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Four Essays on Financial Systems and Economic Performance

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Declaration

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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Summary

This thesis analyses the causes and consequences of access to credit by small-scale enterprises in developing countries and the design of optimal financial systems. The first essay explores the link between informality and access to external finance by Small and Microenterprises (MSEs). A probit model is estimated using data on MSEs from Ethiopia. The results show that informality plays an important role in a firm's access to credit. Specifically, informal firms are about sixteen percentage points more likely to be credit constrained than their formal counterparts. The second essay examines the consequence of credit constraints on a firm's innovation using the same data on MSEs from Ethiopia. We construct a measure of innovation exploiting a question in the survey that asks whether a firm has engaged in some form of innovation or not. Employing various estimation methods to deal with the possible endogeneity of access to credit, the results show that access to credit has a significant and positive effect on a firm's propensity to engage in innovative activities. The third essay examines whether opening a stock exchange boosts per capita income growth in Sub-saharan Africa countries (SSA). Employing a semi-parametric Difference-in-Difference (DiD), i.e., a DiD on a set of matched countries, we show that opening a stock exchange does not appear to have a significant impact on economic growth in SSA as well as in other developing countries in other regions. The fourth essay studies whether the structure of the economy determines the evolution of the optimal structure of the financial system. Employing a measure of economic structure constructed based on a country's comparative advantage and using an innovative instrumentation strategy to deal with the possible endogeneity of economic structure, the essay shows that the structure of the economy exerts a first-order causal effect on the evolution of the structure of a country's financial system.

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Abbreviations

2SLS	Two Stage Least Squares
ATT	Average Treatment Impact on Treated
CSA	Central Statistical Agency of Ethiopia
DEA	Data Envelopment Analysis
DiD	Difference in Difference
FE	Fixed Effects
FOGAPE	Fodo de Grantia para Pequenos Empresarios
GNI	Gross National Income
IV	Instrumental variables
LPM	Linear Probability Model
MFIs	Microfinance Institutions
MOFED	Federal Democratic Republic of Ethiopia Ministry of Finance and Economic Development
NBE	National Bank of Ethiopia
OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Square
RE	Random Effects
ROSCAs	Rotating Saving and Credit Associations
SE	Standard error
SSA	Sub-Saharan Africa

Introduction

By 1980, the median per capita income of countries in the top ten income percentiles was about one hundred times that of countries in the bottom ten percentiles. By 2007, the figure stood at about 150. This large and growing income gap among countries has perplexed economists for a long time. A compelling, but rather optimistic, view is that developing countries are no less well endowed with individuals with a potential talent and enthusiasm than developed countries. Underlying this huge difference, however, is that, in developing countries, only a few individuals achieve their potential as compared to those in developed countries. Although by no means the only factor, access to finance is one of the key causes of the differential propensity among countries in tapping into the potential talents of their people. A well developed financial system makes sure that innovative ideas do not die for a lack of finance. It ensures that individuals from humble socioeconomic background but with novel ideas will have the chance to implement their ideas. It also implies that individuals with limited wealth but with the required intellectual talent will go on to pursue education and training, thus changing their fate, and potentially of their countries. In fact, most of the innovations that brought about the industrial revolution in what are now the developed countries of Europe were around well before the start of the revolution, but their full utilization had to wait until these

countries had undergone a form of financial revolution.

Developing countries fare badly in terms of their financial development, a manifestation of which is the pervasive presence of credit constraints and rationing confronting firms and individuals. This problem is particularly acute among small-scale firms, despite the fact that these firms constitute a significant share of output and provide a source of livelihood for many individuals in these countries. Although there is a debate as to whether these firms can serve as a reliable engine for economic growth, there is less disagreement regarding the fact that these firms are the key sources of livelihood for many poor households of these countries and, therefore, may potentially play an integral role in the process of poverty reduction. Indeed, in many countries, the sheer proportion of individuals engaged in these activities makes it compellingly hard not to view these firms as a potential industrial bedrock. A lack of access to external finance is among the primary bottlenecks faced by these firms. A clear understanding of the key causes and consequences of access to external finance by these firms, therefore, may help in justifying and guiding the design of the right policy instruments to ease their access to external finance. A crucial question is how to put in place a well-functioning financial system. A large number of countries, in particular those in sub-Saharan Africa (SSA), have opened stock exchanges as a means of facilitating financial development. Some argue that stock market formation can play an important role in the region's financial development and hence in easing access to external finance for economic agents in the region (Senbet and Octchere, 2008). However, there are some who are sceptical of whether it is worthwhile for SSA countries to promote stock market formation and development (Singh, 1999). As per this view, given the current state of institutional and

