 thus demonstrate that while Mexican policy makers were engaged in orchestrating the deregulation of downstream PEMEX activities, the world's largest players sought to strength their international standing by placing more emphasis on the development of their refining capacities.

Figure 6.9 Mergers and acquisitions of oil firms in the United States

1980s
Chevron - Gulf Oil
Occidental Petroleum - Cities Service
Texaco - Getty Oil
Occidental Petroleum - Union Pacific
1990s
BP – Amoco
BP - Amoco – Arco
Exxon – Mobil
El Paso Energy – Coastal
1999
Phillips – Tosco
Anadarko Petroleum - Union Pacific Resources Group
Devon Energy - Santa Fe Snyder
Occidental Petroleum acquires Altura Energy and Arco Long Beach
El Paso – Coastal
Chevron – Texaco

Source: Taken from Bonilla Sánchez and Suárez Guevara (2008).

While it is beyond the concerns of the present thesis to cast light on the vertical integration of multinational oil firms, this evidence does reinforce the argument that in the context of economic liberalisation the role of PEMEX was conceived as that of a simple supplier of crude oil – a strategy that eventually transformed Mexico into a net importer of refined and petrochemical products. In that respect, it is useful to consider Figure 6.5 once again since it serves to underline how the proportion of crude exports to the U.S. in relation to the domestic refining of crude by PEMEX grew after the introduction of NAFTA.

[66] It is argued that the driver behind the mergers depicted in Figures 6.9 and 6.10 was the need for firms to further enhance their competitive position (Antill and Arnott 2002).

Figure 6.10 Mergers of major oil firms

Bidder	Firm acquired or merged	Year	Corporate name
BP	AMOCO + ARCO	1998/2000	BP (British Petroleum)
Exxon	Mobil	1999	ExxonMobil
Phillips Petroleum	Tosco + Conoco	2001/2002	Conoco Phillips
Chevron	Texaco	2001	Chevron-Texaco
Valero Energy	USD	2001	Valero Energy
Shell	Motiva/Equilon	2001	Shell
Total	PetroFinal/Elf	1999/2000	Total Final Elf

Source: Bazan Navarrete and Peña Guevara (2007).

Returning to the discussion of PEMEX-Petrochemicals, the issue to be taken into consideration is that up to 1994, the year NAFTA came into effect, the performance of the subsidiary seemed to overlook the regulatory framework put into practice. In that year output continued to be as sound as at the beginning of the decade. Nonetheless, the 1994 peso crisis was about to make things take a turn for the worse.

Divestiture attempts in the wake of economic turmoil

Under the administration of Ernesto Zedillo (1994-2000) the petrochemical division of PEMEX is reported to have endured its sharpest output fall. While in 1995 overall output stood at 13,447 thousand tonnes, by the end of the period it had plunged to 6,835 thousand tonnes (PEMEX 2010a). Consideration of these output figures makes it clear how much the Zedillo administration further weakened the petrochemical division of PEMEX, effectively increasing momentum in comparison with previous presidential periods. The question here concerns the determinant factors that accentuated that drift and the answer arguably lies in the repercussions of the peso crisis that occurred in December 1994, which is seen as an *external determinant* that has contributed to shaping both the development of the Veracruz cluster and *governance structures* of local inter-firm linkages.

In late 1994, Mexico found itself once again in the midst of economic turmoil. A chain of economic, social, and political developments occurring that year culminated in the collapse of the peso in December – a few weeks into the presidential tenure of Ernesto

Zedillo (1994-2000). It is worth mentioning that 1994 is a distinctive year in the country's history. In the international sphere, it marked both the beginning of NAFTA and the country's accession to the OECD – events that signalled the willingness of political elites to forge an economy more integrated with the world[67]. On the domestic front, the uprising of the Ejército Zapatista de Liberación Nacional (EZLN), a leftist revolutionary group that declared war on the Mexican state and seized a number of cities in the southern state of Chiapas on the day[68] NAFTA came into effect, the assassination of both Luis Donaldo Colosio, the presidential candidate of the ruling party (PRI), on March 23 and Jose Francisco Ruiz Massieu on September 28, who was touted to become leader of the PRI in the lower house of the Mexican Congress during Zedillo's term, served to cast a shadow over the optimistic scenario trumpeted by Salinas. While the guerrilla uprising emphasised social discontent concerning the market-orientated policies of Salinas, the political assassinations, on the other hand, were seen to jeopardise the country's long-standing political stability. Financial markets reacted anxiously to these incidents with the peso coming under attack from currency speculators almost at the same time as the assassinations occurred. Foreign reserves plunged from $30 billion in March 1994 to approximately $17 billion in early November. While many argued the currency was overvalued, Salinas allegedly rejected the possibility of devaluation since it would have undermined both the probabilities of the PRI winning the presidential election in August and his stature as a statesman - and with that the possibility of his becoming the head of the World Trade Organisation once his presidential term ended. Another fundamental factor in the lead up to the crisis was that the country's debt obligation loomed large on the immediate horizon – and this worried investors since foreign reserves had shrivelled to almost $11 billion by December 19 (Springer and Molina 1995).

In response to these circumstances, the recently inaugurated Zedillo administration allowed the peso to fluctuate 15 percent above the pre-established ceiling on December 20. The downside of this policy was that investors did not perceive the new value of the currency as credible and a sizeable capital flight followed. In an attempt to ameliorate this problem, the government resolved to institute a floating exchange rate a couple of days later – a decision that implied a greater devaluation of the peso. Faced with the fact

[67] A year earlier, in 1993, Mexico joined the Asia-Pacific Economic Co-operation Forum (Ministry of Economy)
[68] January 1, 1994.

that foreign reserves had fallen to $6 billion by late December and that short-term debt obligations maturing in 1995 were estimated at $50.5 billion, Mexico was on the verge of default. This deteriorating situation raised concerns north of the border and in response President Bill Clinton proposed granting Mexico a loan of $40 billion despite the fact his request provoked intense opposition in Congress (Lustig 1998). A loophole that allowed Clinton to draw funds from the Exchange Stabilisation Fund (ESF), 'a pot of money set aside for emergency intervention in foreign exchange' (Krugman 2008: 51), along with resources from the International Monetary Fund, the Bank for International Settlements (BIS), commercial bank loans, and Latin American and Canadian credit facilities, allowed Mexico to raise $53 billion to help stabilise the peso (Springer and Molina 1995).

Despite the fact that the most controversial aspect of the financial rescue package was the Mexican government agreeing to deposit PEMEX oil export sales as collateral in the Federal Reserve Bank of New York (Springer and Molina 1995, Suárez Guevara 1996, Lustig 1998), it soon became clear that the Zedillo administration had also agreed to encourage the eventual participation of the private sector in certain economic activities still under state control. In fact, *La Jornada*, a Mexico City newspaper, reported on November 2, 1995 that the U.S. Department of Commerce had informed U.S. investors of the business opportunities appearing in Mexico. The government contemplated the privatisation of 61 petrochemical plants along with 22 ports, 58 airports, and 26,000 km of railroads (cited in Bonilla Sánchez 1996: 69). Such a wave of apparent privatisations, at least in the case of the petrochemical division of PEMEX, was revealed to be part of the commitments made by the Mexican government as a result of the 1995 bailout (La venta de petroquímicas, a cambio del apoyo de EU, 1996, January 19). Throughout his term in office, Zedillo stepped up government efforts to divest itself of the petrochemical complexes situated in the Veracruz cluster.

After years of policies that contributed to the deterioration of the status of PEMEX, the regulatory underpinnings to privatise the state-owned petrochemical complexes, which had been accentuated by the economic crisis of 1994, were already in place. On November 14, 1995 the government made public the beginning of the bidding process

to disincorporate the assets[69] of the Cosoleacaque petrochemical complex – once dubbed one of the world's largest ammonia producers (PEMEX Petroquímica 1995). Even though the public tender failed to attract bidders, it did provoke a stir in cities such as Coatzacoalcos and Minatitlán in the state of Veracruz where most of the public petrochemical infrastructure is situated. It is estimated that over 40,000 people demonstrated against privatisation of the Cosoleacaque petrochemical complex in Minatitlán in late October 1995 (Shields 1995: 40, Bonilla Sánchez 1996). Despite public opposition the government all but desisted in its plan. During an official visit to Europe in January-February 1996, it is understood that Zedillo affirmed before the Italian banking community that his government was committed to establishing an appropriate set of rules to facilitate privatisation of PEMEX secondary petrochemical plants (Saxe Fernández 1996: 7-8). There is no doubt this rationale initiated the process leading to disincorporation of the Morelos petrochemical complex situated in Coatzacoalcos in September 1998. While the tender drew the interest of two bidders, financial constraints eventually led to their withdrawal. In the end, the Ministry of Energy was forced to declare the tender null and void (Ocampo Torrea 2006).

Divestiture attempts not only contemplated public tenders, the government also resorted to certain mechanisms to make petrochemical complexes reach a point at which privatisation became more plausible. Zedillo was determined to asphyxiate the sector through the limited allocation of resources – a practice initiated in previous sexenios. In the years following the peso debacle, the petrochemical division of PEMEX suffered deep cuts. It is reported that investment expenditure in 1995 represented just 51.9 percent of that of a year earlier. In other words, it fell from $119.4 million dollars in 1994 to $61.84 in 1995. In 1996 the amount plunged even further to $50.27 million dollars. If these figures are considered in relative terms, and in comparison with those from Salinas' tenure, the picture is even gloomier. While investment in the petrochemical division as a proportion of the overall expenditure of PEMEX averaged 5.17 percent in the 1991-94 period, the figure plummeted to 2.5 percent and 1.53 percent in 1995 and 1996 (PEMEX 2001)[70]. In such a context, it also important to mention that the foregoing administration institutionalised cuts just after PEMEX was

[69] The most important assets included 5 ammonia plants, 1 hydrogen plant, and 1 paraxylene plant (Suárez Guevara 1996: 92-93).

[70] PEMEX shows figures in Mexican pesos. The dollar-denominated investment expenditure is computed with the yearly average value of the dollar as made public by Mexico's central bank.

restructured into subsidiaries. In that sense, Suárez Guevara (1996: 92) claims that 'PEMEX-Petrochemicals was the only division not contemplated in the strategic investment projects of the conglomerate'. Unsurprisingly, the budget allocated to petrochemical complexes dropped from $206.2 million dollars in 1992 to $84.74 in 1993 and bounced back slightly to $119.4 million dollars in 1994. Now, returning to the discussion of budget cuts under Zedillo, it is alleged that the Mexican government agreed with the WB to substantially and abruptly moderate the provision of taxpayers' money to PEMEX-Petrochemicals. It is estimated that $33.99 million dollars were conveyed to petrochemical complexes in 1996. As noted, this figure differs from the $50.27 million dollars reported by PEMEX for the same year, but the reality is that both reflect the extent of the cuts. All in all, the controversial issue to highlight here is that 'such resources were channelled towards - and were barely apt for - the maintenance of plants and pipelines', downgrading the long-established approach to expanding output and installed capacity (Saxe Fernández 1996: 12).

Notwithstanding the questionable results of preceding waves of privatisation, Zedillo insisted that handing over petrochemical assets to the private sector would be advantageous – at least this is what a government-conducted assessment on petrochemical plants concluded (Gilmer and Williams 1999: 2). In justifying such a course of action, policy makers continuously addressed not only the benefits of privatisation, but also the alleged shortcomings of the sector. It was then argued that the petrochemical division of PEMEX operated with obsolete technology and that 'upgrading is only achievable through the technical resources provided by privatisation' (Rey Romay 1996: 54). In that respect, PEMEX staff contended that a certain degree of obsolescence may be attributed to the lack of investment over the preceding decade, but that most petrochemical processes were competitive with respect to industry standards. Another argument referred to the frail financial capacity of the government that purportedly 'holds back the modernisation of existing plants and the construction of new ones required by a growing national demand' (Rey Romay 1996: 54-55). In that sense, it is important to bear in mind that PEMEX revenues are confiscated by the state through a tax regime that hinders the company's organic growth. Government officials also declared that PEMEX-Petrochemicals efficiency 'is lower than those international average standards and that the privatisation will enhance it' (Rey Romay 1996: 55). This is precisely the argument that persuaded policy makers to privatise state-owned

fertiliser plants (Fertimex) in 1991 and 1992. It was argued at the time that by allowing the participation of private capital, the sector would be able to increase output, employment and exports. In a span of a few years Mexico became a net importer of fertilisers and shut down most of its plants. The privatisation of petrochemical plants was proposed using the same underlying principle (Rey Romay 1996: 56).

In the end, the government failed to disincorporate the petrochemical division of PEMEX. It is unclear to what extent social and political opposition as well as flaws in the regulatory framework were responsible for driving off bidders and bringing the plan to a halt. Nevertheless, what is critical to point out is that the state made sure it had laid the groundwork for the complex setting in which the petrochemical industry currently finds itself. This statement not only refers to the outcomes of policies such as the reclassification of inputs and the horizontal restructuring of PEMEX, but also to the implications that the poor performance of PEMEX-Petrochemicals since the second half of the 1990s – a period during which output shrank from 13,066 thousand tonnes in 1994 to 6,836 thousand tonnes in 2000 (PEMEX 2001) - may have over both the quality of transactional linkages in the Veracruz cluster and the development of value chains of petrochemical origin. Given the set of rules introduced in the 1990s, it would be strange to anticipate that these constraints on both PEMEX and its petrochemical division were short-term. The following chapter is set to discuss this issue in greater depth.

CONCLUDING REMARKS

In clear contrast to what ISI policies stipulated (Chapter 5), the road to development embraced by Mexico after the 1982 collapse pushed for a diminished role of the state in economic matters. The establishment of market-orientated foundations also implied the emergence of a regulatory framework intended to encourage greater participation by private actors. The policies to which government officials resorted were economic and trade liberalisation. With respect to the latter, the North American Free Trade Agreement is the most significant example. Mexico viewed NAFTA as the instrument that would reinforce the character of the economic liberalisation program (Haber et al. 2008). The United States, on the other hand, considered it a mechanism that could be used to push for further deregulation in strategic sectors, eventually facilitating access to Mexico's hydrocarbon wealth. Among the repercussions of this situation, articulation of PEMEX to the energy strategy of the U.S. and the sectoral regulations institutionalised

stand out. This context marked the development of the oil and petrochemical industry in the final two decades of the 20th century and beyond.

Additionally, what also contributed to the deterioration of the standing of PEMEX-Petrochemicals, particularly throughout the second half of the 1990s, was the policy setting that followed the 1994 peso crisis. As the Zedillo administration (1994-2000) failed to privatise the petrochemical complexes of Cosoleacaque and Morelos, it seems that his economic team resolved to suffocate the sector instead. Output sharply plummeted towards the end of his term.

As to the Veracruz petrochemical cluster, there is no doubt that the complex multi-dimensional environment described above helps us understand many of the shortcomings that the locality embodies. It not only has hindered the role of PEMEX-Petrochemicals as a reliable supplier of basic inputs, but also has shaped the type of governance structure that characterises transactional linkages between state-owned petrochemical complexes and local buyer firms.

7

OUTSIZED BUT UNDERMINED

PEMEX and its petrochemical division in the wider economic spectrum

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INTRODUCTION

What were the consequences of the political, economic, and institutional drivers contextualised in Chapter 6 on the development of PEMEX and its petrochemical subsidiary in recent times? What does the present standing of PEMEX and the petrochemical industry entail for the wider economic spectrum? In order to concentrate on both queries is first necessary to discuss certain *external determinants* that are believed to stimulate in a more positive manner discussion in this chapter, that is, the tax burden of PEMEX and the composition of the energy matrix of the country.

The second section of the chapter will illustrate the extent to which the aggregate context, which basically refers to *sectoral*, *national*, and *supranational determinants* like the institutionalisation of regulatory policies, the implications of trade liberalisation and the peso crisis, as well as the weak tax collection of the government and the increasing use of natural gas for electricity generation, has shaped the development of the petrochemical division of PEMEX in terms of output.

It is worth mentioning that the analysis does not consider private petrochemical firms situated in the Veracruz cluster. Given the weight of the public petrochemical complexes and the strong ties with the private sector in the locality, the evidence and insights exposed here reflect, to a major extent, the conditions faced by the entire cluster. In this respect, Chapter 8 offers a more detailed discussion of private petrochemical firms.

The third section of the chapter offers an account of the extent to which overlapping *external* determinants have exerted a major influence on a much wider economic

spectrum, that is, the worrying increasing of imports of refined and petrochemical products, and on the standing of PEMEX in comparison with international oil firms, which serves to illustrate that the capacity of oil firms to generate substantial revenue rest on downstream value-adding activities.

REVIEW OF A TROUBLED SECTOR

Despite the fact that Mexico has been a major producer of hydrocarbons since the late 1970s, the development of associated industries is an issue that has raised concerns in recent times. PEMEX, the only supplier of crude and refined products[71] to the domestic market, faces a rather complex scenario as a result, in part, of an unfair tax regime that confiscates a large share of the firm's revenues. It is widely acknowledged that the implications of this problematic are not only inherent to PEMEX, but also to other areas of the national economy. As to the former, which is the focus of the present section, the petrochemical industry is a case in point. Output and installed capacity at PEMEX-Petrochemicals have, at best, stagnated over the last decade and a half. It is therefore of paramount importance to shed light on key variables that indicate the road PEMEX and its petrochemical subsidiary have followed throughout this period.

PEMEX and its tax burden

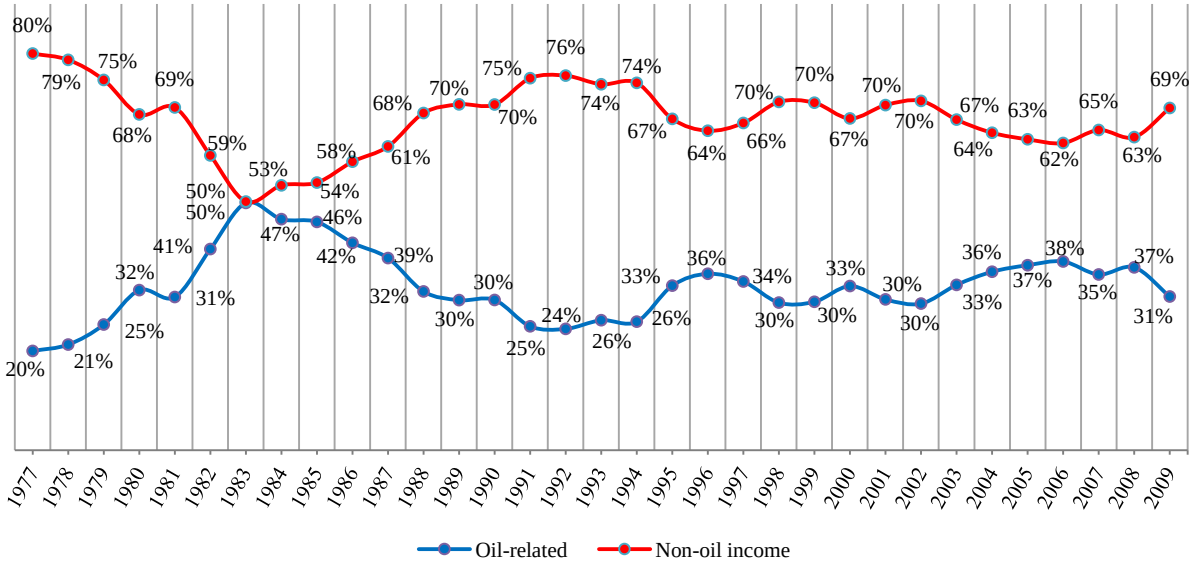
Over the last three decades, hydrocarbon resources have represented a consistently important source of revenue for the Mexican government. Since the 1980s, when PEMEX output climbed as a result of oil discoveries at the end of the preceding decade, a large share of government expenditure has been financed through PEMEX royalties. At the end of the 1970s, for example, the contribution of PEMEX to the state treasury is estimated to have averaged 25 percent. This dependency became more acute as output and exports rose in the 1980s and by that time it is estimated that the tax burden of PEMEX accounted for 39 percent of state revenue. The economic liberalisation the country underwent during this period did little to slow down the "petrolisation" of government finances. During the following decade this figure dropped to 30 percent. However, three decades after the discovery of Cantarell, the offshore oil field that

[71] Refined products refer to gasoline, diesel, jet fuel, liquid fuel, liquefied petroleum gas and other petroleum oils (PEMEX 2009).

yielded more than half of Mexico's output for much of the past decade, the petrolisation of the economy remains a serious concern for policy makers (Figure 7.1).

During this period, PEMEX earnings were drained since the low level of tax collection is considered one of the most significant shortcomings of the Mexican state. The United Nations Economic Commission for Latin America and the Caribbean (CEPAL) (2008) estimates that Mexico's tax collection stands at approximately 9.4 percent of gross domestic product[72]. In the face of such an inadequate tax collection regime, PEMEX royalties came to play a significant role in keeping the state machinery running. As late as 2008, the contributions of PEMEX in the form of taxes were reported to account for 37 percent of state revenue (Figure 7.1).

Figure 7.1 Oil-related and non-oil income as % of government revenues



Source: Banco de México (n.d).

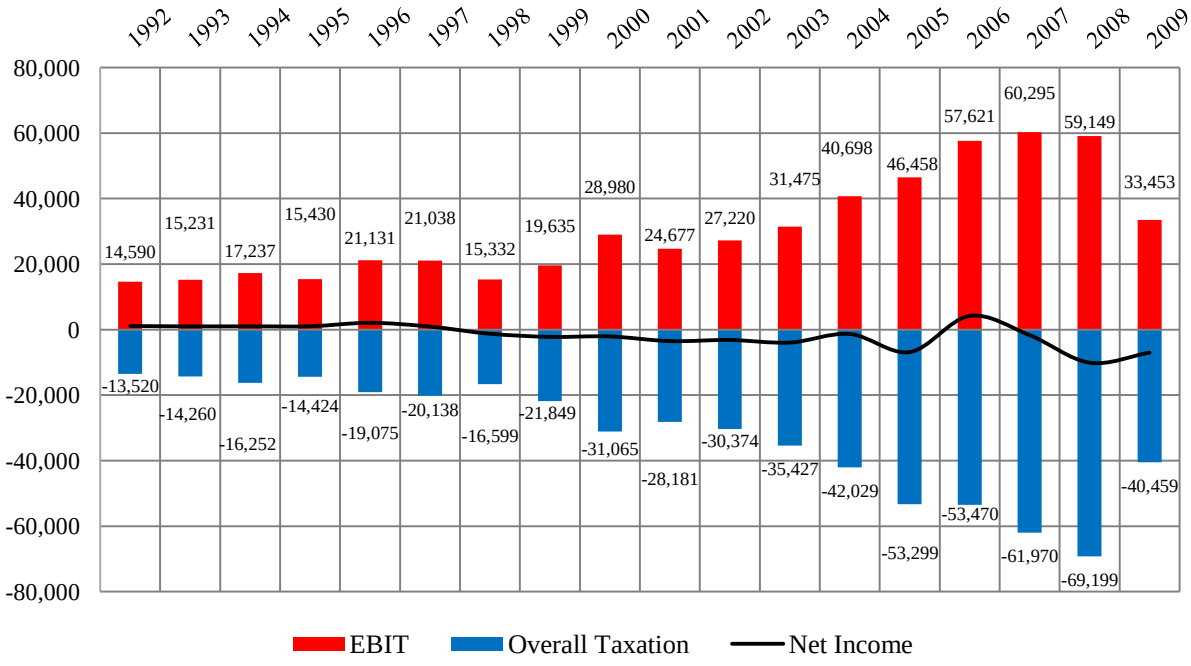
These circumstances demonstrate one of the most critical features of PEMEX. This heavy tax burden prevents Mexico's largest company from reinvesting in key areas such as exploration and refining. With respect to the latter, it must be noted that PEMEX has not been able to expand capacity at the pace one may expect from a major crude

[72] Overall, average tax collection in Latin America, calculated as a proportion of GDP, stood at 18.4 percent in 2008. In Brazil the figure was 35.5 percent and in Argentina 30.6 percent for the same year. According to a report by the United Nations Economic Commission for Latin America and the Caribbean cited in *El Mañana*, a Mexican newspaper. 31/05/2010. México, último lugar de LA en recaudación tributaria: CEPAL.

producer. The atmospheric distillation capacity, which refers to the process of turning crude into refined products, rose from 1,270 thousand barrels per day in 1980 to 1,540 thousand barrels per day in 2009. In a period of thirty years PEMEX managed to expand refining capacity by just 21.26 percent (PEMEX 1990, 2010a).

Another development that merits discussion is the increasing deterioration of the PEMEX balance sheet. Despite the fact that income generated by the company through exports of crude and the domestic sale of refined products is regarded as the second highest in Latin America, the tax burden has put the financial standing of the company to the test. It is becoming standard practice for PEMEX to issue debt on international markets in order to comply with its obligations (Figure 7.2). Such obligations stretch from meeting the financial needs of the state and servicing its own debt to upgrading existing facilities and exploratory projects.