economic development in the region, stock markets are less likely to boost access to finance, and, at worse, their side-effects may outweigh their benefits. From a policy perspective, however, an important question is whether opening a stock market improves economic performance. It is important to see if opening a stock exchange and, in general, active engineering of the structure of the financial system can help ease access to credit and hence boost economic growth. This thesis contributes to some of these themes. It consists of four independent essays. The first two essays explore the cause and consequences of access to external finance for Small and Micro Enterprises (SMEs) in Ethiopia. The third and fourth essays explore a broader issue relating to the design of appropriate financial structures.

The first essay explores the key determinants of access to external finance by Small and Microenterprises (MSEs) in Ethiopia. In particular, the essay examines the role of informality in a firm's access to external financing. Informal firms may *a priori* appear to be credit constrained, in view of the fact that they have limited access to the formal financial sector. However, it is not clear if this is the case in practice, since they can have access to alternative sources of finance. Hence, it is interesting to examine the role of firm informality in their access to credit. This is important in view of the fact that a substantial fraction of MSEs are informal. The essay analyses this theme using a unique dataset on about 1000 SMEs in Ethiopia, collected by the Ethiopian Development Research Institute (EDRI) in 2003. The data contain detailed information on various aspects of MSEs. In particular, the questionnaire contains a detailed section on finance, designed to elicit information on access to formal as well as informal sources of financing investment, and the availability and extent of trade credit, etc. We exploit this to construct a measure of a

firm's demand for and access to external finance. The data also contain information on various characteristics of a firm. In particular, it asks whether a firm is formally registered or not, and we exploit this to construct a measure of informality. Given the nature of the dependent variable, we estimate a probit model. The results show that informality plays an important role in a firm's credit constraint. Specifically, informal firms are about sixteen percentage points more likely to be credit constrained as compared to their formal counterparts. We try to deal with the possible endogeneity of informality and also conduct additional robustness checks. The key empirical findings of the essay remain essentially unaffected. In addition to informality, we show that the gender and education of the owner, and membership of a business association are significantly associated with a firm's access to credit.

The second essay takes the issue of access to external finance a bit further and explores the consequence of credit constraints on a firm's innovation behaviour. This is an important question given that innovation plays a key role in the growth and survival of these firms (Gebreyesus, 2009). Hence, so long as access to credit increases a firm's propensity to engage in innovation, easing access to credit can, therefore, be one possible mechanism through which policies can assist growth and the survival of these firms. We use the same data on SMEs in Ethiopia, noted above, to explore this issue. In addition to the rich information about firm characteristics, the survey also contains information on whether a firm has engaged in some form of innovation or not. We exploit this and construct a measure of innovation. As for access to credit, we use the same measure used in essay one. We employ various estimation methods, primarily to deal with the possible endogeneity of access to credit in the innovation equation. The results reveal that access to credit has a significant and positive effect

on a firm's propensity to engage in innovative activities. Besides access to credit, the result also shows that firms whose owners have vocational training and those owned by male owners are more likely to engage in some form of innovation.

The third essay explores the consequences of opening a stock exchange in the poorer developing economies. In particular, it examines whether opening a stock exchange boosts per capita income growth in SSA countries and how its growth impact in SSA compares to a set of developing countries in other regions of the world. Employing a semi-parametric Difference-in-Difference (DiD), i.e., a DiD on a set of matched countries, we show that opening a stock exchange does not appear to have a significant impact on economic growth in SSA countries. We also show that this is not an issue specific to SSA, as stock market formation does not appear to have a significant effect on per capita income growth in our sample of developing countries in other regions. The key finding of the essay, therefore, lends support to the view that, given the current state of economic development, opening a stock exchange may not assist in easing access to finance and boosting economic growth in the region. The results, on the other hand, contrast with the findings of the limited existing studies on this issue, that show that opening of a stock exchange has a positive, albeit weak, effect on economic growth (Minier, 2009; Baier et al., 2003).

The fourth essay deals with the evolution of the financial structure and the role of economic structure in this. In particular, it examines whether the structure of the economy determines the optimal structure of the financial system. Lin et al. (2009) have recently argued that the structure of the economy guides that of the financial system. We employ a measure of economic structure constructed based on a

country's comparative advantage. Specifically, we rely on the following assumptions to get a proxy for this. First, the structure of a country's economy at a given point in time is determined by its comparative advantage. Following Heckscher-Ohiln theory, countries specialize in and export goods and services in which they have a comparative advantage. Hence, all else the same, a country's comparative advantage can be inferred from its export structure. Secondly, economic sectors and activities have differing needs for different mixes of finance. For instance, economic activities that engage in high risk and high return projects are better served by a market-based financial system (Allen and Gale, 1997). In effect, the measure of economic structure we use is based on a country's comparative advantages weighted by the implied equity dependence. Employing an innovative instrumentation strategy to deal with the possible endogeneity of economic structure, the results show that the structure of the economy exerts a first-order causal effect on the evolution of the structure of a country's financial system. The finding of the essay, therefore, lends support to the view that economic structure guides the structure of the financial sector, thus cautioning against active engineering of the structure of the financial system (Lin et al., 2009).

Chapter 1

Access to Credit and Informality among Micro and Small Enterprises (MSEs) in Ethiopia

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1.1 Introduction

Micro and small enterprises (MSEs) constitute a large fraction of total firms and generate substantial employment and output in many developing countries. In Ethiopia, for instance, a survey by the country's Central Statistical Agency(CSA) in 2002 revealed that there were about 974,679 micro enterprises, generating a means of livelihood for about 1.3 million people (CSA, 2002). The number of small enterprises is also sizeable. A study by the same institution in 2003 estimated it at 31,863, employing about 97,782 individuals(CSA, 2003). For countries like Ethiopia that are highly dependent on the agricultural sector, MSEs constitute an important chan-

nel for economic diversification. Not surprisingly, the country's Poverty Reduction Strategy Paper (PRSP) underscores the role of MSEs *"...as seedbeds for the development of medium and large enterprises (vertical integration)"*, and to *"... absorb agriculturally under-employed labor, and diversify the sources of income for farming families."*(MOFED, 2006, p.155). A separate agency, The Federal Micro and Small Enterprise Development Agency (FeMSEDA), was established in 1998 to facilitate the development of MSEs in Ethiopia.

Effective policy intervention, however, requires understanding the main constraints facing these firms. One important determinant of a firm's productivity and growth is access to external credit. However, it has been well documented that most firms, especially small ones and those in developing countries with less developed financial systems, face substantial credit constraints (Banerjee and Dulfo, 2008; Hubbard, 1998a). This is not surprising given that the financial sector is beset by information imperfections and incentive problems, rendering intermediaries reluctant to lend to firms, especially to MSEs. Therefore, one area of policy intervention necessary to stimulate the growth of MSEs is in improving access to external finance.

An effective intervention, however, requires a clear understanding of which firms are likely to suffer from a problem of access to credit. This will help in guiding a tailored and more effective policy intervention to address the issue. A growing literature (see, for instance, Honorati and Gatti (2008); Dabla-Norris and Koeda (2008)), although mainly focused on large and medium sized firms, explores the importance of informality with regard to access to formal finance. Informality of a firm can be a crucial determinant of its access to credit for various reasons. While screening borrowers, lenders require extensive information, including proper documentation of registration and an operating license, tax-compliance and externally audited financial statements. The informal firms are less likely to possess all of these documents, and almost certainly not to the standard required by formal financial institutions. Therefore, such firms are likely to be denied access to credit. Further, financial contracts are highly sensitive to the availability and enforcement of contract. And

given that informal firms are usually beyond the purview of the formal legal system, it is almost impossible for formal financial institutions to enter into contracts with such firms. Thus, informality is *a priori* an important determinant of a firm's access to external finance.