Figure 7.2 Draining PEMEX revenues
($ millions)



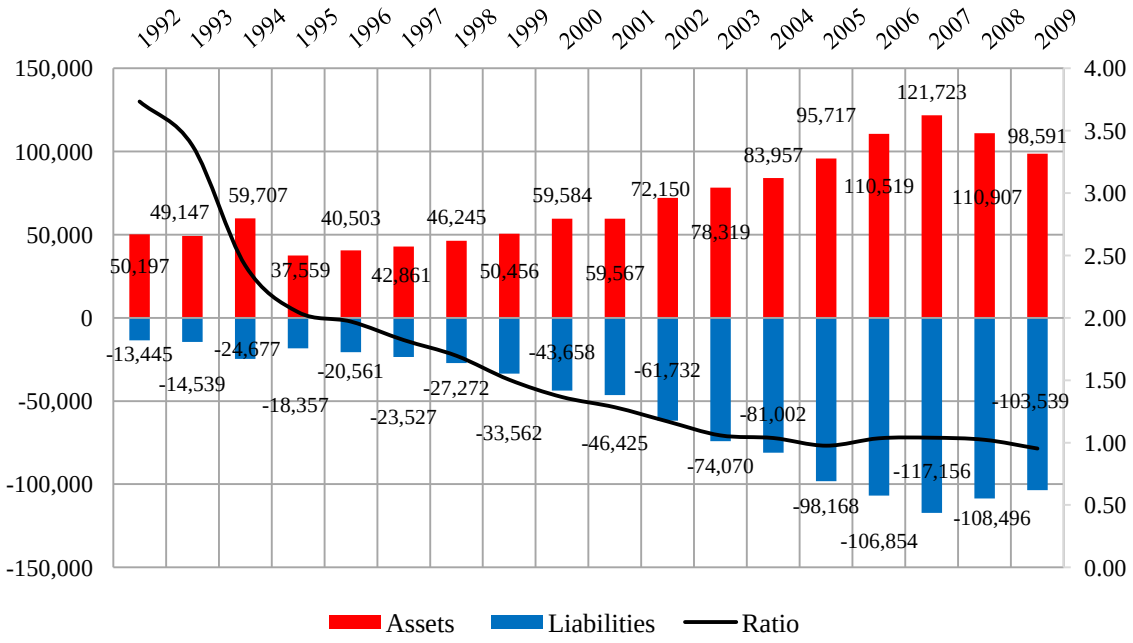
Source: PEMEX (2003, 2010a).

As shown in Figure 7.2, PEMEX net income has been consistently negative since 1998 and the trend has been sharp decline, with the 5-year period beginning in 2003 deserving particular attention. Earnings before interest and tax (EBIT) have hit record levels as a result of both an upward trend in the price of oil and an output of over 3

million barrels per day – up to 2007 when production began to decline. However, the same applies to the parameters at the other end of the spectrum, namely, the tax burden and net loss year after year. By 2005, as the price per barrel rose to $42.71, EBIT climbed to $46.5 billion but a tax burden of $53.5 billion led to a net loss for PEMEX of $6.8 billion. Figures seriously worsened in 2008 when despite a surge in EBIT to $59.12 billion, the tax burden led to a net loss of $10.1 billion. In that year alone PEMEX transferred $69.2 billion to treasury coffers.

The way PEMEX is managed is clear. A fiscal-driven approach has dictated the fate of the most important Mexican firm over the last three decades: the more PEMEX earns the more resources it pays to the government in the form of taxes. It has therefore become apparent that such a line of reasoning is what has guided the judgment of policy makers since the 1970s oil boom. As a result, PEMEX has found itself in the rather paradoxical situation of having to issue debt through international markets in order to comply with an inequitable tax regime at home.

Figure 7.3 Assets vs. liabilities
($ millions)



Source: PEMEX (2003, 2010a).

The deterioration of the financial standing of PEMEX is also reflected in its assets-to-liabilities ratio (Figure 7.3). In 1992, liabilities represented only 26.8 percent of assets. More specifically, the assets of PEMEX in that year were reported to be $50.1 billion,

whereas liabilities were calculated at $13.4 billion. The assets to liabilities ratio therefore stood at 3.7. By 1995, in the midst of the peso crisis, conditions worsened rapidly with liabilities accounting for 49 percent of assets and the ratio falling to 2.046. The figures were to weaken even further a decade later. In 2005, liabilities were greater than assets and the ratio plunged to .975 – a figure indicating that PEMEX debts were greater than the value of its assets. In the subsequent years things did not greatly improve as the assets-to-liabilities ratio averaged 1.032 for the three years to 2008 before plunging to 0.95 in 2009. Once again the sum of liabilities was greater than the value of assets. It is worth noting that during the period of analysis, assets and liabilities peaked at $121 and $117 billion respectively in 2007, figures that roughly correspond to 10 percent of the country's GDP for the year.

It is obvious that these numbers paint a very gloomy picture, but at the same time they lead to a fundamental question: What lies behind all this? Even though the answer is rather complex, in the light of the evidence one is able to draw certain conclusions. PEMEX is managed using an approach that seeks to compensate for taxes the government does not collect from other sectors of the economy. The draining of PEMEX royalties has been privileged over, among other factors, the upgrading of its petrochemical complexes.

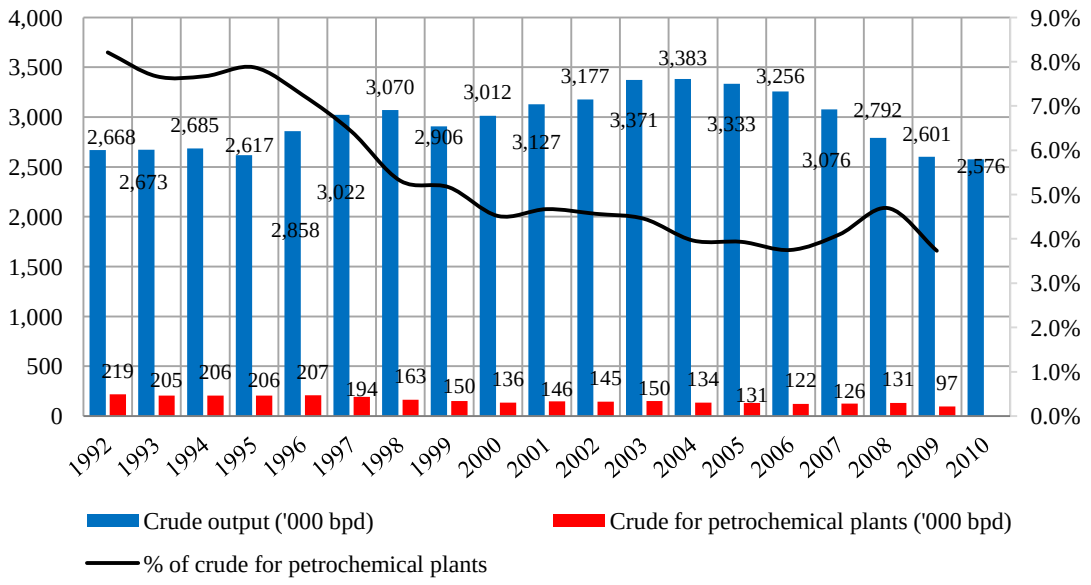
Input supply at risk: a shrinking crude output meets high international prices

It is widely acknowledged that the dominant role of PEMEX petrochemical complexes represents a serious concern for the upgrading of the entire cluster. Private firms face a scenario riddled with uncertainty concerning key features of their relationship with state-owned firms. In a similar fashion, state-owned petrochemical firms have a sour relationship with PEMEX, their parent company. One component of this spectrum is a limited stock of inputs since natural gas and crude are in short supply. If one is to trace the drivers of stretched public petrochemical firm output, it is necessary to consider other dynamics within PEMEX. Mexico's largest company has embraced a set of policies that imposes restrictions on expanding the production of petrochemical inputs. A number of features are at the core of this debate.

The downward trend for crude output over the last five years is a matter that deserves particular consideration. Since 2004, the year when output peaked at 3.38 mbpd, overall

crude production has consistently deteriorated. It is therefore important to mention the role of Cantarell, a field off the Campeche coast discovered in 1976 and whose output in the same year peaked at 2.136 mbpd, accounting for 63.15 percent of Mexico's overall crude production. Output at Cantarell, however, has rapidly declined. The field yielded just 684 thousand barrels per day in 2009 – a figure that represents 26.3 percent of PEMEX production and a staggering fall of 1,452 thousand barrels per day vis-a-vis 2004. All in all, PEMEX output plunged to 2.6 mbpd in 2009 - a sudden drop of 23 percent over a period of five years (Figure 7.4). This figure makes Mexico the world's sixth largest crude producer (PEMEX 2010a). In the future the lack of investment in exploration and the technical restrictions of PEMEX with regard to deepwater drilling may accentuate this drop (Shields 2008), although it must be pointed out that the firm managed to stabilise production at 2.576 mbpd in 2010 (PEMEX 2010b).

Figure 7.4 PEMEX overall output and crude processed at petrochemical facilities

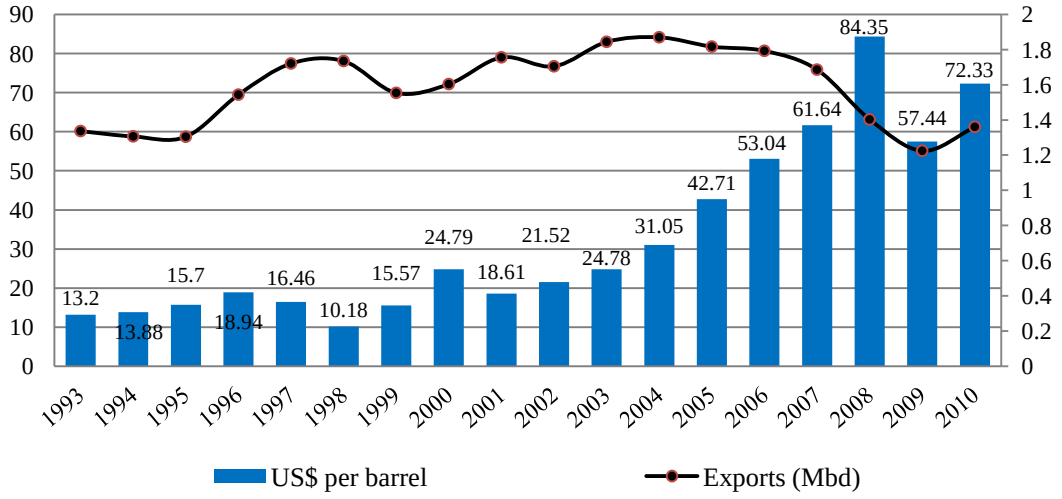


Source: PEMEX (2003, 2010a). PEMEX, indicadores petroleros (2010b).

In addition to declining output, a skyrocketing international price for crude is another factor requiring analysis. Evidence suggests that the age of low-cost oil has come to an end given that prices have more than tripled since 2003. The average price of the Mexican crude basket stood at $24.78 per barrel in 2003 but since then prices have surged with the price standing at $84.35 just five years later – an increase of 340

percent. In a context where falling crude output (Figure 7.4) is coupled with high international prices (Figure 7.5) and weak tax collection by the government, policy makers have been required to establish priorities that are open to discussion. Crude exports are a case in point. For fiscal purposes, crude exports to the U.S. and other countries appear to be more profitable in the short term than any of the other activities of PEMEX. As far as the petrochemical division of PEMEX is concerned, it is important to address the fact that the latter has occurred at the expense of the supply to petrochemical complexes, which process less crude (Figure 7.4) and therefore yield less petrochemical inputs year after year (Figure 7.7).

Figure 7.5 Exports and average price of the Mexican crude basket



Source: PEMEX (2003, 2010a). PEMEX, indicadores petroleros (2010b).

In the first half of the 1990s, when output at petrochemical complexes hit record levels, the amount of oil destined for the processing of petrochemical inputs stood at 209 thousand barrels per day, or 7.9 percent of overall crude production. In the second half of the 1990s petrochemical plants handled 170 thousand barrels of crude per day (bpd), which accounted for 5.7 percent of PEMEX crude output. For much of the past decade the decline was even sharper. In the context of a high international price, particularly from 2003 onwards, the figures indicate a pronounced downhill trend. Crude processed at petrochemical facilities averaged only 4.1 percent (or 132 thousand bpd) as a proportion of the overall crude output for the 2003-2008 period (Figure 7.4). Such a share is not quite half of that attained during the first half of the 1990s. Nonetheless, the

most worrying slump was yet to come. While in 2008 the share of crude processed by petrochemical complexes represented 4.7 percent, the figure stood at just 3.7 percent by 2009. All in all, what these numbers demonstrate is that the crude supply to PEMEX-Petrochemicals has steadily contracted over the last two decades – a factor that in part explains the stretched availability of basic inputs in the Veracruz cluster.

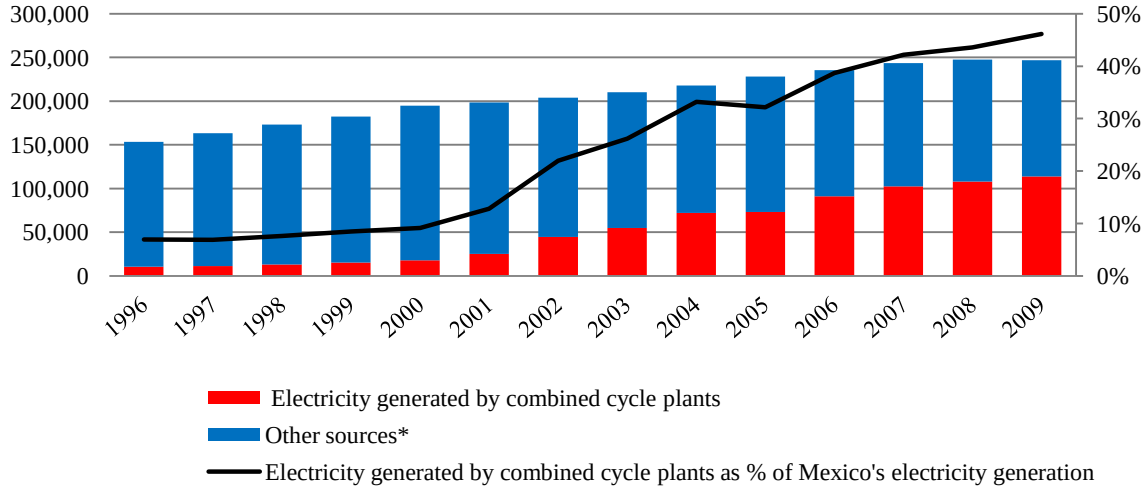
Input supply at risk: the growing use of natural gas for electricity generation

Crude is not the only input demanded by the petrochemical industry. Natural gas, or more specifically dry gas, is also important and is the main feedstock, for example, in the making of ammonia at Cosoleacaque. In reviewing PEMEX estimates, it is evident that the company does not disclose data over the amount of gas it processes at its petrochemical complexes, although it does report how much gas it transfers to other sectors of the economy. In that respect, the generation of electricity is an issue that merits particular consideration. The use of natural gas to generate electricity in Mexico has rapidly increased over the last ten years (Figure 7.6). Regardless of the fact that the government has authorised the participation of private investors in the natural gas market[73] and the generation of electricity, it is understood that environmental concerns, along with a growing domestic consumption, are the forces behind the upsurge. In order to situate the latter in a broader context, it is indispensible to consider how much gas PEMEX assigns to the power sector. When NAFTA came into effect, the proportion of gas PEMEX sent for the generation of electricity in terms of its overall output rose from 18.96 percent in 1994 to 31.21 percent in 2000. This upward trend became even more pronounced in the following years, rising from 36.02 percent in 2001 to 50.42 percent in 2009 (PEMEX 2001, 2010a). To a great extent, the weight of natural gas, or rather the use of combined cycle power plants, in the generation of energy has mirrored the trend described above. Over the last decade and a half, as illustrated in Figure 7.6, it is reported that the generation of electricity in Mexico grew 60 percent. A large percentage of this additional output is attributed to the generation capacity of combined cycle plants which use natural gas as feedstock. In 1996, for example, while 55.8 percent of the

[73] A year after NAFTA came into effect, the government embarked on a process to deregulate the natural gas market. In 1995, the Zedillo administration amended the petroleum law and allowed the participation of private capital in the transportation, storage, and distribution of natural gas as well as in the construction and operation of pipelines. Private investors were also permitted to freely import and export natural gas. Prior to these amendments, PEMEX held the exclusive right to perform the whole spectrum of natural gas related activities (Torres-Baron 2009).

energy generated came from conventional thermoelectric plants, only 6.94 percent came from combined cycle plants. This share grew at modest yet consistent rates towards the end of the decade. From 2000 onwards, however, the use of natural gas as an input for power generation grew rapidly and it is estimated that combined cycle plants accounted for 12.79 percent of the country's electricity output in 2001. The proportion rose slightly above 50 percent in 2009. Since the Energy Ministry estimates that domestic electricity consumption is expected to grow at an average of 4.3 percent in the fifteen years to 2025, it is clear that the share of natural gas in the composition of the country's energy matrix will continue to burgeon (Secretaría de Energía 2007, 2010).

Figure 7.6 Mexico's electricity outlook
(GWh)



Source: Secretaría de Energía (2007, 2010).
* It includes both hydrocarbon (conventional thermoelectric, internal combustion, gas turbine) and alternative sources (hydraulic, nuclear, coal, wind-electric and geothermal-electric).

Even though it is unclear to what extent the increasing use of natural gas for energy generation limits the input available to feed industrial processes at state-owned petrochemical complexes, this situation undoubtedly places further pressure on PEMEX-Petrochemicals. In this sense, and as noted in the present section and the previous chapter, the determinants serving to elucidate the complex scenario of the Veracruz cluster are varied. The limited availability of inputs coupled with high international prices and deregulation of the sector have contributed to a deterioration of the petrochemical division of PEMEX. A brief overview of the petrochemical production at state-owned firms will therefore help reveal more.

THE PETROCHEMICAL ARM OF PEMEX

The Cosoleacaque, La Cangrejera, Morelos and Pajaritos complexes situated in southern Veracruz are of great importance for the petrochemical division of PEMEX. They account for an installed capacity of 12,037 thousand tonnes, which represented 92 percent of the overall installed petrochemical capacity of PEMEX[74] as of 2009. In relation to output, the four complexes yielded 7,576 thousand tonnes of petrochemical raw materials, which is equivalent to 99.8 percent of overall PEMEX-Petrochemicals[75] production for the same year. A review of these variables for the previous two decades shows the figures are similar.

It is well known that the fortunes of the Veracruz cluster are closely linked to the petrochemical division of PEMEX. This is mostly attributed to the fact that the complexes of Cosoleacaque, La Cangrejera, Morelos and Pajaritos supply industrial raw materials that the other firms in the Veracruz cluster process into intermediate inputs. Over the last fifteen years this role has been threatened as output from state-owned facilities has contracted. Figure 7.7 clearly shows how output at the four PEMEX petrochemical complexes has dropped since the 1990s. It is stated in official reports that output reached its peak in 1992 with the production of 11,948 thousand tonnes of petrochemical products – a figure that represented 87.6 percent of the subsidiary's overall production that year. Production was to a great extent solid during the first half of the 1990s, but began to decline in the second half as a result of government efforts to privatise the sector (Chapter 6).

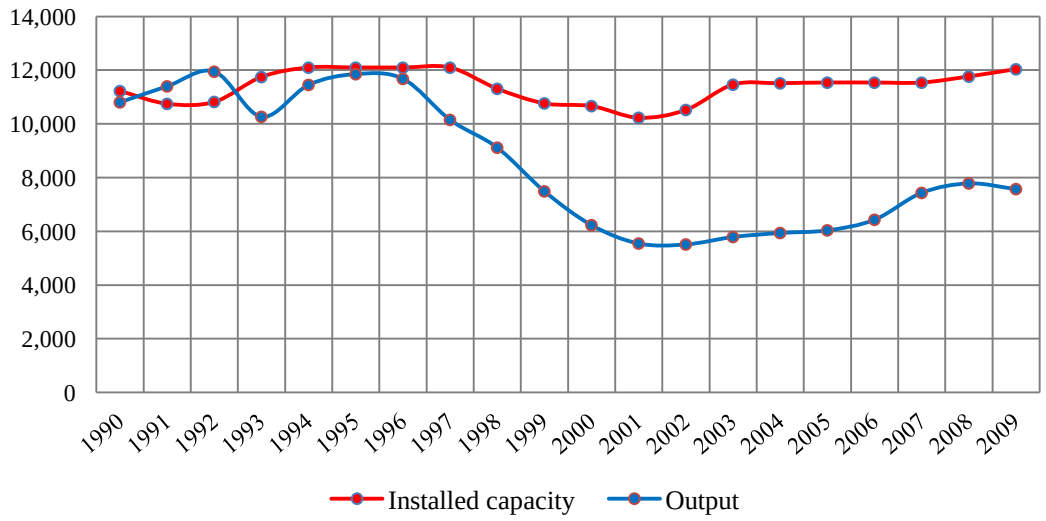
The downward trend for output commenced in 1996 when Mexico was on the road to recovery from the financial crisis that had hit two years earlier. It was during the Zedillo administration, Mexico's president from 1994 to 2000, that the PEMEX petrochemical complexes in Veracruz suffered their sharpest fall in output. By the end of Zedillo's tenure output had plummeted to 6,234 thousand tonnes, down from 11,855 thousand tonnes in 1995. The most dramatic drop, however, occurred in 2002 when production collapsed to 5,515 thousand tonnes. This figure represented 46 percent of the 11,948 thousand tonnes recorded in 1992 – the year when output achieved record levels for the

[74] PEMEX-Petrochemicals installed capacity stood at 13,061 thousand tonnes as of 2009 (PEMEX 2010a).
[75] PEMEX-Petrochemicals reported production of 7,841 thousand tonnes in 2009 (PEMEX 2010a).

decade. For the 1990-1999 period, the output of Cosoleacaque, La Cangrejera, Pajaritos and Morelos represented 88 percent of the entire PEMEX petrochemical division.

One of the conclusions drawn from analysis of the four complexes over the final eight years of the period shown in Figure 7.7 is that output stagnated. However, if the numbers achieved in the 1990s are taken into account, the picture is more devastating. While output averaged 10,618 thousand tonnes annually for the 1990-1999 period, from 2000 to 2009 average output plummeted to 6,431 thousand tonnes per year – a reduction of 40 percent. As for 2009, the last year reported by PEMEX, output stood at 7,576 thousand tonnes, just 63.4 percent of the output recorded in 1992. Nevertheless, the weight of the four petrochemical complexes within PEMEX-Petrochemicals in terms of output surged to 96.4 percent for the 2000-2009 period - mostly as a result of the shutting down of other state-owned plants throughout the country.

Figure 7.7 Installed capacity and output at PEMEX petrochemical complexes*
('000 tonnes)



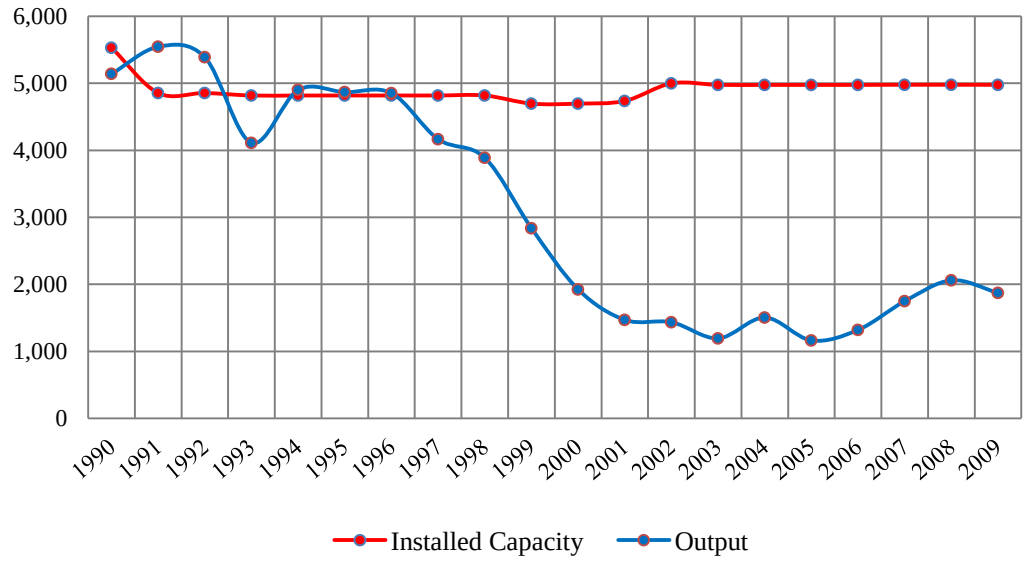
Source: PEMEX (2001, 2003, 2010a).
* It refers to PEMEX-Petrochemicals complexes in the Veracruz cluster.

While there is no doubt that the aggregate performance of the four public petrochemical firms is overwhelmingly negative, it is necessary to point out that complexes differ in terms of installed capacity and output. In order to understand the weight each petrochemical complex carries within PEMEX-Petrochemicals a brief, yet more specific, account is needed.

The Cosoleacaque petrochemical complex

In terms of installed capacity, the Cosoleacaque complex is the largest, accounting for 38 percent of the entire PEMEX petrochemical division in 2009. In terms of output, Cosoleacaque is second to La Cangrejera, yielding 1,871 thousand tonnes of raw materials in 2009 – 24.7 percent of overall production for that year. The core production line of Cosoleacaque is ammonia – a natural gas by-product. Towards the end of the 1980s and at the beginning of the 1990s the firm was touted as the world's largest ammonia producer. Of the overall installed capacity of almost 5,000 thousand tonnes, ammonia output accounted for more than half of the complex's production during this period. For the 1990-95 period, overall output at Cosoleacaque averaged 4,993 thousand tonnes, peaking at 5,546 thousand tonnes in 1991. Nevertheless, conditions deteriorated sharply in the following years (Figure 7.8).

Figure 7.8 Installed capacity and output at Cosoleacaque petrochemical complex (000' tonnes)



Source: PEMEX (2001, 2003, 2010a).

Output began to wane in 1997 with Cosoleacaque producing just 4,165 thousand tonnes of ammonia and other inputs such as carbonic anhydride. Although this figure is high, it represented only 75 percent of the amount produced in 1991. In the light of the Zedillo administration's privatisation attempts (Chapter 6), output continued to tumble for the rest of the term and by 2000 output had fallen to 1,900 thousand tonnes. But the most

worrying scenario was yet to come as output plummeted to 1,160 thousand tonnes in 2005 – a figure that represents just 21.5 percent of 1991 production levels. In 2009, the most recent year reported by PEMEX, the production of inputs at Cosoleacaque stood at 1,871 thousand tonnes – 33.7 percent of the 1991 output level. As can be seen, output remained particularly low throughout the first half of the past decade and there is reason to believe this is mainly the result of high prices for natural gas on the southern coast of the U.S., as some interviewees pointed out during fieldwork. It is therefore important to remember that the price of inputs yielded at state-owned complexes in the Veracruz cluster are tied to those in the U.S., and that domestic production of ammonia is hit hard when natural gas prices north of the border fluctuate. On the other hand, it is also possible to identify a slight recovery in output during the final years of the period analysed. It is recognised by interviewees familiar with the situation that this corresponds to a rise in fertilizer prices – a situation that leads to more robust demand for ammonia.

In relation to capacity utilisation, the figures shown above demonstrate an average of 100 percent for the 1990-95 period, although this steadily dropped over subsequent years in line with the privatisation efforts of Zedillo. In the second half of the 1990s the number stood at 74 percent, mirroring the adverse conditions the industry endured at that time. From 2001 to 2009 production capacity at Cosoleacaque was used at an average rate of a disappointing 31 percent.

Throughout this period, the contraction of ammonia production helps explain the sharp fall in overall petrochemical output so a brief account of this compound output drop is therefore required. While 2,500 thousand tonnes of ammonia were yielded at the Cosoleacaque complex in 1996, output plummeted to 923 thousand tonnes in 2000. Not only the limited availability of inputs previously described contributed to this, it is also alleged that one of the policies that helps to explain this drop during the second half of the 1990s is the pricing of natural gas, as briefly mentioned above. Natural gas is the raw material required for the production of ammonia, an essential compound in the production of urea and other fertilizers. In order to comply with the conventions of a free market economy, the Mexican government tied the price of domestic natural gas to that of the southern coast of the United States, where production costs are allegedly higher than in Mexico and elsewhere. This policy was adopted as the Mexican treasury

considered that a domestic price lower than that on the Texas coast would be considered unfair competition by U.S. based firms. As a result, the domestic price of ammonia and urea skyrocketed as it was no longer set by taking into consideration production costs. Instead, it followed natural gas price trends on the northern coast of the Gulf of Mexico. To mitigate the consequences of this problem for the agricultural sector, the target market of the value chain, the government eliminated import duties for urea. In this way farmers could buy fertilizers at more competitive prices. The grouping of these two policies proved devastating for the Cosoleacaque petrochemical complex and other firms along the value chain as PEMEX ammonia and fertilizer plants in the Veracruz cluster and throughout the country closed down. Mexico became a net importer of fertilizers[76]. In the name of free market policies, government officials played a major role in the dismantling of the natural gas-fertilizer value chain. Similar repercussions occurred throughout the PEMEX petrochemical spectrum.

The La Cangrejera petrochemical complex

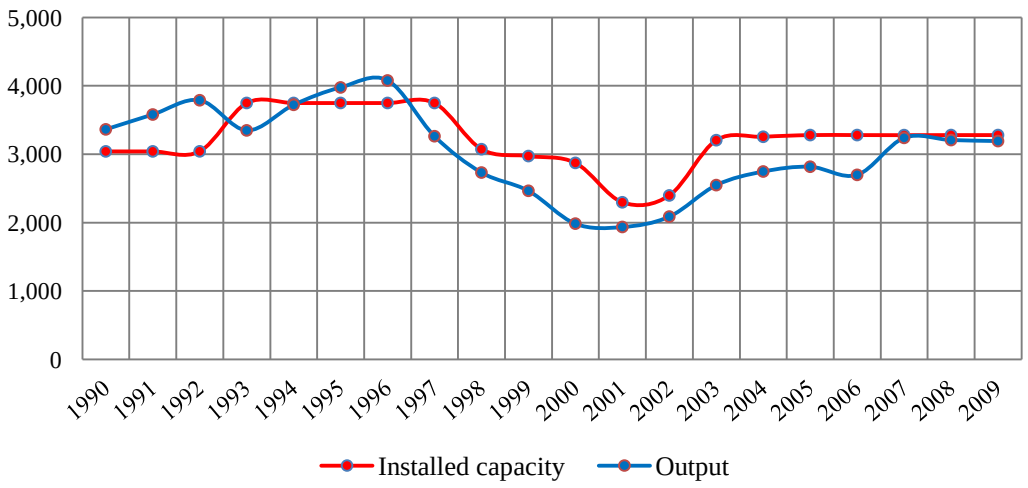
The La Cangrejera complex is the second largest in terms of installed capacity, accounting for 3,280 thousand tonnes in 2009 or 25.11 percent of the entire capacity of PEMEX-Petrochemicals. This firm is in fact the largest if output is taken into account, yielding 42.07 percent of overall production. Of the 7,587 thousand tonnes of raw materials PEMEX produced in 2009, La Cangrejera generated 3,192 thousand tonnes. Similar to the experience of Cosoleacaque in the 1990s, output at La Cangrejera began to drop towards the end of the decade. In the first half of the decade output remained stable and in 1996 the firm registered record levels with output reaching 4,078 thousand tonnes. The following year production began to wane as the petrochemical complex registered a drop of 20 percent. By 2000 output had fallen to 1.985 thousand tonnes, a figure that represented just 48.67 percent of that recorded in 1996 (Figure 7.9).

Things took a turn for the worse in 2001 when La Cangrejera produced 1,936 thousand tonnes - the sharpest drop recorded – with this contraction reflecting what occurred throughout the rest of the sector. However, output recovered in the following years, bouncing back to 2,800 thousand tonnes in 2005 - a rise of 44.6 percent in relation to

[76] According to fieldwork findings, the price for fertilizers has surged in recent years, prompting a rise in the production of ammonia and the re-opening of one fertilizer plant at a local firm, which is allegedly the only plant operating in the Veracruz cluster and in Mexico as of 2008.

2001. During this period PEMEX expanded the production of ethylene-derived products - a compound that feeds industrial processes of several buyer firms in the Veracruz cluster. Output continued to grow and La Cangrejera generated 3,192 thousand tonnes in 2009 – close to 80 percent of the amount registered in 1996. With regard to capacity utilisation, the early years of the 1990s represented a prolific phase for La Cangrejera and from 1997 to 2000 it is reported that capacity was exploited at a rate of 82 percent - a figure that does not reflect the tough times the Cosoleacaque complex was experiencing. Figures were also positive for the following decade with the average rate of installed capacity usage standing at 89 percent from 2001 to 2009. Of particular importance was the period 2007-2009 when the average was 98 percent. The lowest entry level was in 2000 when output represented just 69 percent of installed capacity usage (Figure 7.9).

Figure 7.9 Installed capacity and output at La Cangrejera petrochemical complex (000' tonnes)



Source: PEMEX (2001, 2003, 2010a).

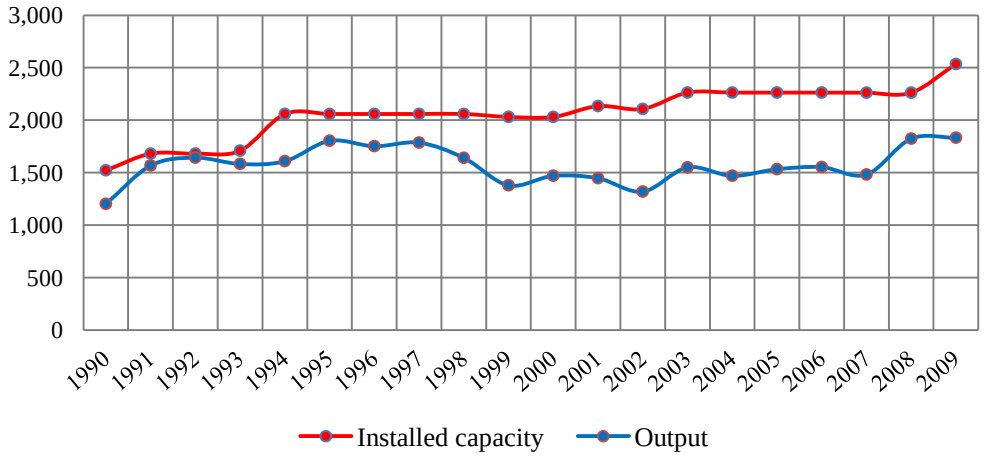
The evidence suggests that La Cangrejera managed to weather the storm experienced by the entire industry over the last decade and a half. To a great extent, this can be attributed to the fact that ethylene represents the most important production line for the PEMEX petrochemical division. Even though overall output remained steady during the period covered by Figure 7.9, this was coupled with skyrocketing imports. Domestic demand for ethylene-derived products and products of ethylene origin dwarfed output. The fact that domestic requirements (at subsequent stages of the associated value

chains) are met through imports is a matter of great concern and a chief component of the sector's problems. An overview of the import of petrochemical products in a later subsection will elaborate further on this.

The Morelos petrochemical complex

The importance of Morelos is overshadowed by that of Cosoleacaque and La Cangrejera as its share of installed capacity and aggregate output make it the third largest firm of the PEMEX petrochemical division. With regard to installed capacity, it represented 19.4 percent of the overall figure in 2009. Morelos was capable of producing 2,535 thousand tonnes – a jump of 12 percent in comparison to a year earlier. In terms of output, Morelos registered record levels in 2009 when it generated 1,833 thousand tonnes of raw materials. In relative terms this amount accounted for 24.15 percent of total PEMEX production for that year, which also means that plants at Morelos were working at 72 percent of capacity (Figure 7.10).

Figure 7.10 Installed capacity and output at Morelos petrochemical complex (000' tonnes)



Source: PEMEX (2001, 2003, 2010a).

Although these numbers do not initially paint a negative picture, in particular because Morelos registered lower figures throughout the previous decade, they do mirror the trend throughout the entire sector. As for the 1990s, the firm had a mixed performance since in the 1990-93 period output averaged 1,500 thousand tonnes, representing 91% use of installed capacity. During the following phase, 1994 to 2000, output surged to

1,640 thousand tonnes, mainly due to greater installed capacity. The (*process*) upgrading of the Morelos complex expanded capacity from 1,700 thousand tonnes in 1993 to 2,060 thousand tonnes in 1994 – a figure that remained stable until the end of the decade.

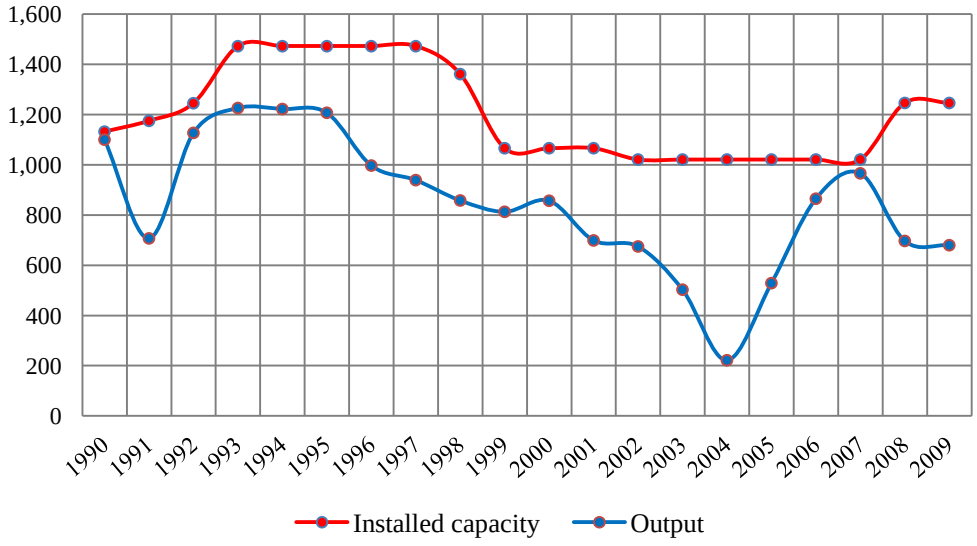
During the same period the Morelos petrochemical plants operated at an average rate of 80 percent. However, 1999 and 2000 offered a glimpse of what was to come as output shrank to 1,380 and 1,470 thousand tonnes and the complex worked at 68 percent and 72 percent of its overall capacity respectively. Up to 2007 output remained steady as was the case in 2001, with Morelos producing 1,470 thousand tonnes of inputs. In 2007 production stood at 1,482 thousand tonnes. Even though the average operation rate for Morelos during the 2001-2007 period plummeted to 67 percent, in 2008 capacity utilization rose to 81 percent - up from 66 percent a year earlier. In that year, Morelos yielded 1,824 thousand tonnes and a similar level of production was reported for 2009. Nonetheless, as Morelos underwent upgrading of its installed capacity, the rate at which this was utilised plunged to 72 percent.

The Pajaritos petrochemical complex

Last but not least, the Pajaritos complex in the city of Coatzacoalcos is the smallest in terms of installed capacity and output. In many respects, both indicators witnessed pronounced shifts over the course of the last two decades. In 1990 capacity utilisation stood at 97 percent, while a year later the number had sunk to 60 percent. Apart from 1991, the firm in fact registered respectable numbers during the first half of the decade with output averaging 1,098 thousand tonnes a year, corresponding to an average capacity utilisation of 83 percent from 1990 to 1995. At the same time, installed capacity reached 1,470 thousand tonnes in 1995, up from 1,130 thousand tonnes in 1990. For the rest of the decade, and in keeping with the sector trend, Pajaritos entered a less productive period with both output and installed capacity contracting. By 2000 the production of inputs shrank to 857 thousand tonnes at plants capable of yielding up to 1,060 thousand tonnes. Capacity utilisation stood at 80 percent, but with an installed capacity 28 percent smaller than that in 1995. From 1996 to 2000 the rate of capacity use averaged 70 percent (Figure 7.11).

Over the course of the following decade the production capacity of Pajaritos remained steady, although output did suffer a different fate. The downward trend accelerated until 2004 when only 222 thousand tonnes were yielded. In that year the rate at which the firm's plants were operating was 22 percent - the lowest level for the entire period. Nonetheless, conditions improved in the following years. Output bounced back to 966 thousand in 2007, coupled with a capacity utilisation of 95 percent. 2008 merits special mention since the upgrading of installed capacity was accompanied by a sharp drop in output of 28 percent (697 thousand tonnes) while installed capacity grew 21 percent (from 1,021 thousand tonnes in 2007 to 1,240 thousand tonnes in 2008). Capacity utilisation sank to 56 percent - a number outperformed by the previous year. By 2009 things had not improved for Pajaritos.

Figure 7.11 Installed capacity and output at Pajaritos petrochemical complex (000' tonnes)



Source: PEMEX (2001, 2003, 2010a).

Despite the fact that the importance of Pajaritos in the fall of overall output is dwarfed by that of Cosoleacaque, its erratic operations over the course of the last two decades helps to highlight the deterioration experienced by the public petrochemical industry in the Veracruz cluster. Although not every firm has performed poorly, aggregate figures tell a story of shortcomings where output is a chief variable. As argued at earlier points of this chapter, to a certain extent the heavy tax burden and falling crude output help us

understand this downward trend. A look at the facts may lead us to wonder about the broader repercussions of this situation and the following section seeks to do just this.

THE OUTCOMES OF DEREGULATION

As indicated in Chapter 6, the administrations of Miguel De La Madrid (1982-1988), Carlos Salinas (1988-1994), and Ernesto Zedillo (1994-2000) introduced a series of policies designed to encourage the participation of private actors in the petrochemical industry[77], ensure compliance of the hydrocarbon industry with the stipulations of a free market economy[78], and increase the efficiency of PEMEX through horizontal restructuring[79]. At this point it is worth remembering that such policies were not the only course of action pursued by the state and were accompanied by the confiscation of PEMEX revenues as described earlier. The stagnation of installed capacity and its inability to transform hydrocarbon inputs into refined and petrochemical products is a case in point and leads to a consideration of the crossroads where PEMEX currently finds itself.

Did the arguments used by policy makers serve to validate the horizontal organisation of PEMEX and did the reclassification of basic petrochemicals lead to the anticipated outcomes? What are the repercussions of the abovementioned policies and the heavy PEMEX tax burden with respect to trade in crude and processed hydrocarbon by-products on the one hand and the growth of the company in terms of revenues on the other? I will attempt to answer these questions by analysing the paradoxical juncture at which Mexico finds itself – the world's sixth largest crude producer[80] whose imports of refined and petrochemical inputs are growing rapidly – as well as briefly comparing the implications of the horizontal structure of PEMEX with the vertical integration of major international energy firms.

The paradoxical scenario of the Mexican hydrocarbon industry

When studying the figures provided in the previous section, it becomes clear that the falling output at state-owned petrochemical complexes in the Veracruz cluster restricts

[77] This is the reclassification of basic inputs as secondary inputs.
[78] To link prices of PEMEX inputs (petrochemicals and natural gas included) to those on the southern coast of the United States.
[79] It entailed the organisation of PEMEX into four subsidiaries.
[80] In the year 2009 (PEMEX 2010a).

the availability of industrial inputs domestically. This situation is exacerbated by the fact that PEMEX-Petrochemicals is, despite liberalisation of the sector in recent decades, the sole producer of a number of petrochemical precursors[81], with this being one of the most detrimental repercussions of the regulatory framework institutionalised in the 1990s. As a result of the uncertainty arising from this context, the development of petrochemical value chains, which are constituted by both user firms in the locality and those associated with the transformation of secondary petrochemicals into final goods, has been hindered. To cope with the problem these companies hold the option of meeting their requirements through imports. The growth in imports of petrochemical inputs is undoubtedly one of the most detrimental consequences of the adverse scenario faced by PEMEX and its petrochemical subsidiary.

To put things into a broader perspective, not only the value of imports and exports of petrochemical products[82] require analysis but also that of products of petrochemical origin[83] over the last two decades. Products of petrochemical origin include textiles, plastics and other chemicals that Mexican-based firms can produce by processing the intermediate petrochemical products yielded by those firms located in the Veracruz cluster. Since indigenous production has been outpaced by demand, imports of these products have increased and during the period 1993-2010 these imports significantly outnumbered exports. In relation to petrochemical products, the national office of statistics (INEGI) reports that exports accounted for $0.492 billion in 1993 while the figure stood at $0.601 billion in 2009 – a disappointing increase of 22 percent over a period of sixteen years. In reviewing the figures at the beginning of the period it can be concluded that since Mexico was not an important exporter of petrochemicals, a substantial share of PEMEX output, which achieved record levels during this period, was consumed locally. On the other hand, this indicates why imports were not particularly significant. However, things changed over the same period with respect to imports as Mexico imported $0.826 billion in petrochemical inputs in 1993 and this led to a trade deficit of $0.334 billion. As late as 2009, the value of imports swelled to $6.160 billion – a rise of 745 percent in relation to 1993. The deficit then widened to

[81] This issue is discussed further in Chapter 8.
[82] The universe of secondary petrochemical products is extensive. The import figure computed by the National Institute of Statistics and Geography (INEGI) includes ammonia, polyvinyl chloride, ethylene, polyethylene, polypropylene, and others.
[83] In addition to the 'petrochemical products' classification, the INEGI gathers data on the trading of products of petrochemical origin (plastics, textiles and other chemicals).

$5.56 billion, which represents 16.6 times that of 1993. It is worth pointing out that the panorama was even darker in 2008 when imports peaked at $8.77 billion. With exports reaching $0.79 billion in the same year, the deficit hit record levels of $7.99 billion – 24 times that of 1993.

The trade figures calculated by the INEGI for January to November 2010 deserve special mention since the national statistics office estimates that exports of petrochemical products totalled $0.764 billion, while imports stood at $8.3 billion. The resulting trade deficit in relation to the first eleven months of the year was $7.54 billion.

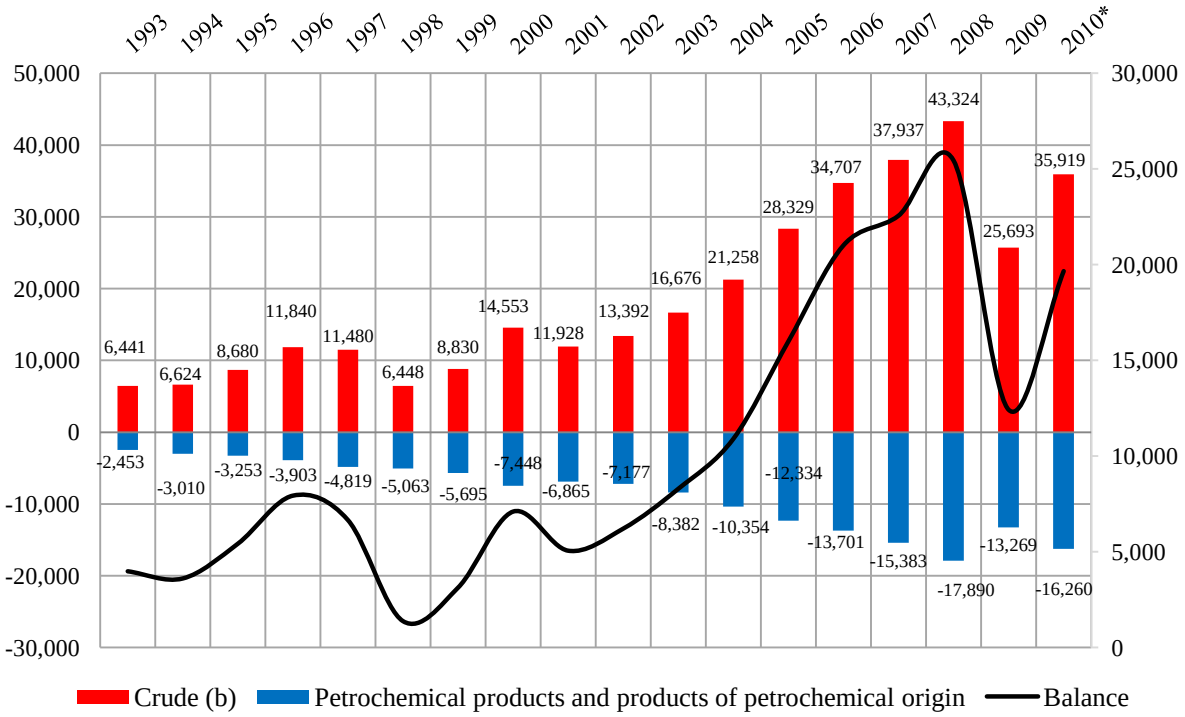
The same logic of analysis is used for the value of trade in products of petrochemical origin such as plastics, textiles and other chemicals during the same period. The INEGI indicated that exports of such products accounted for $0.98 billion in 1993 and $3.5 billion in 2009 – a figure that grew 357 percent during the period. It therefore comes as no surprise that imports grew even more, standing at $1.6 billion at the beginning of the period while the country spent $7.1 billion on products of petrochemical origin from abroad in 2009 – 443 percent more than in 1993. The deficit therefore grew from $0.62 billion in 1993 to $3.6 billion in 2009 – a rise of 580 percent. Once again, these figures were at record levels in 2008 since exports accounted for $4.4 billion whereas imports represented $9.12 billion, leading to a deficit of $4.72 billion – 73 times that of 1993.

The latest available trade figures with respect to products of petrochemical origin cover the period January-November 2010 during which the INEGI estimates that the country's exports totalled $4.1 billion and imports $7.98 billion leading to a deficit of $3.87 billion.

Using a single number for the value of imports in both product categories, it is possible to establish a clearer account of the extent of the problem. In so doing, the value of crude exports serve as the comparable variable. In 1993, for example, imports of petrochemical products and products of petrochemical origin totalled $2.43 billion, representing 38 percent of the value of crude exports for that year. By 2009 aggregated imports swelled to $13.26 billion - 51 percent of crude exports. These numbers not only reflect the worsening of the import-to-export ratio, they also demonstrate that Mexico is increasingly becoming a supplier of crude and a buyer of refined products.

Using the same line of reasoning, the 2004-2009 period deserves particular attention since it is a period when imports grew rapidly. Imports of the products group averaged $13.8 billion annually with the figure being particularly high in 2008 when imports skyrocketed to $17.9 billion (Figure 7.12). With exports of crude oil standing at $43.32 billion for the same year, the overall scene may not appear disturbing - but it is. In 2009, Mexico's oil exports stood at $25.66 billion, a year-on-year contraction of 41 percent. In a similar trend, imports plunged to $13.27 billion, 25.9 percent less than the previous year. As can be noted, the drop in imports of refined and petrochemical products was less pronounced than that of crude exports (Figure 7.12). In the short term things may change swiftly. As Mexico and the rest of the world recovers from the 2009 economic slowdown, imports of petrochemical input, textiles, plastics and other chemicals are predicted to gain pace again, whereas PEMEX oil output (Figure 7.4) is likely to remain at best stagnant in the foreseeable future.