Apart from informality, theory also identifies a variety of other determinants of a firm's access to credit. This paper attempts to identify the factors that determine access to credit for MSEs in Ethiopia, with a particular emphasis on the role of informality. To this end, the paper uses a unique dataset on Ethiopia's micro and small enterprises collected in 2003.

The remaining part of the essay is organised as follows. Section 1.3 discusses the conceptual framework that underpins the prevalence of credit market imperfections, and the determinants of credit constraints facing firms. Section 1.4 details the dataset used, while section 1.5 discusses the econometric methodology. Section 1.6 provides the econometric results and some robustness tests for the preferred econometric specification. Section 1.7 concludes, provides some policy implications and offers some recommendations.

1.2 A brief Background on Ethiopian Economy

This and the next essays are on the Ethiopian economy. Therefore, it is worthwhile to provide a brief overview of some of the key features of the Ethiopian economy. We present a brief discussion of some key economic indicators, such as income level and the poverty ratio, and some indicators of the structure of the economy. We also provide a brief discussion of the country's financial system.

Ethiopia is one of the poorest countries in the world. Per capita income as of 2009, in Purchasing Power Parity (PPP), stood at 850 USD, almost half the figure for Sub-Saharan Africa (SSA). About 41%[1] of the country's population live below the one dollar a day poverty-line, while about 78% live below the two dollar a day

[1]Figure is for the year 2005.

poverty-line. Life expectancy at birth is 58, compared to 80 for developed countries, 69 for the world average and 54 for the Sub-Sahara African. The under-five mortality rate is still very high; of 1000 births, 106 die before their fifth year. Only about 30% of the country's population can read and write (as of 2005).[2]

The structure of the economy is predominantly agrarian. Over the period 1980 to 2009, agriculture, on average, accounted for about 54% of the total value added of the country, almost three times (twice) the figure for low income countries (Sub-Saharan Africa). Over the same years, the contribution of the agricultural sector to GDP has declined by about 10 percentage points. The service sector is the second largest sector of the economy, constituting about 35% of the total value added in the economy over the period under discussion, not far off the 45% for low income countries. Interestingly, the decline in the share of agriculture in total value added over these years is entirely off-set by the increase in the service sector. Industry, on average, accounted for about 11% of the country's total value added over those years, half the average for low income countries and almost a third of the figure for SSA. Its share remained virtually unchanged over this same period. Employing about 85% of the country's population, agriculture is the main source of livelihood and virtually the whole agricultural sector is subsistence.[3]

As is characteristic of a relatively poor economy, the country has a poorly developed financial system. Over the period 1980 to 2009, private credit by banks as a share of GDP was on average about 11%, compared to 71% for high income countries, although close to the 15% for SSA (World Bank, 2010). Over the same year, bank deposits as a fraction of GDP was about 25%, higher than the comparable value for SSA countries, but just about a third of the value for high income countries (World Bank, 2010). The country's formal financial system includes banks, insurance and micro-finance institutions. Although there is a growing equity market, the country does not have an official stock exchange as of yet. In practice, however, the country's

[2]All data is based on World Bank's World Development Indicator (WDI) 2011.
[3]All data is based on World Bank's World Development Indicator 2011.

financial system is essentially synonymous with the commercial banking sector. The country is served by about 14 commercial banks, three of which are state owned. In terms of intermediation, state owned banks have a strong presence. For instance, during the fiscal year 2008/09, about 50% of the total credit disbursed was by the three state owned banks (National Bank of Ethiopia, 2009, p.58). Similarly, 50% of the total deposits was by these three state owned banks (pp. 50). In terms of capital, state owned banks constitute about 67% of the total asset of the country's banking system, while they account for about 43% of the total branch network (pp. 45).

1.3 Access to credit and its determinants: a conceptual framework

The credit market is prone to imperfections, particularly in developing countries like Ethiopia. Two prominent factors underlie these imperfections: asymmetric information and weak contract enforcement. These two features have important implications for the behavior of lenders and on the effectiveness of the price mechanism to clear the market. This section briefly reviews asymmetric information and contract enforcement as sources of credit market imperfections, with the aim of identifying some of the key determinants of a firm's access to credit.