Figure 7.12 Petrochemical imports vs. crude exports
($ millions)



Source: Economic databases of the external sector, INEGI, (2010). PEMEX (2003, 2010a). * Data from January to November 2010 in the case of petrochemical products and products of petrochemical origin.

Regardless of the fact that imports have recently surged, the value of crude exports has also risen and Figure 7.12 demonstrates the balance of these two variables. The trade surplus has widened since 2001 as a result of a combination of factors. Overall crude output rose from 3.127 mbpd in that year to 3.38 mbpd in 2003. From that point onwards output began to fall while the surplus continued to grow, boosted by higher international prices (Figure 7.5). As a result the positive balance jumped from $5.06 billion in 2001 to $25.4 in 2008 before dropping to $12.4 billion the following year. While these figures may lead to a questioning of whether the petrochemical industry is in fact operating in the red, it is simply a matter of bearing in mind that imports of petrochemical products and products of petrochemical origin represent 51 percent of the value of crude exports in 2009 - a controversial figure for a major world oil producer.

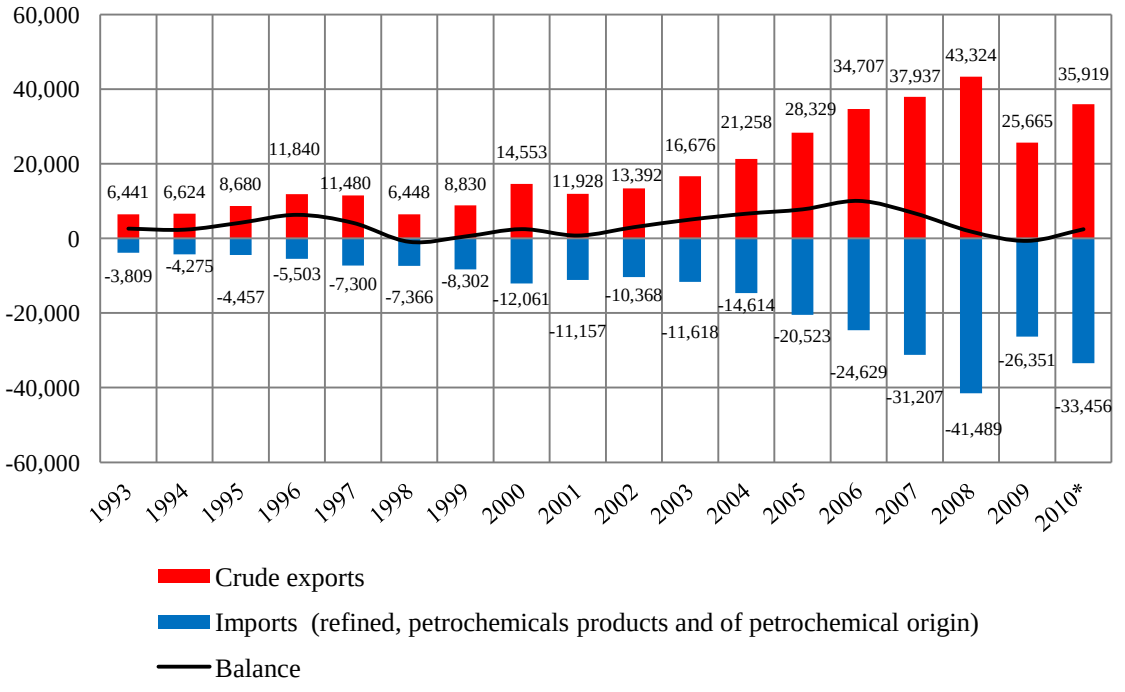
Given this scenario, the point is that the ability of PEMEX to capture larger sums of revenue to both finance public expenditure and offset petrochemical product imports will become more reliant on higher international prices – a factor that is beyond the control of policy makers as hinted at by Figure 7.12. As may be noted, crude export revenues rose from $25.6 billion in 2009 to $35.9 billion in 2010 with this occurring despite PEMEX crude output not varying from one year to another. Such a jump in revenues is therefore mostly attributed to higher prices for the Mexican crude basket - from $57.44 to $72.33 dollars per barrel in each of the years indicated - and to a lesser extent to a modest increase in exports – from 1.225 Mbd in 2009 to 1.361 Mbd in 2010 (Figure 7.5). Imports of petrochemical products and products of petrochemical origin, on the other hand, also surged although at a slower rate – from $13.27 billion in 2009 to $16.26 billion in the period January-November 2010. Nevertheless, and although the figures for December need to be included, imports of these products accounted for 45 percent of crude exports – down from 51 percent a year earlier.

The situation worsens if statistics for refined products are included in the analysis. While it is not in the scope of this chapter to shed light on other areas of PEMEX, the refining of hydrocarbon resources is another issue of increasing concern. As the heavy tax burden prevents PEMEX from expanding its refining capacity, the company has not been able to meet growing domestic demand for refined products such as fuel oil, diesel, jet fuel, liquid fuel, liquefied petroleum gas and other petroleum oils. An even more disturbing scenario can therefore be observed (Figure 7.13) since imports of these

products have escalated rapidly. As recently as 2004 imports of refined products stood at $4.26 billion and it took four years for their value to climb to $13.8 billion. In 2008 the figure was 3.24 times greater than that reported in 2004. That figure is particularly worrying as imports from 1993 to 2000 totalled just $17.43 and averaged $2.18 billion per annum according to the INEGI database on external trade.

A more precise picture of the vertical disintegration of the Mexican economy therefore becomes clear when imports of petrochemical products, products of petrochemical origin and refined products are grouped together (Figure 7.13). In order to conduct this brief analysis, the timeline show in Figure 7.12 will be divided into three phases. The first of these is from 1993 to 2000 – when crude exports averaged $9.36 billion and imports of petrochemical and refined products averaged $6.63 billion a year. These figures represent an exports-to-imports ratio of 1.41.

Figure 7.13 Imports of petrochemical and refined products vs. crude exports
($ millions)



Source: Economic databases of the external sector, INEGI (2010). PEMEX (2003, 2010a). * Data from January to November 2010 in the case of petrochemical products and of petrochemical origin.

The next phase runs from 2001 to 2005. The reason for establishing this period is that the balance began an upward trend as a result of a crude output of over 3 mbpd annually and higher international prices between 2004 and 2005. During this period imports averaged $13.66 billion per year and crude exports $18.32. The exports-to-imports ratio slightly worsened to 1.34.

Conditions markedly deteriorated in the 2006-2009 period. In annual average terms, crude exports amounted to $35.4 billion while imports came in at $31.1 billion – driving the ratio down to 1.14. Exports were just 14 percent higher than imports. The standout year during this period was 2008 when imports achieved a record $41.5 billion and crude exports totalled $43.3 billion - a surplus of $1.8 billion. In 2009, as a result of lower international crude prices (Figure 7.5), overall imports outstripped crude exports by $0.7 billion. The country spent $26.4 billion on imports of refined and petrochemical products and sent crude worth $25.7 billion abroad. Things changed in 2010, as noted earlier, when crude export revenues rose to $35.9 billion – up from $25.7 billion a year earlier. This change is mostly attributed to a considerable jump in the price per barrel. Imports of petrochemical and refined products increased as the economy bounced back from the previous year's economic slowdown[84]. The INEGI reported that imports from January to November 2010 amounted to $33.45 billion – an increase of almost 27 percent with respect to 2009.

Having put these figures into perspective, the reality is that imports of refined and petrochemical products not only threaten PEMEX crude profits, but also place at risk the country's energy security and self-sufficiency (Shields 2008). Should it therefore be considered paradoxical that Mexico exports crude oil before importing it in the form of refined products and other hydrocarbon inputs?

With respect to this scenario, it should be remembered that in the wake of privatisation attempts by the Zedillo administration (1994-2000) in the mid 1990s, scholars such as Ortiz Muñiz (1996: 22) warned that the country was on the route to becoming a mere supplier of crude and a net importer of value-added hydrocarbon by-products and manufactured goods. Figure 7.13 corroborates this view.

[84] The Economic Commission for Latin America and the Caribbean estimates that Mexico's GDP plunged by 6.5% in 2009 (CEPAL 2010). For 2010, the INEGI reported that GDP recorded growth of 5.5% (Economía de México crece 5.5% en 2010, 2011, February 21).

Although the latter account represents one of the dimensions used to scrutinise the paradoxical nature of the Mexican hydrocarbon industry, PEMEX should also be compared with major international energy firms in terms of income.

PEMEX in the international energy scene

The problems faced by PEMEX are not only demonstrated by the trade energy balance indicated lines above. If the structure of international energy firms is taken into consideration it is also possible to offer further insights. The Valero Energy Corporation (VEC) is a San Antonio-based firm that owns 14 refineries throughout the U.S.A., Canada and the Caribbean. Unlike PEMEX, VEC pays no attention to upstream activities. The company does not yield a single barrel of crude. It focuses instead on the production of refined and petrochemical products. In 2007, for example, it was reported that VEC imported $6 billion of Mexican crude, which it transformed into refined and petrochemical products worth $15 billion (Bazan Navarrete and Peña Guevara 2007). This is not to say that these products were marketed in Mexico, but this activity clearly serves to demonstrate the role of PEMEX as a supplier of crude to feed the industrial machinery of the U.S.

Figure 7.14 PEMEX vis-a-vis VEC
($ millions)

	PEMEX	VEC	PEMEX	VEC
	2008		2009	
Assets	111,129	35,629	102,004	32,417
Operating revenues	51,314	68,144	32,796	113,136

Source: PEMEX (2010a) and Valero Energy Corporation (2009).

Furthermore, the different approaches to operational integration pursued by both VEC and PEMEX can be identified when considering variables such as assets, operating revenues (Figure 7.14), and refining capacity. In 2009, for example, VEC reported assets of $34.4 billion and operating revenues of $113.13 billion, while those of PEMEX stood at $102 billion and $31.7 billion, respectively. The question raised here is: how effective are both companies at putting assets to work in order to generate

income? Every dollar of VEC assets produces $3.28 in operating revenues while each dollar of PEMEX assets generates 31 cents. Both examples refer to 2009 estimates. In terms of refining capacity, on the other hand, VEC dwarfs PEMEX. The U.S. firm operates a network of refineries with a capacity to process 2.6 mbpd whereas PEMEX is only capable of processing up to 1.54 mbpd at 6 refineries (PEMEX 2010a, Valero Energy Corporation 2009, Valero Energy Corporation website 10 January 2011).

Further evidence to this effect, presented by David Shields (2005), a leading commentator on the Mexican hydrocarbon industry, shows that in the case of major international oil firms the largest proportion of revenue is generated by the production and commercialisation of value-added products. In this respect, PEMEX is situated at the other extreme of the spectrum. ExxonMobil, for example, owns 42 refineries and 39,000 service stations. Royal Dutch Shell is the owner of 55 refineries and markets output through a system of 55,000 service stations. PEMEX, on the other hand, owns 7 refineries and markets output through a franchised network of 6,000 service stations. Another major distinction that needs to be highlighted is the proportion of refined products sales with respect to crude production. Once again, private firms rank higher. In 2003, ExxonMobil yielded 2.516 mbpd but marketed 7.957 mbpd of value-added hydrocarbon products with a refined product sales-to-crude output ratio of 3.18. Similarly, Royal Dutch Shell produced 2.334 mbpd of crude and sold 7.445 mbpd of refined products – figures that result in a ratio of 3.18. In the case of PEMEX, however, the numbers are rather disturbing since Mexico's largest firm yielded 3.371 mbpd of crude but managed to market just 1.706 mbpd of refined products. With these figures, the PEMEX ratio was 0.51. As can be seen, both ExxonMobil and Royal Dutch Shell place a great deal more emphasis on downstream activities than PEMEX whose core business, one may argue, is the exporting of crude. This latter scenario, as described by the author, is reflected in the abilities of the firms to generate revenue. On average, the revenues of BP, ExxonMobil, and Royal Dutch Shell were almost four times greater than those of PEMEX in 2003 (Shields 2005: 25-26).

By 2010, as Figure 7.15 demonstrates, the revenue asymmetry between PEMEX and international oil companies narrowed. However, while PEMEX managed to increase revenues at a slightly higher rate than Royal Dutch Shell and ExxonMobil between 2003 and 2010, the revenues of the world's second and third largest corporations,

according to Fortune 2010, accounted for three and a half times that of the largest Mexican company.

Figure 7.15 Revenues of major oil firms
($ millions)

	2003	2010
Royal Dutch Shell	205,212	285,129
ExxonMobil	222,654	284,650
BP	235,889	246,138
Sinopec	53,533	187,518
China National Petroleum	N.A.	165,496
Chevron	114,666	163,204
Total	119,250	155,887
ConocoPhillips	91,329	139,515
ENI	60,556	117,235
Petrobras	N.A.	91,869
PDVSA	45,000	91,182
PEMEX	55,929	80,722

Source: Fortune (2010, July 26). Shields (2005), citing 2003 data from Fortune 500.

When these figures are taken into account, it becomes clear that the government strategy concerning PEMEX has not delivered the anticipated results. There is no doubt that the division of PEMEX into four subsidiaries and the lack of investment in exploration and upgrading refining capacity are factors that have damaged the firm's ability to generate revenue. Nonetheless, the decisive factor in this matter is the tax regime. As mentioned earlier, a large share of PEMEX royalties is devoted to financing public spending rather than the development of critical areas of the company. The petrochemical arm of PEMEX is a case in point.

CONCLUDING REMARKS

The context of development for the Veracruz cluster is both complex and multi-dimensional, with factors that initially appear to be unconnected turning out to be relevant. This chapter has also explained the role of high international crude prices and described the country's energy matrix in relation to the petrochemical industry. It is not clear to what extent these determinants constrain the availability of crude (naphthas) and natural gas to be processed by PEMEX-Petrochemicals, and therefore output of basic

inputs in the locality, but the evidence presented suggests a certain degree of influence in that respect.

By and large, the facts presented in this chapter suggest that the weakening of PEMEX and PEMEX-Petrochemicals has hampered the position of Mexico, a leading world oil producer, as a maker of value-added inputs. This has implications for the wider economic spectrum. The rapid pace at which imports of petrochemical products and products of petrochemical origin have grown is a case in point. This context serves to hinder vertical integration of the Mexican economy. It is therefore paradoxical to see PEMEX pursuing horizontal organisation while the trend for its international counterparts is towards vertical integration. The difference in revenues clearly indicates that regulatory measures previously instigated have delivered rather questionable results. All in all, the question that arises is as to what has driven policy makers to turn Mexico into a mere supplier of crude and a net importer of value-added products. In part, the answer may lie in the context of low levels of tax collection, which is mainly attributed to the lack of consensus among political actors. To ameliorate the problem, it appears that the easiest option for the government is to drain the revenues generated by Petróleos Mexicanos.

Bearing in mind the factors exposed, the issue to highlight is that this chapter further demonstrates the significance of analysing the political economy of Mexico in order to understand the development of the Veracruz cluster. The aggregate context, which refers to the sectoral, national, and supranational determinants schematised in Chapter 3, has greatly contributed to deteriorating the capabilities of PEMEX-Petrochemicals as a reliable supplier of inputs. This is to say that the prevailing *governance structure* characterising inter-firm transactions and the trajectory of local petrochemical companies is to a significant extent outlined by *external determinants*. The following chapter puts these subjects into context.

8

VERTICAL LINKAGES IN THE VERACRUZ PETROCHEMICAL CLUSTER

Contextualising governance, transactional dependence, and firm trajectories

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INTRODUCTION

There is no doubt that the scenario portrayed in the previous chapters has imposed significant restrictions on the national economy, PEMEX, and PEMEX-Petrochemicals. This chapter seeks to shed light on the repercussions of this aggregate setting for the transactional dynamics of the Veracruz cluster. To that end, it is important to point out that private petrochemical firms have been particularly affected. The shutting down of firms and the plummeting of output are not the only factors illustrating these repercussions. Another central shortcoming that has been less explored is related to the mechanisms, rules and practices that regulate vertical transactions of petrochemical inputs between PEMEX-Petrochemicals and local buyer firms. Contextualisation of the *governance structure* through which inter-firm transactional linkages are co-ordinated is necessary to demonstrate another facet of the limitations that private firms in the Veracruz cluster experience, as discussed in previous chapters. It is therefore necessary to reflect on the *captive* nature of inter-firm linkages and analyse the extent to which the performance of local buyers has been hampered.

Most of the insights offered here are, to a great extent, the result of findings from fieldwork activities in the locality and this chapter discusses in greater detail the circumstances that helped shape the relationships local private firms have established with PEMEX-Petrochemicals. To do so, the discussion will focus on the trajectory of firms, their standing within the production scheme of the Veracruz cluster, and the determinants associated with the extent of transactional dependence.

The cases presented below reflect the quality of inter-firm linkages in the Veracruz cluster. The first section, which deals with the ethylene oxide chain, is a clear example of how the limited availability of inputs at state-owned complexes hampers the upgrading prospects of user firms, particularly with regards to Industrias Derivadas del Etileno (IDESA), a local buyer firm. The second section discusses the degree to which changing regulatory policies have affected fertiliser firms and serves as an illustrative case that draws a distinction between the implications of the contemporary context of development and that of import-substituting industrialisation policies in the 1960s and 1970s (Chapter 5). The third section not only contextualises the vertical integration of firms in the locality, it also identifies the strategies used by firms to counteract the shutting down of production lines at PEMEX-Petrochemicals. The fourth section, through analysis of a local firm that supplies a particular input to PEMEX-Petrochemicals, shows how state-owned complexes continue to control the transaction of inputs even if located at the buyer end.

By and large, the common denominator is the fact that private petrochemical firms (which are linked to PEMEX-Petrochemicals) are transactionally dependent on suppliers and that the outlook for firms operating in the cluster is hindered by the mechanisms used by PEMEX-Petrochemical to co-ordinate input transactions. With reference to firms affected by the closing down of production lines at state-owned firms, the evidence provided here also indicates the extent to which transactional dependence is experienced by these buyer firms and the extent to which their performance is influenced.

THE ETHYLENE OXYDE CHAIN

Ethylene is a natural gas by-product processed at the Morelos and La Cangrejera petrochemical complexes situated in the municipality of Coatzacoalcos. It is considered the most important PEMEX production line since it is the precursor of several value chains in which firms in the Veracruz cluster take part at later stages: high/low density polyethylene, vinyl chloride and ethylene oxide. These three intermediate inputs are also produced by PEMEX-Petrochemicals and in a similar way to other chains the operations of several private firms depend on this supply. Particular attention must be paid to ethylene oxide since four private firms in the cluster are linked to it: Petroquímica Beta, Industrias Derivadas del Etileno (IDESA), Oxiteno, and Clariant

process ethylene oxide into a broad range of petrochemical raw materials. Of these, the first two companies serve to illustrate the extent to which PEMEX-Petrochemicals wields a great deal of authority over the transaction of raw materials and how its dominant role and the hazardous nature of the input contribute to locking buyer firms into *captive* relationships.

Petroquímica Beta

The origins of the company date back to 1990 with the setting up of COIN, the initial name of Petroquímica Beta. It was established as the result of an initiative undertaken by a construction company named La Nacional. At that time, of all hydrocarbon by-products processed in the region, light gasoline[85], a compound rich in pentanes, drew the interest of La Nacional which realised it could use this petrochemical current to produce a high-grade mixture of pentanes[86]. A group of retired PEMEX workers was approached by the construction firm to join the project in order to take advantage of their technical expertise in petrochemical processes. In 1990, when COIN began operations in the municipality of Coatzacoalcos, it not only became the only firm in Latin America dedicated to the making of high-grade compounds such as n-pentane and isopentane (Figure 8.1), it was also the only petrochemical firm in the locality formed with the involvement of local workers as shareholders. Initially, the main supplier of COIN was the petrochemical complex of La Cangrejera, located less than 7 km from the plant.

For much of the 1990s COIN remained under the ownership of the original shareholders. However, with the deterioration of the business climate in the wake of the 1994 economic downturn, by 1998 the Southampton Refining Company (SRC), a Texas-based firm and competitor of COIN in the North American market, acquired the assets of its Mexican counterpart. From that time on it is reported that COIN operated at full capacity[87], marketing its entire output in the United States. However, things changed once again in 2000 as inputs mirrored the upward trend of crude prices and the price of inputs supplied by PEMEX-Petrochemicals was reported to be higher than the

[85] The term light gasoline refers to a group of compounds (n-pentane, isopentane and neopentane) that embody a given quality. Petroquímica Beta transforms such products into high-grade pentanes.
[86] Pentanes are used in the making of polystyrene (foams, expanded, moulded), which has a broad range of applications: disposable coffee cups, packing materials, buoys, boat bumpers, moulded automobile and refrigerator parts, CD cases, rigid panels, and so on (Burdick and Leffler 1990).
[87] 20,000 tonnes per annum.

price of COIN intermediate products. As a result, production languished during the following three years. In this context, it is important to underline the fact that transactional relationships between private firms are regulated by yearly contracts for which prices are often fixed. COIN was therefore unable to adjust the price of pentanes in line with increases for inputs and its financial obligations mounted, eventually leading to its assets being seized by creditors. A group of Mexican engineers, which already owned a plant that processed ethylene oxide derived products, acquired the firm in 2005, changing its name to Petroquímica Beta. The acquisition coincided with the launch of a polyethylene plant at the neighbouring petrochemical complex of Morelos.

In 2005 the new shareholders diversified the product portfolio of Petroquímica Beta. The production of triethanolamine (used in the cosmetic and construction industry), nonylphenol (employed in the detergent industry), and polyethylene glycol (used in a wide range of industries such as agriculture, metallurgy, home care, cosmetics, paints, and textiles) allowed the firm to *move into more sophisticated product lines*. Nonetheless, the inputs required by these intermediate raw materials are ethylene oxide and ammonia, with the only suppliers and producers in Mexico being the La Cangrejera, Morelos and Cosoleacaque complexes. Despite *product upgrading*, Petroquímica Beta became even more transactionally dependent on PEMEX, as can be seen in Figure 8.1.

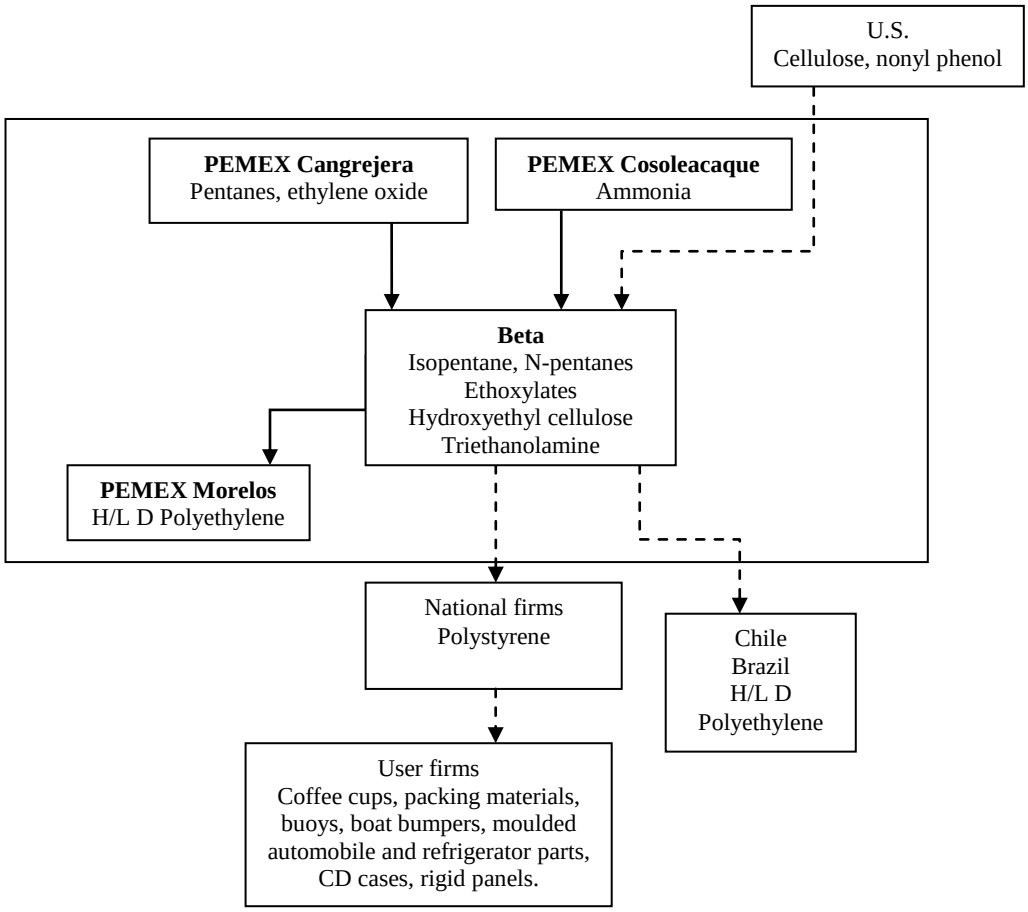
In 2009 product portfolio expansion continued (*product upgrading).* It is acknowledged that the production of hydroxyethyl cellulose, an input that has specific applications in the cosmetic and home care industry, commenced in August 2009[88]. This made Beta the only firm in Latin America processing the compound. The raw material, cellulose, is imported from the United States, whereas ethylene oxide is provided by PEMEX-Petrochemicals.