Stiglitz and Weiss (1981) demonstrate that adverse selection, when coupled with moral hazard, results in equilibrium credit rationing. As the risk type of a potential borrower is its private information, lenders can not charge each borrower an interest rate commensurate with its risk. Instead, they are forced to charge some average interest rate. This, however, forces a low-risk potential borrower to exit the market, thus reducing the quality of the borrowers' pool faced by lenders– the adverse selection effect. Further, a high interest rate reduces the owner's stake in the business and may encourage it to invest in high-risk high-return projects and even to shirk– the moral hazard problem. Hence, lenders can not rely solely on the interest rate

to allocate credit under asymmetric information. The second major source of credit market imperfection is contract enforcement. A crucial feature of the credit market is that it is a market for trade in promises. However, promises can be broken and the temptation is high for a borrower to voluntarily default on their loan.

The above snapshot of the main features of a credit market indicates how the interest rate is a fairly ineffective instrument in allocating credit.[4] Under such circumstance, lenders rely strongly on other measures to extend credit, the common method being to directly screen borrowers for their creditworthiness. To that end, lenders use various observable attributes of a borrower. Firm level studies of access to credit, therefore, try to identify observable attributes of a firm (as well as other factors) that determine its credit constraints.

Among the attributes of a firm that lenders may use as an indicator of the repayment probability is the size and age of potential borrowing firms. The size of a firm may give an indication of its strength[5] since this may be the result of cumulative past growth, and may also be an indicator of potential future growth of the firm. Further, large firms are more likely to have greater transparency in terms of their operation and performance, for instance, in the form of having an audited financial statement. Hence, lenders are more willing to lend to large firms, and such firms are less likely to be credit constrained. The explanation is equally relevant for the age of the firm (Winker, 1999).[6] Therefore, MSEs are likely to be credit constrained, particularly younger and smaller ones.

The attributes of the owners of the firm are also viewed among the determinants of its access to credit. Various studies show that the gender of the owner plays

[4]Ethiopia has consistently maintained a low interest rate. For instance, the nominal lending rate by commercial banks remained at around 10% between 2001 and 2005, while the real interest rate has been considerably lower particularly since 2003, (National Bank of Ethiopia, 2004). In spite of this, the overall credit to the private sector as a proportion of GDP remains low by the standards of developing countries with an average of 24% over the period 2000 to 2005 (World Bank, 2010)

[5]Various studies reveal that older and larger firms have higher rates of survival (see, for instance, Farinas and Moreno (2004))

[6]Winker (1999) provides a formal model showing that the age of a firm may reduce the probability of being credit rationed.

an important role in access to credit with, in particular, female-owned enterprises more credit constrained than male-owned ones (de Mel et al., 2008a). The skill and education of the manager/owner can also exert a direct impact on a firm's likelihood of getting external funding for various reasons. First, the skill and education of the owner/manager plays a key role in preparing convincing loan applications and in successful negotiations with lenders. Second, banks may also use the skill and education of a firm's management team to infer its quality. Hence, firms with highly educated owners/managers are more likely to get external funding.

Another important attribute of the owner, albeit difficult to measure, is personal motivation. Various studies indicate that differences in motivation can explain differences in performances in specific tasks among individuals with similar ability (Shane et al., 2003). One manifestation of motivation is self-efficacy, an individual's belief in his/her 'ability to muster and implement the necessary personal resources, skills, and competencies to attain a certain level of achievement in a given task (Shane et al., 2003, p.11). This attribute is crucial for a firm's ability to secure the necessary loans. [7] Thus, firms owned by motivated individuals are less likely to be credit constrained than those owned by less motivated individuals.

The location of the firm could also be another important factor in determining its access to credit. In particular, the density of potential borrowers can be important. In a less dense market where there are relatively few potential borrowers, banks may have prior information about the potential borrower, such as the operation and performance of the firm and the history and background of its owners (Banerjee and Newman, 1998; Stiglitz, 1990). Hence, firms in areas that are densely populated with potential borrowers are more likely to face credit constraints than those in less densely populated ones. Furthermore, location may capture the unequal spatial distribution of financial institutions.

Trade and supplier credits can play an important role in easing access to credit

[7] For instance, in view of the general opaqueness of MSEs, one way that banks can identify creditworthy borrowers is to subject them to lengthy screening, which only persistent potential borrowers are willing to go through.

(Fafchamps, 1997). This is particularly so if it is between larger firms with relatively easy access to credit from formal financial institution and small firms that are usually excluded by such lenders. However, this type of transaction crucially depends on the existence of understanding and trust between firms. Membership of a business association can play an important role here as it increases acquaintances, the flow of information and trust among member firms. Thus, MSEs that are members of a formal business association, which usually have large firms as their members, are more likely to benefit from trade and supplier credits and hence are less likely to be credit constrained than those that are not members of such associations.

As for incentive issues, a lender can use various mechanisms to entice borrowers to act in line with its own interest. One mechanism is the use of collateral (Bester, 1987). Firms that have resources as collateral (or resources likely to be treated as collateral) are more likely to gain access to credit. In view of the general lack of such resources, MSEs are at a disadvantage here. The sector of the firm can also be an important factor in access to credit. For instance, lenders may infer the growth or riskiness of a firm from the growth and the general riskiness of the sector in which it operates.

Another important firm attribute that determines access to credit is its formality. This is so for a number of reasons. First, while screening borrowers, lenders require extensive information. Among this is appropriate documentation of registration and/or an operating license, tax-compliance and externally audited financial statements. Informal firms are less likely to have all of these documents. Therefore, such firms are likely to be denied access to credit. Secondly, as noted above, collateral plays an important role in a firm's access to credit from formal sources. However, in an attempt to be flexible and effectively hide from regulatory agencies, informal firms are less likely to invest in fixed assets that are usually considered by formal financial institutions as appropriate collateral. By virtue of this, informal firms are more likely to be credit constrained than their formal counterparts. Finally, financial contracts are highly sensitive to the availability and enforcement of contracts. And

given that informal firms are usually beyond the scrutiny of the formal legal system, it is almost impossible for formal financial institutions to enter into contracts with such firms. Therefore, informality is *a priori* an important determinant of a firm's access to external finance. However, it needs to be noted that the nature of the relationship could be reversed, where a firm that is credit constrained may opt to operate informally. This is so because by operating informally and avoiding tax, it may be able to conserve resources that can be used for investment purpose. Thus, informality may be endogenous to credit access and this creates an econometric problem when empirically modelling access to credit.

1.4 Data and Description

1.4.1 Data and sampling method

The paper utilizes data on microenterprises in Ethiopia collected by the Ethiopian Development Research Institute (EDRI) in 2003. Almost 1000 small scale enterprises with employees of 10 or less, selected from six major towns spread over the various regions of the country, were interviewed. A multi-stage sampling procedure was used in selecting the sample of firms. In the first stage, the sample size and number of towns to be covered was fixed. Owing to resource constraints, the sample size was restricted to 1000 firms selected from six towns. In the second stage, the towns were selected based on three characteristics – their population density, their population of microenterprises and their regional representation. Accordingly, Addis Ababa, Awassa, Bahirdar, Jimma, Mekele and Nazreth were selected. In the third stage, the total sample size was allocated among the towns in proportion to the number of microenterprises located there. Finally, a random sample of firms were selected from each sector in each town from a sample frame generated for each town. Data were collected on 974 firms, distributed across each town as follows: Addis Ababa (240), Jimma (147), Awassa (141), Bahirdar (145), Mekelle (150), Nazreth (151).

The main objective of the survey was to identify the characteristics and opera-

tions of microenterprises in the country. As such the data contain detailed information on various aspects of MSEs, such as the background of the owner(s) (i.e., gender, education, etc.); characteristics of the firm (e.g., age, location, whether it was started from scratch or inherited, whether it is formal or informal, etc.); business environment (e.g., the legal and regulatory framework, taxation, availability and access to public services, infrastructure, etc.). In particular, the questionnaire contains a detailed section on finance, designed to elicit information on access to formal as well as informal sources of financing investment, the availability and extent of trade credit etc. Therefore, we believe the data are sufficiently rich to enable a study of the key determinants of an MSE's access to credit in Ethiopia.