Despite recent expansion, n-pentane and isopentane continue to be the most important Beta production lines. Contrary to what happened in the late 1990s, output is chiefly commercialised in the domestic market - only twenty percent is exported. PEMEX-Petrochemicals is arguably the largest buyer since it needs isopentane to run the high and low density polyethylene plants at the Morelos complex. As can be observed, Beta is locked into *captive* forward and backward linkages with PEMEX-Petrochemicals and

[88] Data obtained from the company's website http://www.gpb.com.mx/main.html (March 12, 2010).

this represents a certain degree of risk for firm's operations. The fact that Beta relies on a single supplier (ethylene oxide) can be considered a disadvantage since PEMEX schedules temporary shutdowns of its plants for maintenance purposes, warning clients it will be unable to supply inputs for a given period of time. Problems arise when the maintenance periods are longer than estimated - a situation widely seen among user firms as recurrent - since this means Beta is unable to supply its own clients and this can lead to legal action.

Figure 8.1 Backward and forward linkages of Petroquímica Beta



Source: Based on the author's database and the company website: http://www.gpb.com.mx/main.html (March 12, 2010).

But not only maintenance tasks force PEMEX-Petrochemicals to interrupt supply. It is understood that the firm also suffers shortages of its own raw materials, resulting in limited availability of certain compounds. It is estimated, for example, that the level of production of ethylene oxide is unable to match domestic demand. Therefore, output expansion prospects for intermediate inputs at Beta and elsewhere are compromised.

To make matters worse, it is argued that the price at which PEMEX markets its hydrocarbon by-products is adjusted on a monthly basis. If the international price of natural gas or crude fluctuates, so does the price of inputs. For Beta, and any other private firm, this is a concern as it complicates earnings estimates, activity planning, product pricing, and other financial and operational parameters. Even though the transactional relationships between PEMEX-Petrochemicals and private firms are formalised through contracts, it is understood that the observance of these contracts is weak on the side of PEMEX-Petrochemicals. Furthermore, when a private firm turns out to be a PEMEX supplier, it is recognised that contracts also favour the state-owned entity. PEMEX-Petrochemicals allegedly demands from local private firms a flat price for the term of the contract. Clearly, this is a practice that both dramatically deteriorates the quality of inter-firm linkages in the locality and demonstrates that PEMEX-Petrochemicals governs input transactions.

Similarly, the role of Beta as supplier demonstrates an even more acute problem. As noticed lines above, it is a recurrent practice for PEMEX to carry out maintenance works on its plants and the H/L D polyethylene production line is no exception. When PEMEX announces that a plant, which partially runs on isopentane, is to cease production, Beta must also halt production. The firm is not in a position to continue operations as it lacks infrastructure for storage of its own output. If Beta wants its plant to keep running, the supply of isopentane to the Morelos complex must flow continuously. The *captive* nature of Beta as supplier is further emphasised by the status of PEMEX-Petrochemicals as the only producer of polyethylene in the country, meaning that the capabilities of Beta also contribute to strengthening the type of *governance structure* that characterises transactional linkages with PEMEX-Petrochemicals.

Industrias Derivadas del Etileno (IDESA)

Grupo IDESA is a Mexican petrochemical company with production facilities in the states of Puebla and Tlaxcala, on the country's central plateau, and in the Veracruz cluster. The plants situated in the industrial corridor of the Morelos petrochemical complex are the most recent, where the production of glycols and amines commenced in 1997 (Figure 8.2). Like many of the other firms in the Veracruz cluster, it was critical

for IDESA to locate its plants in Coatzacoalcos for a number of reasons. In that respect the plant manager, Gilberto Godoy, stresses that:

> ethylene oxide, the input needed for the manufacture of glycols, is produced locally by PEMEX-Petrochemicals, and it is a compound extremely flammable and explosive. Its transport entails a series of specifications that firms must comply with. If IDESA were located elsewhere in Mexico, transport costs would significantly increase the price of by-products and seriously hamper the firm's competitiveness. As ethylene oxide is supplied through pipelines, we have a great logistic advantage.

Drawing on the plant manager comments, it is necessary to mention that the aim to supply ethylene oxide from the Morelos complex to IDESA through a pipeline was to reduce the risks the handling of ethylene oxide implies for the company and neighbouring urban centres. Other ethylene oxide buyers, such as Clariant and Oxiteno, are understood to have established facilities in the Veracruz cluster for the same reasons.

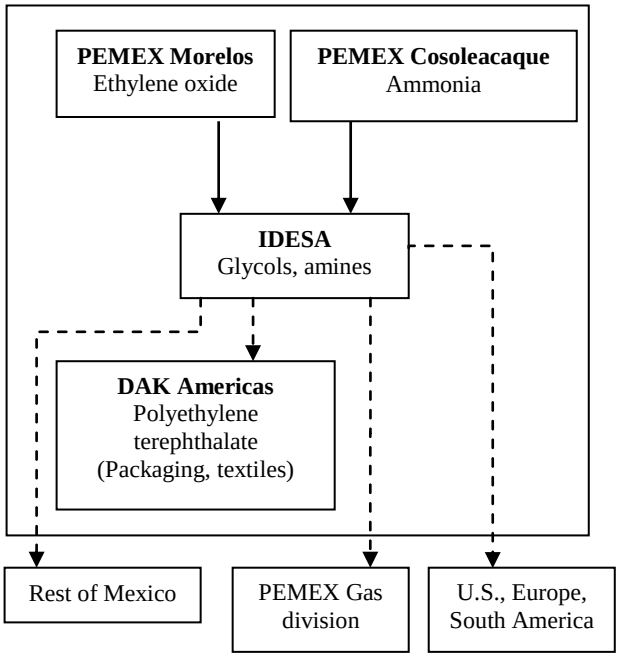
With respect to the firm's production lines, the most important one is glycols, compounds used as industrial raw materials in the manufacture of a wide range of products[89]. The installed capacity of the plant is 200,000 tonnes per annum, although capacity utilisation is usually around 50 percent[90], as discovered during fieldwork. The largest client of the firm in the locality is DAK Americas, the maker of polyethylene terephthalate in the city of Cosoleacaque. In fact, spatial proximity with respect to the buyer is considered to be another fundamental factor that prompted the setting up of IDESA back in 1997 – just a year after DAK Americas commenced operations. Returning to the discussion of IDESA production lines, the second most important production line is amines. Similar to glycols, amines are precursor compounds that have

[89] IDESA mainly produces three types of glycols. Monoethylene glycol is the main ingredient in automotive antifreeze and cooling systems. It is also used in the making of polyethylene terephthalate (PET), which is used in fibre, film, plastics and blow-moulded bottles (Burdick and Leffler 1990). It represents 90 percent of glycol output. The second most important glycol is diethylene glycol, which is mainly used in the making of unsaturated polyester resin. It accounts for 9 percent of output. Triethylene glycol is employed in the making of thermal, hydraulic and brake fluids (http://www.grupoidesa.com) Accessed on October 10, 2009.

[90] As of April 2008.

a large number of applications[91]. The installed capacity of the plant is reported to stand at 45,000 tonnes per annum and the plant normally operates at 100 percent of capacity. Ammonia, the essential input, is processed at the Cosoleacaque petrochemical complex situated 30 km away in the neighbouring city of Minatitlán. In this particular case, inputs are transported in tankers from Cosoleacaque. This is to say that IDESA's degree of *transactional dependence* is illustrated by the fact that PEMEX-Petrochemicals is the sole supplier (and domestic producer) of ethylene oxide and ammonia. Figure 8.2 exhibits that the *captive* character of IDESA as buyer is no different from that of many other private firms in the Veracruz cluster since IDESA relies heavily on input supply from PEMEX to maintain its plants working.

Figure 8.2 IDESA linkages



Source: Based on the author's database.

[91] IDESA processes three types of amines. According to the company's website, monoethanolamine 'is used in the manufacture of cosmetic intermediaries, lubricant additives, perforation additives, in the production of taurine, wood treatment, amongst other'; diethanolamine 'is used in the manufacture of insecticides and herbicides, surfactant agents, in the purification of natural gas as pH leveller'; and triethanolamine 'is used in construction as an additive, in the manufacture of cosmetic intermediaries, textile additive, surfactant agents, amongst other' (http://www.grupoidesa.com). Access on October 10, 2009.

At the other end of the spectrum, although IDESA's output tends to be primarily commercialised among private users, the firm also supplies PEMEX-Petrochemicals. But contrary to what Petroquímica BETA confronts in its relationship with PEMEX-Petrochemicals, IDESA appears to have a 'healthier' association with the state-owned company. The marketing of monoethanolamine, a compound that PEMEX uses in its natural gas plants, is far from being representative of IDESA's main line of business.

Predictably, the problem arises when PEMEX is the supplier. Since IDESA began operations in Coatzacoalcos, output at Morelos has remained stagnant. In 1998 ethylene oxide output amounted to 324,000 tonnes, while a decade later the figure stood at 344,000 tonnes (PEMEX 2009) - a rise of just 6 percent. During this period PEMEX upgraded its production capacity from 328,000 tonnes in 2004 to 400,000 tonnes per annum in 2006 (ANIQ 2008), but this has proved inadequate to cope with private sector demands. The IDESA glycol plant is a case in point as the only reason why this plant operates at 50 percent of installed capacity is the inability of the Morelos petrochemical complex to supply IDESA with sufficient ethylene oxide. In this context, a major concern for the firm is the consumption of energy, which is proportionate to the installed capacity of the plant. The cost of transforming ethylene oxide into glycols increases as capacity utilisation drops, thereby reducing IDESA's chances for expansion. While it may be assumed that importing this input could represent a solution, as mentioned earlier the handling of the compound is hazardous. Imports would imply sophisticated logistics for transporting the compound in specialised carriers, paying high rates of insurance, obtaining government permits, and arranging storage of the input, all of which make the international trade of ethylene oxide restrictive[92]. In the case of ethylene oxide, the *captive* nature of IDESA as buyer (and that of other buyers such as Beta, Oxiteno, and Clariant) is in some measure attributed to the hazardous nature of the input.

The constraints PEMEX-Petrochemicals places on IDESA also include maintenance works conducted at the Morelos petrochemical complex which during such periods is unable to supply ethylene oxide. When this happens, IDESA is forced to shut down its

[92] U.S. imports and exports of ethylene oxide averaged less that $4 million and $8.5 million per annum from 2005 to 2009, respectively. In the case of Mexico, the figure for imports stood at less than $1 million per annum for the same period, whereas exports were practically non-existent, as reported by the United Nations Trade Commodity Statistics Database. This is an indication of the hazardous nature of the input.

glycols plant to carry out maintenance in line with PEMEX. Nonetheless, PEMEX frequently fails to complete works within the proposed schedule which reduces the supply of ethylene oxide for much longer periods and consequently affects IDESA's obligations with its clients. The plant manager puts it this way:

> The role of PEMEX as supplier is very complex [...]. When they shut down their own plants supply of ethylene oxide tends to be interrupted and that forces us to shut down plants as well. In theory we plan to shut down our plants every year for a period no longer than thirty days, but on some occasions we have had to do so for up to three months. [...] we always intend to adjust our operations to theirs, but if PEMEX fails to reinitiate production in time, so do we.

Here, it is important to describe the situation that demonstrates the dominant role of PEMEX-Petrochemicals in the locality. Despite the possible interpretation of the interruption of supply as a breach of contract, rarely do affected firms take legal action against PEMEX-Petrochemicals since it would take years for the dispute to be settled, and more importantly, it would further deteriorate transactional relationships. While PEMEX argues the situation is the result of technical problems, IDESA is in a different position as it may face sanctions if it fails to comply with contractual obligations. The unreliability of PEMEX as supplier therefore forces IDESA to devote some of its resources to devising plans to maintain stocks and invest in storage facilities so that even when the plant is not running IDESA can maintain the supply of glycols to users. All in all, the point to consider is that private firms operate on an uneven playing field with regard to compliance with the regulatory framework, which compromises the prospects for upgrading and performance.

A REVIEW OF THE FERTILISER INDUSTRY IN THE LOCALITY

If the liberalisation of the Mexican economy is thought to have delivered mixed economic results, the fertiliser industry could be considered to epitomise the most disturbing face of this liberalisation. In the Veracruz petrochemical cluster two companies merit special attention in this regard: Soluciones Químicas para el Campo y la Industria (SQCI) and Agromex. These are former state-owned firms dedicated to the production of nitrogen fertilisers and whose fate has been determined by the implementation of market orientated policies over the course of the last two decades.

Unlike Fefermex and Agrofermex, local firms that also produce fertilisers but have managed to complement their input supply matrix with imports and secure markets for their products, SQCI and Agromex are not in the same position. The firms rely heavily on industrial raw materials provided by PEMEX-Petrochemicals and serve a chain in which imports are their main competition. The conjunction of these two factors has exerted a major impact on the fertiliser sector in the country, and particularly on SQCI and Agromex.

In order to gain a more comprehensive understanding of the sector's problems, at this point it is necessary to move beyond the regional context. The uncertainty resulting from policies for the pricing of natural gas on the domestic market and trends in the international price for fertilisers have seriously affected local players with SQCI and Agromex having little power to deal with the repercussions. Since the end of the 1990s these factors have effectively determined whether firms can continue operations or must close down. A succinct analysis of the firms' trajectories helps to demonstrate both the implications economic liberalisation policies have had at the local level and the vulnerability of local firms relying on a single input supplier.

A brief historical context

Although the genesis of the fertiliser industry is rooted in the constitution of Guanos y Fertilizantes de México, a government-owned company that emerged in 1943, the sector really came into its own over the course of the following decades with the participation of private investors. The setting up of Fertilizantes Monclova in 1956, Fertilizantes del Istmo in 1960, and Fertilizantes del Bajío in 1963 facilitated the distribution of fertilisers to distant agricultural regions since these companies established facilities in the north, east and south of the country. Despite the participation of private capital in the sector, Gustavo Díaz Ordaz, Mexico's President from 1966 to 1972, nationalised the existing firms to form Fertilizantes Mexicanos (Fertimex) in line with the government strategy of playing a greater role in economic matters (Clouthier 1983).

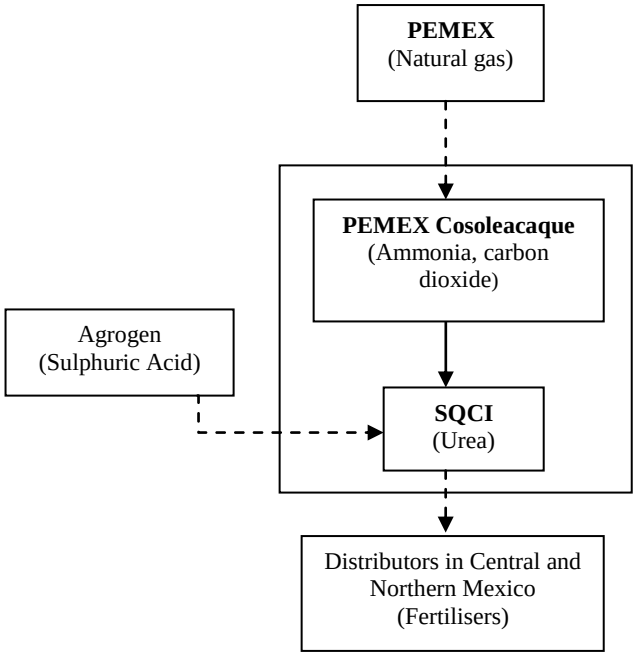
Fertimex was intended to encourage the production, distribution and supply of fertilisers to agricultural producers and the newly created firm built facilities throughout the country. As far as the Veracruz cluster is concerned, the current plants of SQCI (1964) and Agronitrogenados (1982) initially operated under the ownership of Fertimex. At the

time the plants were established, location was determined by access to raw materials supplied by PEMEX. In 1991, in accordance with the privatisation program undertaken by the government, Fertimex subsidiaries were handed over to private capital. The site at Minatitlán was acquired by SQCI, whereas Grupo Acerero del Norte, the largest steel maker in Mexico, bought the plant in Coatzacoalcos (Agromex).

Soluciones Químicas para el Campo y la Industria (SQCI)

Soluciones Químicas para el Campo y la Industria (SQCI) is a Mexican firm in the municipality of Minatitlán that produces nitrogen-based compounds such as urea, ammonium nitrate and nitric acid[93]. The company's most important product is urea; a compound used either as fertiliser in its own right or as an ingredient for multi-component fertilisers. The required inputs feeding SQCI production lines are ammonia and carbon dioxide, both supplied by the petrochemical complex of Cosoleacaque; and sulphuric acid, a feedstock produced by Agrogen, a firm located in the state of Querétaro, in Mexico's central region.

Figure 8.3 SQCI backward and forward linkages

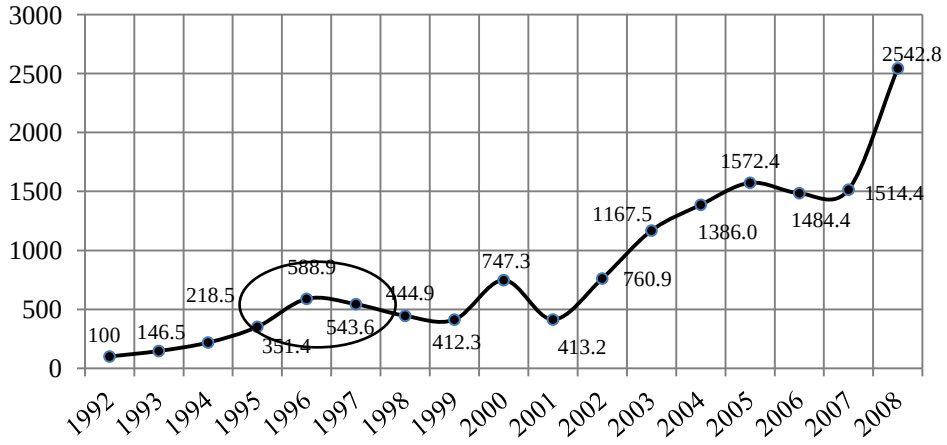


Source: Based on the author's database.

[93] The installed capacity is 270,000 tonnes per annum in the case of the urea plant; 110,000 for the production of nitric acid; and 140,000 for the production of ammonium nitrate.

SQCI (Figure 8.3) is embedded in a chain whose precursor is the natural gas provided by PEMEX-Gas. The fortunes of the firm are therefore vulnerable to variations in the price of this commodity. Back in the mid 1990s, shortly after the government privatised Fertimex plants, the price of ammonia skyrocketed. As the government tied the domestic price of natural gas to prices on the southern coast of the United States - among the highest in the world at that point of time - the production costs of a wide range of by-products mirrored this trend. Ammonia, the most important input for the making of fertilisers, deserves special attention. The price of ammonia peaked in 1996 when it recorded a 67 percent increase in comparison with a year earlier (Figure 8.4), according to PEMEX (2003, 2009). This surge led to the shutting down of both ammonia plants at the petrochemical complex of Cosoleacaque and most existing fertiliser plants in Mexico over the course of the following years. Even though the price of ammonia followed a downward trend in subsequent years, it still made the production of fertilisers economically unviable. As a result of this policy, the business environment for the fertiliser industry dramatically deteriorated, turning Mexico into a net importer of fertilisers.

Figure 8.4 Ammonia price index



Source: PEMEX (2003, 2009).
Note: Based on prices at the Cosoleacaque petrochemical complex in Mexican pesos.

This panorama was largely feared by the private sector despite the government's argument that its decision would result in a more competitive industry when fertiliser plants were privatised in the early 1990s. The claim at that time was that further measures must be taken. The private sector believed that in order to strength the

fertiliser value chain the spinoff of state-owned ammonia plants was necessary. The administration of Carlos Salinas, Mexico's President at the time rejected the proposal.

Nevertheless, the scenario described above is not sufficient to demonstrate the debacle of the fertiliser industry in Mexico since factors such as the structure of the domestic natural gas market and the type of policies rich natural gas countries put into practice must also be taken into account. Regarding the first factor, it is more profitable for the government, which relies heavily on hydrocarbon revenues, to tie the domestic price of natural gas to that in the United States. In that manner the government can capture a much larger rent, as described by Juan Jose Pestaña Mendoza, the plant manager:

> It is alleged that the cost for PEMEX to produce gas is probably in the range of $2-3 per million BTU. Reasonable profits would set the price of natural gas 30 percent higher than its production cost, but the structure of the market allows Mexican policy makers to set a much higher price in line with those in the U.S. - 3 or 4 times the production cost for PEMEX.

At the other end of the spectrum the dilemma is also linked to strategies introduced by other natural gas producing countries, of which Russia is a case in point. Russian authorities sought to stimulate their economy through increasing output of hydrocarbon resources. In the mid 1990s, when the price of natural gas stood at approximately $9-10 per million BTU in North America, the price in Russia was estimated to be as low as $1. Even though prices in Russia have soared since then, it is understood that the gap continues to be considerable. In the light of these arguments, the question that arises is as to what determines prices in different regions and it is argued the difference might be based not only on supply (the extent of gas reserves and output)[94] and demand, but also on the particular role the economic structure of each country plays in setting prices. In the case of Mexico, pricing policy instruments follow the guidelines of an economy integrated with that of the United States. Russia, on the other hand, decided to expand its economy by establishing a highly competitive natural gas price and developing existing fields – policies aimed at fostering the growth of associated industrial sectors.

[94] As the world's largest exporter of natural gas, Russia has some ability to dictate prices. Europe, and more specifically former Soviet states, is heavily dependent on the supply of Russian gas (Gelb 2007, January 5).

As a result, Russia's natural gas output has climbed during this period and the country has become a major player in the fertiliser industry[95].

Although the problems of the sector merit a more detailed debate, it is evident that critical components of the aggregate context have marked the development of the fertiliser industry in Mexico. In respect to that issue, Pestaña Mendoza explained how domestic production costs and falling international prices have played a central:

> Let's infer that the difference between international prices and domestic production costs of urea ranges from $60 to $80, which happens to be the firm's profit per ton. Now let's say that the domestic production cost of urea is $100, while imports from Russia are priced at $200. That means the domestic price should range from $110 to $200. If the price of the national urea is higher, it would not be competitive against the Russian urea. If the international price is more competitive that the one we can offer so it is not convenient for us to produce. If the price we have is $100 and international prices are close or lower than that, domestic users would not buy urea from us – and that is what has been occurring for the last fifteen years as raw material [ammonia] prices have increased and urea international prices have fallen sharply.

Turning now to the discussion on SCQI, past incidents involving the firm clearly illustrates what the sector has had to confront. Following the rise in the price of raw materials, the company was forced to cease operations in 1997 and 1998 since the production of fertilisers was no longer profitable. As a result the financial standing of SCQI deteriorated and it was unable to pay the salaries of workers, who in response went on strike for a period of three years. After negotiations with the union, the strike was called off in 2001 and SQCI re-commenced operations the following year with the intention of capitalising on falling ammonia prices. SQCI resumed production for a period of just five months as the three plants were once again closed down in August 2002 when the price of ammonia once again began to surge. Most workers decided to abandon the firm at this point. However, three years later the situation had improved

[95] The information provided by the interviewee regarding prices of natural gas in North America and Russia and production costs in Mexico may not be accurate, but it does reflect the conditions leading to the shutting down of fertiliser plants in Mexico.

slightly and in 2005 SQCI was able to re-start production at its nitric acid[96] and ammonium acid plants, although both operated at 30 percent of capacity until 2006. In 2007 the price of nitrogen-based fertilisers increased, prompting SQCI to re-commence production of urea in April of that year. By the end of 2007 the overall output of the company reached 153,000 tonnes with urea representing more than half of that figure. For the twelve months to May 2008, the three SQCI plants were reported to be working at 90-93 percent of installed capacity. This suddenly favourable business climate can be attributed to a number of factors. Not only did the price of fertilisers in Mexico double in comparison to a year earlier, the price of urea produced in natural gas rich countries also began to rise from the end of 2006 making imports from Russia and other countries less attractive. As late as May 2008 SQCI was the only urea producer in the country.

In short, the latter scenario demonstrates that *national and supranational* determinants significantly influence both the co-ordination of transactional relationships between Cosoleacaque and SQCI and the overall performance of firms.

At the local level, SQCI also faces challenges. With regard to ammonia, the most important input, the Cosoleacaque petrochemical complex is the sole supplier in the country and this restriction places SQCI in a very vulnerable position since it relies exclusively on PEMEX for its supply. While Cosoleacaque has never reported a shortage of ammonia, such transactional dependence does raise concerns since the supply may be interrupted if PEMEX shuts down ammonia plants for maintenance, something it does at short notice. However, when PEMEX is carrying out maintenance works on one plant, it does keep another running. Cosoleacaque also has tanks for storing input, guaranteeing the supply for several days and ensuring the supply of ammonia is not interrupted. Nevertheless, the widespread belief that PEMEX is an erratic supplier is viewed as a factor that weakens trust between firms.