1.4.2 Definition of variables and summary statistics

Measuring access to credit is problematic, as access has many dimensions. In this paper, we primarily use one measure which is constructed as follows. A survey question asked firms whether they had ever received credit from banks or Microfinance Institutions (MFI). For those firms that replied 'yes' to this question, there was a follow-up question that asked whether the loan secured was of the requested size, was disbursed on time, and was of the requested type of maturity. If the loan obtained by the firm fails in regard to any of these three criteria, the firm is treated as credit constrained and the variable takes a value of 0. For those that never received a loan from either of these institutions, there is a follow-up question that asked whether they have ever applied for one. Those that have applied for a loan but did not get one were treated as if their loan application was rejected and are considered as credit constrained. This leaves those firms that neither applied for a loan nor ever received one. For these, there is a further question that asked why they did not apply. Among the replies to this question is: 'because the firm did not need a loan', or 'because it had better source of financing'.[8] This sub-group are treated

[8]For example, from informal financial institutions such as Rotating Saving and Credit Associations(ROSCAs), relatives and friends, loan from other governmental and non-governmental

as having no problem in their access to credit and the variable assumes a value of 1. The remaining respondents, those who said they did not apply for a loan because they thought they would not get it or because they did not have the collateral required or because the application process was deemed cumbersome, are treated as credit constrained and hence assigned a value of 0. This measure is defined as 'credit_1' in the subsequent analysis.[9] The nature of the question, therefore, enables the construction of a measure that provides in our view a good approximation to the way in which access to credit is conceptualised in the literature (see Claessens (2006) for a detailed review).[10]

Table 1.1 provides a description of the variables included in the regression analysis alongside summary descriptive statistics. The measures constructed here are strongly motivated by the findings in the existing literature on access to credit as reviewed in section 1.3. As can be seen, using the more restrictive measure of access to credit (i.e., whether a firm obtains a loan from either a bank or microfinance institution, ('credit_2')) only 15% of the firms have actually access to credit. In view of the construction of the variable, this implies that about a sixth of sampled firms have ever received a loan from either banks or microfinance institutions. In contrast, using our preferred measure of access to credit constructed for this paper ('credit_1'), about 42% of the firms reported having access to credit.

Various explanatory variables designed to capture firm as well as owner(s) attributes are used in this paper. Among the attributes of the owner(s) are gender,

organisations.

[9]We have also used another measure of access to credit, 'credit_2', a binary variable that takes a value of 1 if the firm has ever received a loan from banks or MFIs and zero otherwise.

[10]Nevertheless, the main weakness of the measure is that it does not specify the year in which the loan was actually secured. This makes it problematic, for instance, to determine whether some of the explanatory variables actually predate the outcome of interest. This has forced us to exclude some additional explanatory variables from the regression models reported here. There is no further information in our data to enable us construct alternative and comparable measure of access to credit. Although there is limited information on firms' use of trade credit, since our preferred measure of credit constraint is broad enough to include a firm's access to credit from any source (including, but not limited to, informal sources, trade credit, etc.), we believe that there is limited information to shed (as far as the importance of informality to credit constraint is concerned) by using a measure of access to trade credit.