With respect to certain capabilities of SQCI, it is worth pointing out that the firm lacks infrastructure for the storage of inputs. Since the supplier and buyer are situated in close proximity it was considered from the very beginning that the optimal means for transporting ammonia was through a pipeline and it is reported that SQCI plants run on the daily supply from Cosoleacaque. In the case of a more serious contingency in which

[96] Nitric acid itself is both an input for the making of ammonium nitrate and/or a final product.

PEMEX is unable to produce ammonia and/or carbon dioxide, although this has not been the case, SQCI would have no option but to bring production to a standstill. The fact that SQCI is unable to store ammonia appears to be a stumbling block for if the firm decided to import ammonia this would involve highly structured logistics that SQCI has not undertaken in the past. It would imply storing ammonia at the port of Coatzacoalcos, situated 27 km from the plant, and devising a consumption schedule for its daily requirements. In so doing, the firm would incur additional operating costs that would further hamper its competitive standing. In the end, it appears that SQCI has no other alternative but to remain dependent on the supply of ammonia from PEMEX-Petrochemicals.

As one can observe, SQCI's degree of transactional dependence is not only associated with its capabilities, but also with the policy setting that has marked the development of state-owned firms in recent years. Despite the opening of the sector in the 1990s, PEMEX continues to be the only producer (and supplier) of ammonia on the domestic market. The fate of SQCI is another example of the *captive* relationships prevailing in the Veracruz cluster.

Agromex

In a context of market orientated policies, if one is to mention the hardest hit firm in the Veracruz cluster, Agromex would be a sound candidate for top spot. The company, which commenced operations in 1982 under the control of Fertimex, endured the implications of a deteriorating business environment that led to the cessation of production in 1998. Before that, nitrogen fertilisers such as urea and ammonium nitrate were the main production lines.

Of all the private firms in the Veracruz cluster, Agromex arguably has the most strategic positioning. It is not only situated at the heart of the industrial corridor of the Pajaritos petrochemical complex in Coatzacoalcos, it is also on the banks of the Pajaritos lagoon which affords it access to the Gulf of Mexico. At the time of its conception in the early 1980s, two factors determined the location of the firm. As output was expected to stand at more than a million tonnes of fertilisers per annum[97], the government estimated that

[97] There are 2 urea plants with a production capacity of 450,000 tonnes per annum each. The ammonium nitrate plant can yield 270,000 tonnes per annum.

much of it would be consumed in the distant north-eastern and north-western regions of the country, where the most productive agricultural regions are situated. The construction of a pier at the lagoon greatly facilitated the marketing of production. Furthermore, it is widely acknowledged that the supply of natural gas was plentiful at that time - a factor that stimulated the expansion of associated industrial sectors in the locality and elsewhere. These two factors were of great importance for the building of world class urea plants in the municipality of Coatzacoalcos.

Agromex remained under state ownership until 1992 when Grupo Acerero del Norte (GAN), a steel maker with headquarters in the northern state of Coahuila, acquired the firm. Under the new administration, output peaked at 1.08 million tonnes of urea in 1996. In terms of employment, large numbers of temporal workers had to be hired at times of high production with the figure reportedly climbing from 650 full time workers to almost 1,200. Nonetheless, as noted in the last subsection, the sector deteriorated rapidly the following year and Agromex failed to operate for much of 1997. Something similar occurred in 1998 when output dropped to 750 thousand tonnes and in 1999 fertiliser plants were in production for only six months due to a combination of events. At the national level, for example, the government introduced policies that proved counterproductive for the sector by referencing the price of natural gas to that in the United States. At one point the price of natural gas is reported to have stood at $2 but it soon climbed to $4-5 and then to $10 per million BTU. The price of ammonia, the main input used by Agromex, mirrored this trend. On the other hand, policy makers also encouraged the use of natural gas in electricity generation, a move in line with the environmental provisions of NAFTA, thereby reducing the supply to petrochemical plants (Chapter 7). At the international level, the prices of nitrogen fertilisers from countries of the former Soviet bloc were competitive and distributers were keener on importing urea from Russia and satellite countries than buying it from domestic producers such as Agromex. These factors prompted calls for the introduction of a tariff barrier, but the government argued such a move would further increase the price of agricultural inputs for farmers.

This combination of factors is summarised by Rigoberto Robles Cabrera, the operations manager of the firm, who contended that:

> There was a time in which one could find fertilisers at very competitive prices abroad, while the domestic price of gas was sky high. [...] it was very expensive for us to produce fertilisers and very cheap to import from countries such as Russia and Ukraine. That is why the domestic market became flooded with imports and we were put out of business. We could not compete [...].

In the wake of these events, Agromex was compelled to bring its production to a halt in 1999 - a scenario that worsened its financial standing. In the end, as the company could not afford to pay the salaries of its 650 unionised workers, a strike broke out soon afterwards. Despite the closing down of production facilities, Agromex was in a position to generate revenues. In 1992 the parent company, Grupo Acerero del Norte, also acquired the rights to use a dock by the Pajaritos lagoon. As the rest of the urea plants in the country faced the same situation, imports increased. Paradoxically, this dock was then placed at the service of companies buying fertilisers from abroad - the former clients of Agromex. In this way the firm managed to meet its payroll obligations. However, as things did not improve over the course of subsequent years the plants have remained closed and the main source of income for Agromex continued to be the dock. The offloading and loading of ships along with product storage services became the firm's core business. As a result of this panorama hundreds of workers had to be laid off. In February 2008, Agromex was reported to have 130 unionised and 20 non-unionised workers.

In the Veracruz cluster, Agromex is not the only firm with facilities for the production of nitrogen fertilisers as SQCI runs a much smaller urea plant in the neighbouring city of Minatitlán, as mentioned earlier. It is worth mentioning that even though both firms faced the same challenges after the liberalisation of natural gas prices in 1996, SQCI managed to re-initiate operations in 2007 due to higher prices for urea and a less competitive price for natural gas in rich producing countries. While it was believed possible for Agromex to start producing urea again since the size of its plants and the infrastructure available would lead to greater efficiency. But the plants have remained idle for a decade. The cost of repairing damage to plants is what may prevent Grupo Acerero del Norte from re-initiating production. Despite claims in early 2010 by a

prominent figure of the union[98] that represents local private petrochemical firms to the effect that Agromex may re-initiate operations after an investment of $35 million (Chinas Cordova 2010), this investment did not materialise in the end. Agromex is arguably the most illustrative example of the extent to which determinants external to the locality can influence the performance of firms.

VERTICAL INTEGRATION AMONG PRIVATE FIRMS

In general terms, the role of public petrochemical complexes is to supply basic inputs to private firms in the region, which at the same time process them into intermediate compounds. These intermediate compounds are used by other firms, mainly situated close to large consumer centres, for the manufacture of final goods. The intermediate phase of the process of transforming basic petrochemicals into tangible goods may involve more than one link, or firm. This form of industrial organisation is present in the Veracruz cluster as Tereftalatos and DAK Americas are petrochemical firms that have merged with the intention of taking a long-standing strategic alliance to the next level. Agrofermex and Fefermex, both fertiliser firms, have taken a similar path.

Tereftalatos Mexicanos and DAK Americas

Like many of the other private firms situated in the Veracruz cluster, Tereftalatos Mexicanos (Temex) and Eastman Química (currently DAK Americas) were conceived with the intention of further processing industrial raw materials produced by the petrochemical division of PEMEX[99] in the locality and taking advantage of other local externalities. The fact that the La Cangrejera petrochemical complex produced the inputs demanded by the two companies determined their location in the municipality of Cosoleacaque. It is widely recognised that the production processes of Temex and DAK Americas are strongly linked to one another with Temex dedicated to the manufacture of terephthalic acid (TPA), the input required by DAK Americas to produce polyethylene terephthalate[100] (PET) – a compound extensively used in the bottling and textiles industries. A diagram of where both firms are located along the value chain would show Temex as the second link and DAK Americas as the third - with the La

[98] Sindicato de Trabajadores de la Industria Química **y** Petroquímica, Carboquímica, Similares y Conexos de la República Mexicana**.**
[99] In the following sections, I will use the terms PEMEX and PEMEX-Petrochemicals interchangeably.
[100] Commonly known as polyester fibre or Dacron (Burdick and Leffler 1990)

Cangrejera complex first (Figure 8.5). This prompted Alpek, the parent company that controls Temex, to acquire Eastman Química. Although such vertical integration (*functional upgrading*)[101] benefitted both companies in terms of technical co-operation and simplified management practices, there is an issue that jeopardises the running of plants for, to varying degrees, PEMEX-Petrochemicals is an important provider of inputs for Temex and DAK Americas.

As PEMEX-Petrochemicals is a fundamental component in the history and operations of both firms, it is therefore necessary to consider the circumstances in which Temex and Eastman Química were formed and the way PEMEX-Petrochemicals has been linked to them since their inception. Temex, for example, began operations in 1978 – a time when the government sought to encourage the industrialisation of hydrocarbons. In the case of DAK Americas, the establishment of its PET plant in 1996 was the result of a business opportunity arising from the processing of TPA by Temex.

In a more specific account, the setting up of Temex is associated with the projected construction of paraxylene plants at the Cosoleacaque and La Cangrejera complexes in the 1970s. It is important to point out that paraxylene is an essential input in the manufacturing process of TPA. During this period, as the government sought to stimulate expansion of the industrial base associated with the production of paraxylene, the construction of a PTA plant appeared to be an appealing development. The government crafted a scheme of tax incentives with the aim of drawing the interest of potential investors. Nacional Financiera, a Mexican development bank, and Somex, a state-run Mexican conglomerate at that time, teamed up with Celanese, a Dallas-based chemical firm, the International Finance Corporation of the World Bank and British Petroleum to create Tereftalatos Mexicanos[102] - a firm that would use paraxylene in its production process. The capital constituting Temex was both public and private and despite government participation the company was managed as a private entity – a condition that private investors demanded in order to make the venture possible.

[101] In the case of the Veracruz cluster, I use the term functional upgrading to refer to the ability of firms to integrate vertically, which implies the production of more downstream intermediate inputs (Figure 2.3). The GVC literature, on the other hand, uses the same concept when firms acquire new functions in the chain such as design and marketing. This also indicates vertical integration.

[102] Nacional Financiera held 23 percent of the company's shares, Somex 28 percent, Celanese 24 percent, the World Bank 16 percent and British Petroleum 9 percent, according to fieldwork findings.

In its early stages the firm faced difficulties concerning input supply as the construction program of PEMEX paraxylene plants was way behind schedule. Regardless of the fact these plants were planned to commence production in 1975, production did not begin until 1982 - four years after the launch of Temex. Meanwhile, the company had no alternative but to run on imported inputs.

In 1988 Temex was acquired[103] by Grupo Alfa, one of the largest conglomerates in Mexico. During the first half of the 1980s, Grupo Alfa faced trying times as a result of the deterioration of the economic climate in the country (Chapter 6). After undergoing a restructuring process, it reorganised its investment portfolio into four business groups, leading to the creation of its petrochemical arm: ALPEK[104] - the subsidiary that controls Temex.

As to DAK Americas, the firm is situated down the value chain as it turns Temex TPA into PET. It commenced operations in 1996 under foreign ownership. Eastman Chemical Company (ECC), a Tennessee-headquartered firm, sought to expand its business portfolio in Mexico given the favourable conditions. In the 1990s the conglomerate saw an opportunity for the production of PET - a compound used in the bottling of soft drinks. At that time, it is estimated that the consumption of soft drinks in Mexico was growing at a rate of 12-15 percent per annum – a figure that made the sector attractive. Furthermore, what also favoured ECC was the fact that the bottling sector in Mexico was increasingly shifting from the use of glass to PET. These were without a doubt the drivers that ECC took into consideration for the establishment of the PET plant.

The other important issue to solve was location and ECC considered two sites: Altamira, a petrochemical enclave close to the United States border, and Cosoleacaque in the state of Veracruz. The decision was made on the grounds of technical services and input supply. Given that ECC wanted to focus on the production of PET, it was important to have access to a series of technical services for the running of the facilities. Temex was in a position to offer such services and a strategic alliance between the two companies was established as a result.

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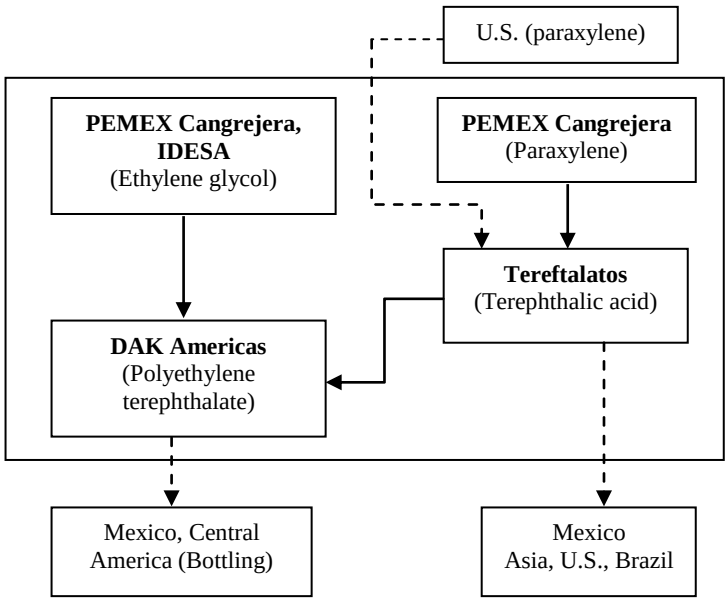
[103] Of all the previous holders, British Petroleum was the only one that decided to keep its share.

[104] This information on Grupo Alfa was obtained from its website: http://www.alfa.com.mx/ingles/qsomos/hist_1998.htm (Accessed on 12 May 2010).

Figure 8.5 The integration of Tereftalatos and DAK Americas



Source: Based on the author's database.

On the supply side, the making of PET requires not only TPA, but also ethylene glycol. Alpek, the parent company of Temex, planned to install another TPA plant in Altamira, but the locality lacked ethylene glycol whereas in the Veracruz cluster the Cangrejera petrochemical complex and Industrias Derivadas del Etileno (IDESA), a private firm, could supply this compound. The availability of inputs proved to be a driver in the decision of ECC and the plant was installed in the municipality of Cosoleacaque - situated a stone's throw away from the Temex TPA plant and 35km from ethylene glycol suppliers.

Since its conception in 1996, Eastman Química established a sound association with Temex and this laid the foundations for further integration. In the years to come, Grupo Alfa, the controlling conglomerate of Alpek, benefitted from a period of favourable economic conditions and it sought to strengthen its business segments through acquisitions. In 2007, as Alpek pushed for a *functional upgrading* of its operations, the petrochemical arm of Grupo Alfa acquired Eastman Química and the name of the company was changed to DAK Americas. While the acquisition created synergies for both firms, certain supply challenges persisted as the configuration of the input supply

matrix of both DAK Americas[105] and Temex is somewhat different. The former firm has outlined a strategy favouring the participation of private firms as main providers: Temex itself, which provides TPA, and IDESA, a firm located in the neighbouring municipality of Coatzacoalcos that supplies ethylene glycol. Although PEMEX-Petrochemicals also produces ethylene glycol, DAK Americas has sought to reduce its exposure to the risks of having the state-owned firm as a partner. IDESA is therefore the main supplier of that particular input. With respect to suppliers, Rubén Muñoz Méndez, plant manager at DAK Americas, believes that 'the mechanisms governing its relationship with private firms are arguably more trustworthy than those with PEMEX-Petrochemicals'.

With regard to the issue of the Temex supply matrix, the firm faces a more complicated setting and the availability of paraxylene in the locality is a major concern. The paraxylene installed capacity at the Cangrejera petrochemical complex is reported by the National Association of the Chemical Industry (ANIQ 2008) to stand at 240 thousand tonnes per annum. However, despite the existence of a domestic market that demands paraxylene, output plummeted between 2005 and 2008. PEMEX (2010a) indicates that La Cangrejera yielded 220 thousand tonnes in 2005, but by 2008 output had dropped to 112 thousand tonnes[106] – a quantity dwarfed by the needs of Temex. If the TPA plant, which can yield 600 thousand tonnes per year, operates at full capacity, paraxylene consumption is estimated to reach 400 thousand tonnes annually. Considering its 2008 output, PEMEX would only be able to supply about 25 percent of what Temex consumes. At that time, the extent of Temex *transactional dependence* on La Cangrejera is illustrated by the fact that this state-owned firm was the only domestic paraxylene producer – a factor that forced Temex to import 75 percent of its requirements. It is estimated that Alpek alone, which also has another TPA plant in Altamira, imported over 800 thousand tonnes of paraxylene in 2007. That figure represented more than seven times the output La Cangrejera complex yielded in 2008.

While the aforementioned facts reveal that PEMEX-Petrochemicals is far from being the supplier that firms expect, Temex and DAK Americas have to some extent weathered the storm. Both firms keep their plants running through schemes that secure

[105] According to the interviewee, the installed capacity of DAK Americas for the production of PET is 150,000 tonnes a year, marketing 80 percent of the output domestically and 20 percent abroad.
[106] As of 2009, it is reported that PEMEX-Petrochemicals ceased production of paraxylene (PEMEX 2010a).

the provision of inputs, but this comes at a cost. The fact that La Cangrejera is not in a position to cope with Temex demand has repercussions elsewhere as paraxylene imports are skyrocketing. It can be observed in Figure 8.6 that imports climbed from $489 million in 2005 to $945 million in 2009 - a rise of 93 percent over a period of four years. Throughout that period, U.S.-based firms provided 96 percent of Mexico's paraxylene requirements. If the import figure mentioned above is accurate, ALPEK is arguably the only importer of paraxylene in Mexico.

Figure 8.6 Paraxylene Imports, 2005-2009 ($)

	World	USA	Overall volume (tonnes)
2005	489,051,412	489,051,364	646,972
2006	674,830,776	660,871,785	892,742
2007	891,048,774	820,993,968	820,141
2008	906,498,482	806,090,875	796,943
2009	945,413,786	945,412,512	773,962

Source: United Nations Commodity Trade Statistical Database.

The latter scenario corresponds to fieldwork conducted in 2008. Information for 2009 indicates that PEMEX has ceased production of paraxylene at the La Cangrejera complex and it can be therefore concluded that ALPEK sources almost all its paraxylene needs in the United States. While it is unclear why this production line was shut down, previous experience would indicate that government officials may have claimed process technology was obsolete, as Rey Romay has argued (1996). The point to consider here is that the role of PEMEX-Petrochemicals fails to encourage the performance of buyer firms and for Temex and many other companies in the Veracruz cluster, a more reliable supply of inputs from state-owned firms would be a form of upgrading in itself.

The import of paraxylene from the U.S. implies another set of circumstances worth describing that serves to contextualise the diminished competitiveness of PEMEX-Petrochemicals. Adolfo Pérez Vidal, plant manager at Temex, depicted this issue in a revealing manner:

> [...] paraxylene is obtained from the processing of aromatics, which is a group of crude-derived basic petrochemical products. In the United States, aromatics

> replaced the use of methyl tert-butyl ether to increase the octane of petrol, and this resulted in a limited supply of derived compounds, including paraxylene [...]. The price of paraxylene skyrocketed as it was linked to that of petrol. [...] but Temex continues to import paraxylene from the United States as the final price per tonne decreases in line with a discount scheme set by suppliers, and Temex benefits from it since it is able to acquire large volumes [over 800 thousand tonnes in 2007].

And that is one of the advantages that the company is offered abroad. At home, the picture is rather different. While PEMEX-Petrochemicals production facilities are situated within 35 km of the Temex TPA plant, the state-owned firm is unable to set a competitive price for paraxylene per tonne for instance the local supply is allegedly more expensive than inputs from the United States.

Notwithstanding the latter scenario, and given the empirical evidence collected during fieldwork, it is believed that Temex would continue to source inputs in the locality if PEMEX had not ceased production of paraxylene. It is evident that spatial proximity is also a determinant that strengths the *captive* nature of transactional relationships in the Veracruz cluster.

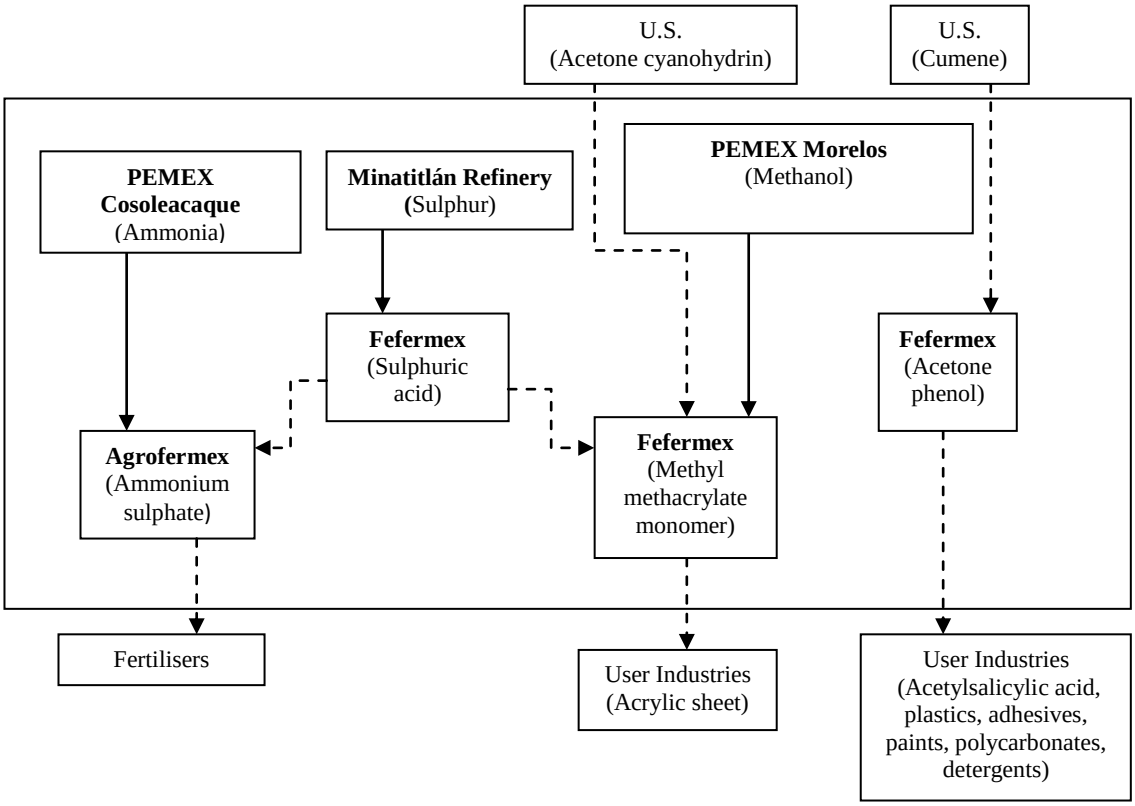
Fefermex and Agrofermex

Another example of how private firms in the Veracruz cluster vertically integrate operations is that of Fefermex and Agrofermex - sister firms whose production processes in some measure associated with one another. But before embarking on this analysis it is necessary to address the fact that Fefermex is a much larger company than Agrofermex in terms of installed capacity and production lines. Fefermex is constituted by facilities for the production of petrochemical inputs such as sulphuric acid, methyl methacrylate monomer (MMM), and acetone phenol. Sulphuric acid is the product linking both firms, as shown in Figure 8.7. This compound, along with ammonia supplied by the Cosoleacaque complex, is what Agrofermex uses in the making of ammonium sulphate[107] - the firm's only production line. This suggests that the extent of integration between the two companies is not as wide-ranging as that of Temex and DAK Americas.

[107] Ammonium sulphate is a final product used as fertiliser.

As with most of the firms in the Veracruz cluster, what led to the establishment of Fefermex in 1975 and Agrofermex in 1963 in the municipality of Cosoleacaque was the opportunity presented by the processing of raw materials by PEMEX. Both firms depend heavily on input supply from the state-owned company, although this is even more pronounced in the case of Fefermex as its three production lines are linked to PEMEX-Petrochemicals (Figure 8.7). It is this transactional dependency that has disrupted the firm's operations from the start since PEMEX has proved to be an unpredictable supplier. Much of the discussion in this subsection is in fact dedicated to putting this situation into context and a brief review of past incidents will to a great extent help describe the circumstances that led to the merging of these firms.

Figure 8.7 The structure of Fefermex and Agrofermex



Source: Based on the author's database.

Fefermex is a petrochemical company that began operations in 2004, although the origins of the existing infrastructure can be traced back to 1975 when Fenoquimia, the previous owner of the complex, first established facilities to produce acetone[108] phenol.

[108] Acetone is primarily used in the pharmaceutical industry in the making of acetylsalicylic acid. It is also used for the production of paints and adhesives.

In 1976 the firm expanded its capacity with the construction of the methyl methacrylate monomer plant[109] (MMM) and the sulphuric acid and acetone cyanohydrin plants. These two plants were originally established to feed the production of MMM, although sulphuric acid is also used in the making of ammonium sulphate at Agrofermex (Figure 8.7).

The reason why Resistol and Celanese, the early parent companies of Fenoquimia, decided to establish the firm in the locality was the fact that certain inputs were being produced at the Cosoleacaque petrochemical. Cinta Céspedes, director of the petrochemical division of Fefermex, explained that:

> During these years PEMEX operated a plant for the production of acrylic nitrile, a by-product of which is hydrocyanic acid, the input required to run the acetone cyanohydrin plant. It therefore made sense for the controlling companies to establish Fenoquimia close to the Cosoleacaque complex [located less than 10 km from Fenoquimia].

However, things took a turn for the worst. Resistol and Celanese could not anticipate that the situation would deteriorate shortly after this, in 1980, when PEMEX decided to shut down the acrylonitrile plant at the Cosoleacaque complex. Cinta Céspedes recalled that:

> Fenoquimia had no option but to re-allocate the production of acetone cyanohydrin and since PEMEX owned another acrylonitrile plant at its Tula Refinery [a site situated over 500km away from Fenoquimia in the country's highlands] Fenoquimia built another acetone cyanohydrin plant adjacent to the Tula refinery, closing down the one in the Veracruz cluster.

Once the problem of producing acetone cyanohydrin was solved, the MMM plant continued to operate normally until 2002 when Fenoquimia found itself in a very complicated situation once again when PEMEX, the only domestic producer of acrylonitrile, decided to shut down its Tula plant. In the wake of this unfortunate series of events, the firm had no alternative than to close down its acetone cyanohydrin plant.

[109] MMM is the input used in the production of acrylic sheet.

From that moment on the company had to devise a scheme for importing input in order to keep the MMM plant operating. The strategy it devised proved successful until 2004.

In the case of the acetone phenol plant, the story is basically the same. The plant entered into operation in 1975 and ran on imported input. By the early 1980s it is reported that PEMEX-Petrochemicals commenced production of cumene[110] at the Cangrejera petrochemical complex situated in the municipality of Coatzacoalcos, but the capacity of the plant was dwarfed by the requirements of Fenoquimia. The acetone phenol plant then relied on supply from PEMEX-Petrochemicals and imports until 1998 when PEMEX argued that the scale of the cumene plant and the obsolete technology made production unviable and the plant was closed down. As a result, Fenoquimia had to continue managing its acetone phenol plant with imported cumene, a strategy that eventually weakened the standing of the firm since it entailed additional logistical costs.

Furthermore, it is widely acknowledged the cycle of the petrochemical industry deteriorated during the early years of the past decade since high prices for raw materials accompanied a period of low prices for intermediate products. This gloomy picture is what forced Fenoquimia to eventually announce the temporary closure of its acetone phenol plant in 2002.

To make matters worse, around that time the company faced accusations of breach of contract in connection with the MMM plant. In that respect Cinta Céspedes summed up how events unfolded:

> The dispute was settled in court and the verdict was adverse for Fenoquimia with the payment of damages representing a substantial drain on the company's resources, prompting shareholders to re-evaluate their investment portfolio. [...] petrochemical assets were no longer considered strategic and the four plants were shut down in 2004.

An important interpretation of the above is that the establishment, rise and fall of Fenoquimia were greatly determined by the role of PEMEX as supplier. In the case of the Veracruz cluster, the evidence analysed demonstrates that the flow of inputs from supplier (PEMEX-Petrochemicals) to buyer is not a factor that should be taken for

[110] Cumene is a by-product of crude.

granted and that is a statement widely accepted among high ranking officials at local private firms. A case in point is Cirilo Domínguez, production coordinator at Agrofermex, who stressed that:

> PEMEX is a very unreliable supplier of industrial raw materials, though this is because of rough [sectoral] policies [institutionalised in previous years]. [...] keep in mind that every six years [presidential periods] we have different ideas as to what to do with the oil industry, and that cannot continue happening, the oil industry must be managed independently [from political interests].

The latter clearly illustrates that Domínguez is well aware of how *external determinants* can shape local dynamics such as upgrading prospects for firms and the quality of transactional relationships between state-owned complexes and buyers.

Furthermore, the decision of Fenoquimia to shut down its acetone cyanohydrin plant in the Veracruz cluster and construct another in Tula is an unambiguous indication of the extent to which the firms is *transactionally dependent* on the supplier. Once again, the fact that PEMEX-Petrochemicals was the only domestic producer of acrylonitrile was determinant in turning Fenoquimia into a *captive* buyer at that time.

Of the four production lines Fenoquimia shut down, the sulphuric acid plant drew the interest of Agrofermex, a neighbouring firm. Throughout the history of Fenoquimia it is reported that this plant operated with great success. Sulphur, the required input, is produced in large quantities in the locality by the Minatitlán Refinery, and the supply is arguably consistent. The fact that sulphuric acid feeds the production of ammonium sulphate, a compound produced by Agrofermex, represented an opportunity for Fenoquimia to continue operating and for the interested firm to expand operations (*functional upgrading*). At first, the intention of Agrofermex was to lease the plant for a year. As the deal proved beneficial for both firms, Consorcio Alfa Omega, the controlling group of Agrofermex, decided to acquire not only the sulphuric acid plant but also the entire assets of Fenoquimia. The acquisition was completed by the end of 2004 and the company was renamed Fefermex.

Since the conception of Fefermex, the new administration programmed investments to restart operations and expand capacity. On December 11, 2008, Consorcio Alfa Omega

inaugurated a second sulphuric acid plant, re-opened the MMM and the acetone phenol plant, and laid the first stone for the construction of two ammonium sulphate plants[111]. To this end, the import of inputs was deemed essential. As for the production of MMM, Fefermex outlined a scheme to run the plant on acetone cyanohydrin imported from the United States. In the same way, methanol, another relevant raw material in the making of MMM, would be bought in the United States with the possibility of it being supplied by PEMEX at a later stage. The acetone phenol plant was expected to rely on a mixture of suppliers. At an early point, the plant would work with cumene sourced in the United States but eventually the feedstock would be acquired from PEMEX-Petrochemicals, which is reported to have unveiled plans to reinitiate production at the Morelos petrochemical complex. In the case of the sulphuric acid plants, the Minatitlán Refinery would continue to supply the input.

From the perspective of Agrofermex, it can be concluded that the devastating outcomes associated with *captive* relationships between Fenoquimia and PEMEX-Petrochemicals represented an opportunity for Consorcio Alfa Omega to expand operations, introduce further vertical integration (*functional upgrading*), and *move into more sophisticated product lines*.

MEXICHEM DERIVADOS - A PRIVATE FIRM AS VALUE CHAIN PRECURSOR

Although one of the characteristics of the Veracruz cluster is that public firms normally supply basic inputs, Mexichem Derivados does not fit that profile and is viewed as the precursor of a value chain. Mexichem Derivados produces chlorine which is a compound that PEMEX requires to run a vinyl chloride plant (VCM). VCM is at the same time used in the making of polyvinyl chloride (PVC) - a type of plastic used for a broad range of goods including floor coverings, pipes, clothes, and bags, and it is in this way that Mexichem Derivados inserts itself into the PVC value chain. The firm, situated in the industrial corridor of the Pajaritos petrochemical complex in Coatzacoalcos, is a subsidiary of Mexichem[112], one of Mexico's largest petrochemical conglomerates. One interesting point that deserves attention here is that several of the firms controlled by Mexichem form part of the PVC value chain originating in the locality, which is to say

[111] As reported by www.latinpetroleum.com (June 10, 2010).
[112] Mexichem is a Mexican chemical conglomerate.

that Mexichem Derivados is part of a conglomerate that has sought to vertically integrate its operations. Nonetheless, before elaborating on this issue it is necessary to explain the roots of Mexichem Derivados.

The origins of Mexichem Derivados can be traced back to the early 1980s when the name of the company was Cloros de Tehuantepec, although in order to offer a detailed account of the company's origins it is necessary to take into account the wider empirical context. Towards the end of the 1960s the government was interested in developing the chlorine-PVC value chain and PEMEX brought a vinyl chloride plant into operation at the Pajaritos petrochemical complex in 1968 - one of the company's first production lines in Coatzacoalcos. The capacity of the plant was 70 thousand tonnes per annum (ANIQ 2008) and the input necessary for running the VCM plant was chlorine – a compound produced at a PEMEX plant adjacent to the Pajaritos petrochemical complex. During this period PEMEX decided to spinoff the chlorine plant, which was acquired in 1967 by CYDSA[113], a Mexican chemical conglomerate. As the demand for VCM grew over the course of the following years the government considered building a much larger plant. In tune with the expansion of state-controlled petrochemical firms, PEMEX completed the construction of a 200,000-tonnes-per-annum[114] vinyl chloride plant in 1982. The plant was named Clorados 3 and would consume a much larger amount of chloride, making the government aware of the fact that the construction of a supply plant was urgent. The planning of chlorine-producing facilities began in 1978 and the project drew the interest of Grupo Somex, a state-owned corporation with interests in several sectors of the economy, and Nafinsa, a state-owned development bank. What also prompted the building of a chlorine plant in Coatzacoalcos was the fact that salt brine[115], the required input, could be obtained in the locality. A company called Azufrera Panamericana mined sulphur and sodium chloride at Jaltipán, a municipality located 40 km away from Coatzacoalcos, thereby facilitating construction of the chlorine plant. On January 18, 1981, Cloros de Tehuantepec began operations with a capacity of 678 tonnes per day.

[113] The company that emerged from that spin off was named Industria Química del Istmo (IQUISA), which is also located in the industrial corridor adjacent to the Pajaritos petrochemical complex that commenced operations in 1968, according to the company's website. CYDSA is a Mexican conglomerate that controls IQUISA. (Accessed on October 18, 2009)

[114] According to the 2008 Yearbook of the Chemical Industry, published by the National Association of the Chemical Industry (ANIQ).

[115] Salt brine is also known as sodium chloride salt.

For several years Cloros de Tehuantepec remained under the management of Grupo Somex in the form of a state-owned company. In 1987, in tune with the government's privatisation program, the plant was acquired by Pennwalt[116], a chemical conglomerate whose holdings also included smaller chlorine plants in Jalisco and the State of Mexico[117]. From that time on the fate of Cloros de Tehuantepec would be linked to that of Antonio Del Valle, one of the shareholders of Pennwalt and the former owner of Bancrecer, one of the banks the government nationalised in 1982 in the midst of the debt crisis.

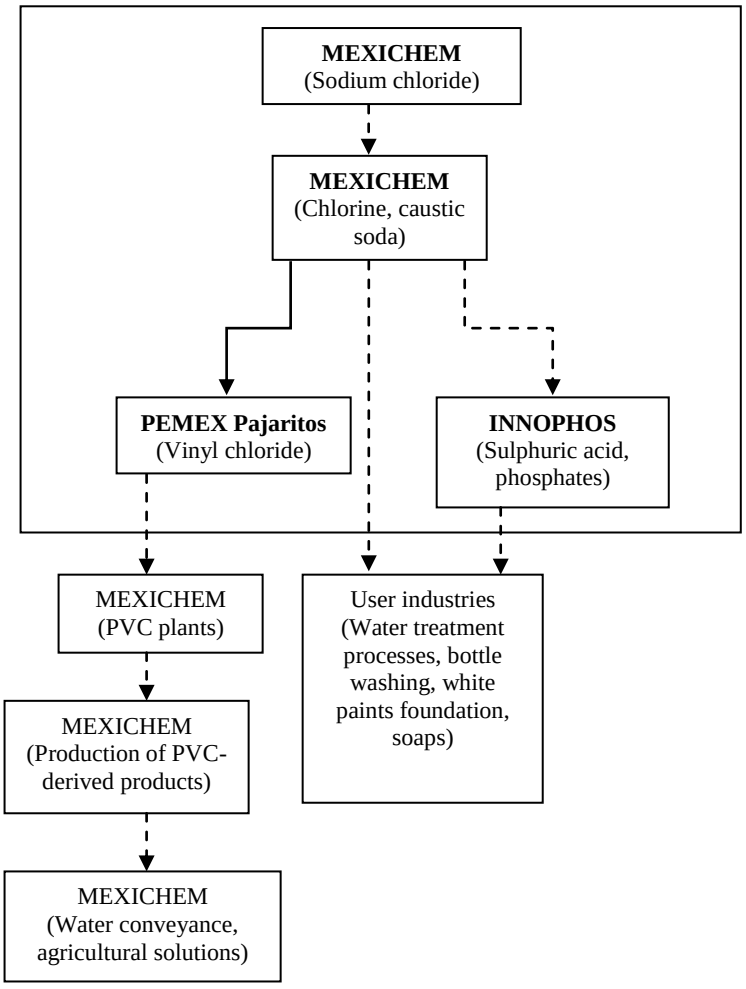
When describing how Mexichem Derivados forms part of a vertically integrated conglomerate, it is important to mention certain key developments with regard to the participation of Antonio Del Valle in the banking sector. The national banking system remained under public ownership for a period of ten years until President Carlos Salinas (1988-1994) decided to re-privatise banks in 1992, a decision that represented an opportunity for Antonio Del Valle and his partners to re-enter banking. They did so by acquiring Banco Internacional (Bital) - a transaction that involved a payout of $300 million. Over a period of ten years Bital established the largest network of branches in Mexico, drawing the interest of international financial institutions wishing to expand their global presence. In 2002 HSBC, a London-based bank, acquired a controlling interest in Bital. The participation of Antonio Del Valle at Bital is reported to have been settled with shares in chemical firms the bank had taken over in previous years. These firms, situated in the states of Tlaxcala and Puebla, formed a conglomerate that was known in the 1990s as Mexichem, and their main production line was PVC. That marked the moment when Antonio Del Valle sought to expand the firm's operations by vertically integrating the subsidiaries. In 2004, Cloros de Tehuantepec became Mexichem Derivados (Ortega 2008) - a firm with the potential to consolidate the development of the PVC value chain (Figure 8.8).

Mexichem accelerated its growth throughout the second half of the last decade and the firm's acquisitions proved determinant to that end. The conglomerate bought firms with operations not only in Mexico, but also in countries such as Argentina, Colombia, Chile, Brazil, Peru, the United States and the United Kingdom (CNNExpansion, February 2, 2010). The driver behind this strategy was to push for 'greater vertical integration

[116] A firm owned by private national and foreign investors, including Total - the French oil company.
[117] Jalisco and the State of Mexico are states situated on the country's central plateau.

synergies and add value to the raw materials produced by the company', as stated in the company's 2006 annual report. In so doing, particular emphasis has been placed on the chlorine-PVC value chain - the business line that yields more than half of Mexichem revenues. However, the company's integration lacked a specific link in the chain: the production of VCM that PEMEX carries out at the La Cangrejera petrochemical complex. Antonio Del Valle, Chairman of the Board of Directors, believed that the role of PEMEX in the structure of the value chain was a factor hampering his company's competitiveness (Ortega 2008).

Figure 8.8 Chlorine-PVC vertical integration



Source: Based on the author's database and the firm's website (June 15, 2009).

Before going more deeply into this issue, it is necessary to describe how the vertical integration of Mexichem has occurred. From the outset, the group controlled a PVC plant at Tlaxcala that is currently operating under the name of Mexichem Resinas

Vinílicas. The subsequent incorporation of Cloros de Tehuantepec in 2004 was a step towards strengthening the standing of Mexichem in that sector. The conglomerate continued the integration of associated firms into its structure and in order to merge the upstream links of the value chain, the acquisition of Union Minera del Sur[118], a company in the neighbouring city of Jaltipán with deposits of sodium chloride, the fundamental input in the making of chlorine at Mexichem Derivados, seemed logical.

In line with such a strategy, the firm embarked on an aggressive plan of acquisitions in Mexico and abroad targeting downstream players. It is reported on the company's website that Grupo Primex, a Mexican firm that produces vinyl resins for the domestic market, was acquired in 2005. Mexichem was particularly busy in 2007, acquiring Amanco, a Brazilian maker of PVC pipes with subsidiaries in other Latin American countries; Petco, a Colombian petrochemical company that produces vinyl resins; 50 percent of Geon Polimeros, a maker of PVC products; and DVG Industria e Comercio, a Brazilian maker of rigid PVC pipes[119]. The vertical integration of Mexichem does not stop with the manufacture of PVC products since the business model also incorporate PVC specific applications. Through its Amanco subsidiary in Argentina, Mexichem was ready to provide solutions for the conveyance of fluids throughout Latin America - a service demanded in the agricultural and construction sectors (Ortega 2008). Although these firms do not represent the entire universe of Mexichem acquisitions in recent years, they clearly demonstrate the firm's strategy: integration of most of the links of the chloride-PVC value chain. In this respect Figure 8.8 illustrates the course of action taken by the conglomerate to add value to its basic inputs. From the extraction of sodium chloride at Union Minera del Sur and chlorine produced at Mexichem Derivados to firms located in the Veracruz cluster and water conveyance and agricultural solutions.

Nonetheless, the conglomerate's most profitable business line has a missing link, as briefly mentioned above. Mexichem Derivados supplies chlorine to the Pajaritos petrochemical complex, which blends it with ethylene to produce vinyl chloride (VCM). PEMEX then sells VCM to Mexichem PVC subsidiaries. VCM is transported by rail to Puebla and Tlaxcala and by ship to Altamira and Colombia, where Mexichem has

[118] Unión Minera del Sur was previously known as Azufrera Panamericana.
[119] Information obtained from Mexichem website: http://www.mexichem.com/web_mexichem/empresa.php?page=gobierno.php (June 15, 2009).

manufacturing sites. With regard to how the chlorine-PVC value chain is structured, Del Valle is quoted in a 2008 report by the CNNExpansion online magazine as saying 'this scheme is completely illogical, it is not competitive'. In the wake of this context, three scenarios could be contemplated. One would be to lease the Clorados 3 plant from PEMEX, but the concern is that such a move would irritate the oil workers union, as Ortega puts it (2008). The second scenario would be to build a PVC plant in Coatzacoalcos. Even though this is by far the most plausible answer, the firm does not plan to build in the short term. The idea was seriously considered at the time Mexichem acquired Cloros de Tehuantepec, as Contreras Milán, plant manager at Mexichem Derivados, explained:

> [...] a sum of $170 million had been authorised by the shareholders for the development, but planning was brought to a halt as PEMEX-Petrochemicals was not in a position to guarantee the long term supply of VCM [a fundamental ingredient for the PVC project]. PEMEX-Petrochemicals is not trustworthy as supplier.

As the venture failed to materialise, the logistical costs for the integration of the chlorine-PVC chain were higher for the company. The projected PVC plant in Coatzacoalcos, as Contreras Milán continued to clarify, 'would have entailed the shutting down of PVC subsidiaries in Puebla and Tlaxcala and the firm would no longer have had to pay insurance and transportation costs.'

The third option would be the construction of a VCM plant by Mexichem - an alternative that seems logical in terms of the configuration of the value chain but complicated when other factors are considered. One of these factors is that ethylene, the input combined with chloride to produce VCM, is only produced by PEMEX-Petrochemicals for the domestic market. Although ethylene is considered the precursor of the most important PEMEX petrochemical value chain, output has stagnated over the last ten years and there are no signs that the situation will change in the short and medium term. The supply of this to the VCM plant would therefore be compromised. To make matters worse, exports of ethylene are sizeable with PEMEX-Petrochemicals exporting 141 thousand tonnes worth $52.6 million in 2009 (United Nations Trade Commodity Statistics Database, 2010). From this perspective, the construction of a VCM plant run by private investors is not conceivable with today's levels of ethylene

production and exports and it seems that for the time being Mexichem will continue to deal with PEMEX-Petrochemicals in the chlorine-PVC value chain. With regard to this statement, it is important to emphasise the dual role of La Cangrejera since the state-owned petrochemical complex is both a client of Mexichem Derivados and a supplier to other subsidiaries of the conglomerate (Figure 8.8). Similar to many of the other PEMEX petrochemical plants, the VCM plant often undergoes maintenance works that may cease production and a technical stoppage means the main client of Mexichem Derivados stops consuming chloride and at the same time cuts off the supply of VCM to other subsidiaries of the conglomerate. The repercussions are distressing for the entire value chain since Mexichem Derivados must find new markets for its chloride production and PVC subsidiaries must find new sources of VCM supply. Despite the fact technical stoppages at the VCM plant have affected the performance of Mexichem Derivados; the interviewee was not in a position to provide more information in connection with this point. Instead, it was recalled a time in which PEMEX-Petrochemicals stopped operations of the VCM plant for a period of six months between 2003 and 2004 due to maintenance works. On that occasion, what allowed Mexichem Derivados to continue producing were the implications of bad weather conditions on the southern coast of the United States. The hurricane season seriously affected chlorine producers and forced them to shut down their plants for several months. Mexichem Derivados took advantage of the situation and channelled its output to that market. By the time operations returned to normal on the U.S. southern coast, PEMEX had re-commenced production at its facilities.

Similar to many of the other firms in the locality, the degree of *transactional dependence* experienced by Mexichem Derivados is significant. The firm plays the role of supplier and in the end, as the evidence indicates, Mexichem Derivados participates in a *captive* relationship whereby PEMEX-Petrochemicals, the only producer of VCM in the country, is the player that greatly influences the co-ordination of input transactions.

CONCLUDING REMARKS

The development of private petrochemical firms in the Veracruz cluster is not only hindered by the political economy of the country described in previous chapters. The mechanisms and practices used by PEMEX-Petrochemicals to co-ordinate input

transactions have also played an important role. In that respect, the erratic supply of inputs, the hazardous nature of petrochemical raw materials, and the fact that state-owned firms are frequently the only local sourcing alternative are among the factors that have clearly constrained both the performance of private firms and their prospects for upgrading. Nonetheless, it must be addressed that certain firms, such as Temex and DAK Americas, have managed to weather these adverse conditions although the exposure of their input matrix to PEMEX-Petrochemicals production processes is limited. Other firms, such as Beta, IDESA and SQCI, on the other hand, have fewer alternatives since their transactional dependence is considerably higher. In general terms, however, it can be deduced that the nature of local and external determinants (that shape the quality of relationships) have prevented both adequate articulation of local value-adding activities and the expansion of output in the Veracruz cluster.

By contextualising the trajectories of firms, transactional dependence, and the *captive* nature of inter-firm linkages, this chapter has linked the empirical evidence of the case study with arguments forming part of the global value chain approach. In a similar way, the empirical evidence discussed here was used to demonstrate that in order to understand the development of clustered firms - principally those operating in a developing country context - it is necessary to consider the economic, institutional, and political setting. The petrochemical cluster situated in the Mexican state of Veracruz is an example of this.

9

FINAL REMARKS

In this thesis I argue that *sectoral*, *national*, and *supranational* determinants have played a significant role in shaping both performance of petrochemical firms in the Veracruz cluster and development of value chains of petrochemical origin. I also contend that traditional approaches to examining industrial clusters in less advanced countries are inclined to play down the importance of the domestic economic, institutional, and political setting. For example, in the field of regional science and business studies, as pointed out in Chapter 3, advocates stress the weight of local externalities and co-operation between firms and associated institutions in driving the upgrading prospects of companies. The global value chain theory adopts a similar approach. Since this stream of literature emerges at a time when the geographical organisation of production is increasingly reconfigured by the globalisation of the world economy, the subject of discussion has centred on cross-national linkages that brand-marketers and retailers from the industrialised world establish with their counterparts (suppliers) in less advanced countries, taking no account of national determinants of development.

Having said this, one fundamental question arises: is upgrading in developing country firms therefore related to the mechanisms through which cross-national relationships are co-ordinated? While the existing empirical evidence is enthusiastic in that respect, little if any attention is paid to the indigenous factors that outline i) the capabilities of firms engaging in (global) circuits of production, distribution and exchange and ii) governance structures of vertical intra-cluster relationships.

The significance of studying the trajectory of the Veracruz cluster and the nature of transactional relationships between PEMEX-Petrochemicals and local firms lies in the fact that both are heavily influenced by determinants (external to our case study) inherent in the development path Mexico has followed over the past five decades. This

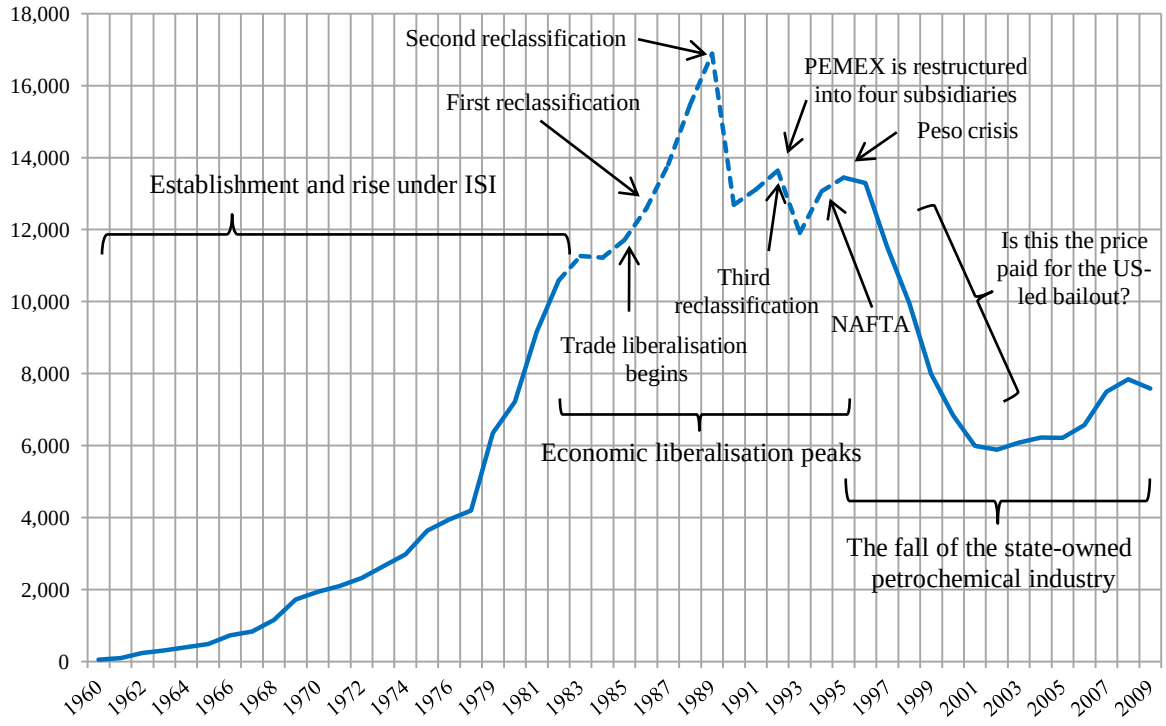
thesis contends that an analysis of Mexico's political economy is fundamental for understanding the rationale behind prevailing governance structures in the Veracruz petrochemical cluster. This approach to examining industrial clusters in developing country settings has been to a significant extent disregarded in the relevant literature, and that is linked to one of the overarching contributions of this thesis: to have complemented the operationalisation of value chain concepts with an analysis of political, economic, and institutional *determinants* pertaining to Mexico's development.

LOOKING AT THE BROADER PICTURE: THE ESTABLISHMENT AND RISE, FALL AND STAGNATION OF MEXICO'S PETROCHEMICAL INDUSTRY

The phases of establishment and rise, fall, and stagnation of the country's petrochemical industry - to which the pool of state-owned and private firms in the Veracruz cluster are central - have taken place under economic foundations that at first underlined import-substituting industrialisation strategies and then resorted to market-orientated policies, as illustrated in Figure 9.1.

From the 1960s to the early 1980s the industrialisation of hydrocarbon resources (into basic petrochemical inputs) was at the epicentre of the economic strategy. The government promoted the setting up and expansion of a wider base of economic activities (value chains) in order to encourage vertical articulation of the national industrial apparatus. Throughout that period, petrochemical output grew from 56 thousand tonnes in 1960 to 10,590 thousand tonnes in 1982 (PEMEX 1978, 1991, Snoeck 1986). Installed capacity, on the other hand, expanded from 2,340 thousand tonnes in 1970 to 14,883 thousand tonnes in 1982 (Snoeck 1986) – 70 percent of which was situated in southern Veracruz (PEMEX 1983). The availability of industrial raw materials in the locality drew the interest of private petrochemical firms to the point that 21.4 percent of the country's installed capacity to process secondary petrochemicals products was located in the state of Veracruz by 1982 (IEPES 1982). Furthermore, 65 percent of the local private firms currently associated with the production processes of PEMEX-Petrochemicals began operation during these years. If one takes into consideration these figures, it is clear that the Veracruz cluster in particular and the petrochemical industry in general mushroomed under the tutelage of the state.

Figure 9.1 Evolution of PEMEX petrochemical output, 1960-2009
(000' tonnes)



Source: PEMEX (1977, 1991, 2004, 2010a) and the author's database.

Although this development was accompanied by favourable economic circumstances, the increasing borrowing requirements of the public sector to finance industrial expansion and the changing nature of the external environment (higher international interest rates coupled with falling crude prices) dramatically worsened the financial imbalances of the government by the early 1980s (Lustig 1998). All these circumstances contributed to sending the country into economic turmoil in 1982. The extent of the collapse not only brought economic growth to a halt, the government also abandoned import-substituting industrialisation. As Mexico embraced market-orientated policies from that moment on, the role of PEMEX and its petrochemical industry with respect to the articulation of associated value chains was set to take a turn for the worst in the forthcoming years.

The new context of development entailed the state in diminishing its involvement in economic planning. To that end, policy prescriptions of the International Monetary Fund and the World Bank proved fundamental in encouraging the increasing participation of private actors. The reclassification of basic petrochemicals inputs - the

production of which was initially reserved to the state - as secondary petrochemical inputs opened up the sector to private capital. In the long run, one of the most detrimental consequences of this policy is that investment inflows did not materialise to the extent the government had estimated, leaving PEMEX as the only domestic producer of key petrochemical inputs up to the present day. As observed in Chapter 8, the degree of transactional dependence that several local firms experience with respect to state-owned firms is fundamentally rooted in these circumstances; and this clearly illustrates the extent to which *external* determinants, that is, the institutionalisation of sectoral regulatory policies in the wake of a changing development context, impinge on the character of inter-firm linkages in the Veracruz petrochemical cluster.

Government officials also resorted to trade liberalisation. The North American Free Trade Agreement is undoubtedly the most significant case in point. While Mexico viewed NAFTA as the instrument that would reassure the character of the economic liberalisation program inaugurated by Miguel De La Madrid (1982-1988) and extended by Carlos Salinas (1988-1994) (Haber et al. 2008), the U.S.'s assessment was that it would be the mechanism which would eventually facilitate greater access to Mexico's hydrocarbon wealth. The latter must be understood in the light of the increasing dependency of the U.S. on imported oil from volatile regions at that point of time. Prior to and during NAFTA negotiations, the Mexican government accelerated the deregulation of the petrochemical and oil sector. In relation to the former, policy makers further narrowed down the list of basic petrochemicals in 1989 and 1992, which by extension entailed the opening up of the sector to foreign investors (DOF 13/10/1986, DOF 17/10/1992, Maxfield and Schapiro 1998). With respect to oil, President Carlos Salinas enacted a law that horizontally reorganised PEMEX into four subsidiaries, introducing guidelines to set the price of inputs in accordance to international references. The regulatory framework that emerged from these policies not only represented the avenue that could lead to further deregulation (Ángeles Cornejo 2001), it also contributed to delineating the complex context in which vertical transactional linkages in the Veracruz cluster are currently embedded. The latter is demonstrated by the dissolution of the natural gas-ammonia-fertiliser value chain since the second half of the 1990s.

Another *external driver of local governance* that must be considered at this stage is the increasing use of natural gas – a precursor in the making of a broad range of petrochemical inputs such as ammonia and ethylene oxide - for the generation of energy. It is widely understood that environmental concerns and a growing domestic consumption are the forces behind the upsurge. It is estimated that the weight of combined cycle plants, which run on natural gas, in the composition of the energy matrix of the country grew from 6.94 percent in 1996 to slightly over 50 percent in 2009. This figure is in line with the proportion of gas PEMEX supplies to the power sector in terms of its overall output, which rose from 18.96 percent in 1994 to 31.21 percent in 2000 and to a staggering 50.42 percent in 2009 (PEMEX 2001, 2010a, Secretaría de Energía 2007, 2010). While it remains problematic to appraise the extent to which the mounting use of natural gas for energy generation has constrained the availability of petrochemical raw materials in the Veracruz cluster, the issue to highlight is that this scenario has undoubtedly put further pressure on PEMEX-Petrochemicals to meet user firms' demands.

The tax burden of PEMEX and the low level of tax collection in the country, as previously discussed in Chapter 7, are also *drivers* of great consequence. Since the Mexican government has failed to capture a larger share of the GDP in the form of taxes to finance public spending, PEMEX revenues serve to fill the gap. During the 2000-2009 period, a third of government income was provided by PEMEX (Banxico n.d.). This heavy tax burden prevents Mexico's largest company from reinvesting its own royalties in key areas such as refining and exploration. As to the latter, a fundamental repercussion is related to crude output, which has decrease from 3.383 mbpd in 2004 to 2.576 mbpd in 2010 (PEMEX 2010b). The fiscal approach with which PEMEX is managed and the high international crude prices in the last six years (Figure 7.5) have made policy makers prioritise crude exports with the intention to generate capital inflows to maintain the public machinery running. Of the total exports from 2005 to 2009, which accounted for 52.68 percent of overall PEMEX crude output throughout the period, exports to the U.S. accounted for 80.9 percent – an even larger share than that in the post-NAFTA era in the 1990s (Figure 6.5) In this setting the point to emphasise is that the Mexican government continues to encourage the generation of revenues through exports (to the U.S.) at the expense of supplying crude to petrochemical complexes, as Figure 7.4 illustrates.

PEMEX AND THE UNITED STATES ENERGY SECURITY STRATEGY

Since NAFTA came into effect in 1994, the entanglement of PEMEX into the U.S. energy security strategy became accentuated. Of the total exports from 1994 to 2000, which accounted for 53.1 percent of overall PEMEX output throughout the period, exports to the world's largest energy consumer averaged 76.64 percent – an explosive jump in comparison to the 1980-93 period when the share of exports to the U.S. averaged 54.41 percent. This entailed a paradoxical implication for Mexico – a major oil producer. The amount of Mexican crude processed at U.S. refineries was frequently larger than that refined by Mexico itself. From 1988 to 1993 exports to the U.S. accounted for 59 percent of the crude processed by PEMEX. From 1994 to 2000 the proportion soared to an average of 92 percent (PEMEX 1989, 1990, 2000, 2010a). With respect to state-owned petrochemical complexes in Veracruz, the latter scenario compromised the availability of crude (naphthas) for the making of inputs. The amount of crude processed by PEMEX-Petrochemicals decreased from 206 thousand barrels in 1994 to 136 thousand barrels in 2000 and to 97 thousand barrels in 2009 (Figure 7.4). As a result the production of aromatics, which are naphtha by-products, plummeted from 1,700 thousand tonnes in 1994 to 667 thousand tonnes in 2000. This asphyxiated the performance of local firms such as Temex and Fefermex since the production of paraxylene and cumene ceased during this period (Chapter 8). The making of other important aromatic compounds such as benzene, toluene, xylene, and styrene also dropped dramatically – a drift that has continued until present. In 2000 the aggregate PEMEX-Petrochemicals production of these inputs represented just 45.15 percent of that in 1994. As late as 2009 the figure plunged to 36.46 percent in relation to the year NAFTA came into effect (PEMEX 2003, 2010a). All things considered, it can be concluded that limited availability of industrial raw materials in the Veracruz cluster and therefore the erratic role of state-owned firms as suppliers are stumbling blocks in one way or another associated with both the entanglement of PEMEX into the U.S. energy security strategy and the policy setting that emerged in the wake of economic liberalisation.

Likewise, it is worth pointing out that the political economy of the country is also strongly linked to the dynamics of the complex relationship with the United States, Mexico's largest trade partner. A central ingredient of this relationship is the mutual

energy dependency – a paradoxical situation for the oil national industry. While Mexico exports crude to its northern neighbour, the U.S. exports natural gas and value-added hydrocarbon products to Mexico (Figure 7.13). This is an indication that crude exports in the end serve to feed the industrial apparatus of the U.S., encourage the international expansion of U.S. oil firms and, last but not least, boost the prospects of U.S. oil firms to eventually capture a larger share of the growing Mexican petrochemical market. The vertical integration of PEMEX, to which the petrochemical complexes situated in the state of Veracruz are a fundamental component, may be therefore viewed as representing a risk to the long-term availability of crude for U.S. firms. For instance, a barrel of oil (naphthas) processed at petrochemical plants in Mexico could be interpreted in the following ways: it is a barrel that U.S. firms do not turn into petrochemical inputs and/or refined products that could later cater for the sizeable Mexican market; it is a barrel that the U.S. would presumably have to source from either politically and/or socially volatile regions or less reliable/friendly suppliers. The dismantling of the Mexican state-owned petrochemical industry (and development of the Veracruz cluster) must be therefore understood in the wake of this multi-dimensional context.

POLICY IMPLICATIONS

This thesis has illustrated the adverse aggregate environment in which the Veracruz cluster is embedded. It is important to ask: how can PEMEX-Petrochemicals and local private firms enhance their prospects to upgrade? To achieve this end, would it therefore necessary to change the economic, political, and institutional setting? If so, what does it imply? As noted in Chapter 7, one of the most significant shortcomings of the Mexican state is the heavy dependence of public spending on oil revenues, with this representing a third of the government income. Ultimately, the driving force behind this situation is the lack of consensus among political actors that would serve to approve a comprehensive tax reform. In 1990 the share of tax collection is reported to have stood at 11.4 percent of GDP. By the year 2000 the figure was 11 percent. The UN Economic Commission for Latin America and the Caribbean (CEPAL) has estimated that Mexico collected 9.4 percent[120] of its GDP as late as 2008 - a figure dwarfed by other Latin

[120] The figure does not include PEMEX contributions.

American countries. While this drawback has persisted for decades, no major structural amendment has been institutionalised in recent years. And the outlook has been aggravated as crude output has plummeted by approximately 24 percent from 2004 to 2010, that is, from 3,383 bpd to 2,576 bpd over a span of six years (Figure 7.4).

Generally speaking, this deadlock is somewhat associated with the national political scene. Mexico began to experience a democratic transition in 1997 when the party that held power since 1929 – the Revolutionary Institutional Party (PRI) – failed to obtain an absolute majority at the Chamber of Deputies for the first time and when Vicente Fox, the candidate from the conservative National Action Party (PAN), defeated the PRI at the presidential election in 2000. A critical inadequacy is that since then Mexico has been ruled by hung legislative bodies where no single political party has held the required majority to approve structural reforms and this has been exacerbated by the lack of consensus among key political actors. The fact that state-owned petrochemical complexes are erratic suppliers of raw materials in southern Veracruz is similarly related to the fiscal approach with which policymaker have administered PEMEX, which at the same time is rooted in a political system whose members have failed to orchestrate a comprehensive tax reform. In this environment of limited resources, the government has prioritised public spending over the requirements of PEMEX to re-invest its own revenues in strategic areas, with the petrochemical division a case in point.

What are the broader implications of the setting just described? The most damaging consequence of the adverse scenario confronted by PEMEX is undeniably the growth of imports of hydrocarbon by-products. In 2009 imports of refined, petrochemical products, and products of petrochemical origin amounted to $26.35 billion and outstripped the amount of crude exports, which stood at $25.66 billion. A year later crude exports climbed to $35.91 billion whereas imports from January to November totalled $33.45 billion. The point is that the ability of PEMEX to capture larger sums of revenue in 2010 has been attributed to a jump in the international price of crude (Figure 7.5) – a factor that is beyond the control of policy makers. On the other hand, imports of hydrocarbon by-products grew larger as Mexico bounced back from the economic slowdown experienced in 2009. All this illustrates that economic gains from crude exports are offset by the increasing domestic demand of refined, petrochemical

products, and products of petrochemical origin, revealing the limited capacity of PEMEX to add value to its own hydrocarbon resources.

The fact that Mexico can be seen as a mere supplier of crude and a net importer of value-added hydrocarbon by-products leads us to argue that policymakers and government officials have serously failed to appreciate the weight of vertically articulating the activities of PEMEX, that is, exploration, production, refining, and marketing. Contrary to this approach, David Shields (2005), who is a journalist and private consultant in energy matters in Mexico, claims that vertical integration as well as production and commercialisation of value-added products are the strategies that major oil firms have followed to expand internationally and boost revenues. While PEMEX concentrates on production and exports of crude, companies such as Exxon Mobil and Royal Dutch Shell have focused on refining and marketing. As regards distillation capacity, PEMEX, which yields two to three times more crude than its private counterparts, refines up to 1,540 thousand barrels per day (bpd), whereas Exxon Mobil and Royal Dutch Shell possess facilities to process up to 6,271 and 3,639 bpd, respectively (PEMEX 2011). By concentrating on downstream value-adding activities Royal Dutch Shell and Exxon Mobil generated $285.12 and $284.65 billion, respectively. By focusing on upstream activities PEMEX yielded $80.72 billion (Shields 2005, PEMEX 2011). When these figures are taken into account, it becomes apparent that the government strategy concerning PEMEX has failed to deliver the expected results. There is no doubt that the restructuration of PEMEX into four subsidiaries and the lack of investment in exploration and upgrading refining capacity are determinants that have constrained the firm's ability to generate revenue and compromised vertical articulation of the country's industrial apparatus.

With respect to the dynamics in the Veracruz cluster, it is evident that the scenario depicted above has played an important role in deteriorating the current standing of PEMEX-Petrochemicals and thus the quality of vertical linkages. As discussed in Chapter 8, local private firms are locked into *captive* relationships with state-owned firms. It is certain that this type of inter-firm governance has constrained the performance of private firms, particularly in the case of those that are transactionally dependent on PEMEX-Petrochemicals. Hence the question that arises is as to what is the scope for petrochemical private firms to upgrade. Despite the fact that firms have

managed to *move into more sophisticated product lines* (Beta) and integrated vertically (Temex - DAK Americas, Agrofermex - Fefermex), it is claimed that a major boost would be to enhance the quality of input transactions. This is to say that a more reliable supply of raw materials on the part of PEMEX-Petrochemicals would surely be a form of upgrading in itself.

Nevertheless, as noted lines above, upgrading the supplying capacities of state-owned firms is an issue highly linked to political issues and therefore complicated to achieve under the existing environment. If PEMEX is to continue to contribute to the country's development, what is badly needed is an adequate tax regime permitting investment in critical areas of the firm such as exploration, research and refining. To that end, political actors must put aside group interests and orchestrate and implement a comprehensive tax reform.

HORIZONTAL CO-OPERATION

Given that the supply of petrochemical inputs is a widespread predicament faced by most firms in the locality, one might expect a high degree of inter-firm co-operation on the buying side. However, the evidence indicates that the importance of horizontal co-operation among firms (and between firms and associated institutions) is fragile. To put this into context is important to underline that the extent to which local firms are affected by the unpredictable character of PEMEX as supplier widely varies from one case to another. This is believed to be associated with the extent of product fragmentation within the cluster. While fertiliser-producing firms confront skyrocketed input prices of ammonia, other buyer firms may have to deal with the closing down of particular state-owned facilities, or to operate at a low capacity utilisation due to the insufficient production at PEMEX-Petrochemicals. Furthermore, the wide range of intermediate inputs derived from basic petrochemicals yielded by PEMEX shapes the constitution of the Veracruz cluster in terms of the number of value chains, or rather, local vertical linkages. Buyer firms in the locality belong to different value chains as they process different basic inputs that are turned into an even larger number of intermediate products that either serve different industries or have specific applications. In relation to marketing their own output and access to inputs, for example, local buyer firms do not compete with one another. In that sense, horizontal co-operation may be more relevant in industrial clusters where participants, in this case local private firms,

have more bargaining power and input supply and output are more homogeneous. In industrial clusters where local suppliers rule transactional relationships and input supply and output is rather heterogeneous, there is reason to believe that horizontal co-operation would tend to be weak.

The latter examples are robust grounds on which horizontal linkages among local firms can be built, but the disproportionate influence of PEMEX-Petrochemicals over the rest of the actors, along with the fact that the decision-making process is greatly centralised in the hands of government officials at the Ministry of Finance and the Ministry of Energy in Mexico City, is very likely to weigh down any collective action in the locality.

POTENTIAL RESEARCH DIRECTIONS IN THE FUTURE

Discussion in this thesis has reiterated the fact that most of the available empirical evidence concentrates on examining value chains in which buyers from the industrialised world farm out manufacturing activities to firms in less advanced countries, where the former exercises a high degree of control over the production process. Another distinction concerning this body of literature is that the firms analysed tend to be privately owned. In that respect this thesis looked at a case study that somewhat differs from what emerges from conventional empirical evidence in value chains, that is, inter-firm linkages within an industrial cluster that are governed by state-owned suppliers. This is what indicates the sort of potential research directions this work might motivate. I believe that the analytical and conceptual framework I developed here could contribute to analysing inter-firm relationships in which the participation of the state is significant. In this particular context the question worth addressing is: what sort of value chains will the researcher be dealing with? When the state intervenes at the point of production, Gereffi (1994: 101) claims that value chains are very likely to be driven by producers – like the output-input linkages in the Veracruz cluster.

That said, examples of value chains in which state participation is predominant can be found in many developing countries, for example, in the petrochemical and copper industry in Venezuela and Chile, which correspondingly could offer empirical evidence worth considering.

Closely resembling the Mexican experience, the development of the petrochemical industry in Venezuela has been led by the state. The La Corporación Petroquímica de Venezuela (PEQUIVEN) is the petrochemical subsidiary of Petróleos de Venezuela (PDVSA), the state-owned oil and natural gas firm. PEQUIVEN owns three petrochemical complexes situated in different locations of the country and produces petrochemical precursors that clustered firms use in their own industrial processes[121]. The extent to which the state is involved in petrochemical value chains is illustrated not only by the ownership character of PEQUIVEN, but also by the fact that PDVSA provides 55 percent of government revenues, according to Venezuela's profile at the CIA World Factbook[122]. In studying governance structures that arise in transactional relationships between PEQUIVEN and buyer firms, it will be of critical importance to consider the path of development that Venezuela has pursued in recent times. This would require special attention to be paid to the degree of state intervention.

Another empirical case worth looking at is the copper industry in Chile. While the state participates in this sector through the Corporación Nacional del Cobre (CODELCO), Chile's state-owned mining company and world's largest copper producer (CODELCO 2010), private firms are also actors of sizeable importance. Overall, copper provides a third of government revenues, with CODELCO alone representing 13 percent (Bloomberg, May 2, 2011). The latter figure indicates that Chile's government is to some extent less dependent on copper revenues than Venezuela with respect to oil. Additionally, conventional wisdom indicates that the role of the Chilean government is less interventionist than Venezuela's. Given the state-owned nature of CODELCO and the approach to development adopted by Chile in recent decades, the question that arises is: what types of governance structures in the copper value chain are likely to prevail? Could we find differences in the quality of transactional relationships between Chile's CODELCO and buyer firms of cooper in comparison to Venezuela's PEQUIVEN and buyer firms of petrochemical products? Could there be any particular determinants inherent in these two cases shaping governance structures rarely discussed in value chain literature as in the case of the Veracruz cluster?

[121] Data obtained from the company's website http://www.pequiven.com/pqv/ (July 12, 2011).
[122] https://www.cia.gov/library/publications/the-world-factbook/geos/ve.html (July 13, 2011).

To address these questions it will be necessary to situate the analysis within the local context of development, that is, to discuss economic, political, and institutional factors determining how inter-firm relationships are co-ordinated in such value chains. For instance, issues like the democratic transition and the instigation of market-orientated policies in Chile could help us understand the development of the copper industry. With respect to Venezuela, it will be similarly instructive to explore the impact of socialist and interventionist policies embraced by the current administration on the vertical integration of the country's hydrocarbon industry.

CONTRIBUTIONS OF THE THESIS

This thesis lays down an approach to examine governance of inter-firm linkages in a manner that conventional studies around value chains tend to underestimate. In reviewing existing empirical studies, it is clear that the analysis focuses on value chains from the perspective of how power relationships among firms serve to shape the co-ordination of value-adding activities and the extent to which suppliers in developing countries can enhance production capabilities. And the discussion is generally inclined to isolate the implications of local determinants for the quality of inter-firm input transactions. Is boosting production capabilities of developing country firms not influenced by the national context of development? This thesis embraces a critical position in that respect and contends that understanding the prospects of developing country firms to attain greater levels of productivity and competitiveness require us to shed light on the home-grown context of development. One of the contributions of this thesis is to have crafted an analytical framework that complements the global value chain approach with analysis of the political, economic, and institutional environment of Mexico to examine the trajectory of the Veracruz petrochemical cluster and distinguish *governance* structures of vertical transactional relationships between state-owned and private petrochemical firms in the locality.

In addition to the inherent characteristics of the petrochemical industry in southern Veracruz, that is, the degree of product fragmentation, the hazardous nature of inputs, and spatial proximity, the present analysis illustrates that *external* factors must be considered when analysing industrial clusters embedded in a developing country context. In that regard it is worth reiterating that Chapter 5, 6 and 7 scrutinises how the extent of state intervention in the light of import-substituting industrialisation policies in

the 1960s and 1970s, the oil boom in the second half of the 1970s, the economic liberalisation process embarked on by Mexico in the 1980s and 1990s and its lingering implications, the institutionalisation of sectoral regulatory policies, the reliance of the government on oil revenues, the implications of the North American Free Trade Agreement, and the U.S. energy security strategy contributed to outlining the development of petrochemical firms in southern Veracruz and local power relationships. The approach I implemented in this thesis demonstrates thoroughly that the prospects for upgrading in developing country firms are not only associated with the type of governance structures characterising input transactions, as the GVC literature suggests, but also with the indigenous context of development.

On the conceptual front this thesis also makes an important contribution. As noted in Chapter 3, two types of value chain are recognised, that is, buyer-driven and producer-driven. While empirical studies have been largely concentrated on exploring the first type of production organisation, producer-driven chains have received little if any attention. The theoretical framework introduced by Gereffi et al. (2005), which distinguishes five types of governance structures exclusively concerning *buyer-driven* chains (Figure 3.1), and the empirical evidence embodied by the Veracruz petrochemical cluster helped conceptualise the type of governance prevailing in transactional relationships between state-owned firms and private local firms. The conclusion is that those local firms that use raw materials supplied by PEMEX-Petrochemicals are viewed as *captive buyers* since the cost of switching suppliers is rather high. The latter is ultimately exacerbated by the fact that state-owned petrochemical complexes exercise a disproportionate degree of control over input transactions – power asymmetry attributed to the hazardous nature of inputs, spatial proximity between suppliers and buyers, and the worth of *external* determinants. For instance, the second contribution of this thesis is to have conceptualised (Figure 3.2) and analysed *producer-driven* intra-cluster relationships in a context of significant state intervention.

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