Table 1.1: Variables and Summary Statistics

Variable	Description	Mean	Min	Max
credit_1	As defined in the paper	0.42	0	1
credit_2	Dummy variable that takes value of 1 if the firm has ever obtained a loan from either banks or microfinancial institutions, and 0 otherwise.	0.15	0	1
license	Dummy variable of 1 if the firm has operating license and 0 otherwise.	0.75	0	1
Tigray Region	Dummy of 1 if the firm is located in Tigray regional state and 0 otherwise.	0.15	0	1
Oromia Region	Dummy of 1 if the firm is located in Oromia regional state and 0 otherwise.	0.30	0	1
Addis Ababa	Dummy of 1 if the firm is located in Addis Ababa and 0 otherwise.	0.25	0	1
$AmharaRegion^{\S}$ [a]	Dummy of 1 if the firm is located in Amhara regional state and 0 otherwise.	0.15	0	1
Southern Region	Dummy of 1 if the firm is located in Southern Nation Nationalities and People (SNNP) regional state and 0 otherwise.	0.15	0	1
Manufacturing	Dummy of 1 if the firm is categorized as manufacturing and 0 otherwise.	0.36	0	1
Trading	Dummy of 1 if the firm is categorized as trading activities and 0 otherwise.	0.26	0	1
$Service^{S}$	Dummy of 1 if the firm is categorized as rendering services and 0 otherwise.	0.38	0	1
Business association	Dummy of 1 if the firm is a member of business association and 0 otherwise.	0.08	0	1
Age	The age of the firm, given by the year 2003 less the year in which the firm started to operate for the first time.	8.84[8.708] [b]	1	61
Employment	The total number of individuals working (includes paid, unpaid and the owner worker) in the firm when it started to operate.	2.97[2.391]	1	36
Collateral	Dummy of 1 if the firm has a title deed over an asset that may be accepted as a collateral for bank loan, and zero otherwise.	0.59	0	1
Accounting	A dummy of 1 if the firm maintains accounting record and 0 otherwise.	0.44	0	1
Male	A dummy of 1 if a firm is exclusively male-owned and 0 otherwise.	0.74	0	1
$Female^{\S}$	A dummy of 1 if a firm is exclusively female-owned and 0 otherwise.	0.23	0	1
Mixed ownership	A dummy of 1 if the firm is owned by male and female.	0.03	0	1
Vocational	A dummy of 1 if the owner of the firm has vocational training, and 0 otherwise.	0.13	0	1
Motivation	This variable is meant to capture the entrepreneurial motivation of the owner. It is constructed based on the response to the question why the person is in this business. The variable takes a value of 1 if the respondent says s/he is in because s/he has the skill required or because s/he thinks it will be profitable. And it takes a value of 0 otherwise.	0.57	0	1
Price setter	A dummy of 1 if the firm is setting its own price, and 0 otherwise.	0.59	0	1
Produced by formal	A dummy of 1 of the good the firm produce or services it render is also provided by large business enterprise.	0.84	0	1
Business type	A dummy of 1 if the firm is a sole proprietorship and 0 otherwise.	0.94	0	1

Sample Size=974

[a] § Indicates that the variable is a base category estimation.

[b] Values in square bracket are standard deviation and are only reported for continuous variables.

education level and some measure of entrepreneurial motivation. About 6% of the sample of firms are owned by more than one individual. Hence, the gender variable used in this paper ('male') is constructed such that it takes a value of 1 if the firm is exclusively male owned and zero otherwise. As noted in table 1.1, 74% of the firms are exclusively male owned. The variable, 'Vocational', is a measure used to capture the owner's level of education. Given the fact that a firm can have more than one owner, this variable takes a value of 1 if one of the firm's owners had vocational level training before joining the business and 0 otherwise. About 13% of the firms have at least one owner with vocational level training. As noted in section 1.3, a potential determinant of a firm's credit constraint, and in general firm performance, is the motivation of the entrepreneur. Understandably, this is hard to measure empirically. We utilize a question in the survey that asks why the owner (at least one of the owners in case of multiple owners) is in this business. One manifestation of motivation is the perception the person has about his/her capability in achieving their objectives. If the respondent says s/he is in the business because s/he has the skill required to run the firm or because s/he was confident it would be profitable, then this variable takes a value of 1, and zero otherwise. Using this measure, 57% of the firms are owned by motivated entrepreneurs as defined in this way.

Apart from the attributes of the owner(s), the set of explanatory variables also includes firm attributes. As noted earlier, informality is potentially an important determinant of a firm's credit constraint. The variable 'license', one of the key explanatory variables in the analysis, captures this status. It is constructed such that it takes a value of 1 if the firm has an operating license (i.e., the firm is classified as a formal sector firm) and 0 otherwise. Having an operating license entitles a firm to the rights and privileges of being a legally recognized entity, the basic privilege being that the firm can engage in its main activity without worries of being prosecuted for doing so. Unlike an unlicensed firm, it can enter into formal contracts with other economic agents, including with the government. More pertinent to our discussion, it means that a licensed firm can apply for credits from formal sources,

thereby potentially easing its credit constraints. Having a license also means that the firm is required to abide by government regulations relating, for instance, to labour and product standards. It may also involve paying the applicable taxes. Our definition of informality corresponds to the main conceptualization used in the informal economy literature, that informality does not necessarily means producing goods and rendering services that are illegal but that the firm is out of the purview of government regulations (Perry et al., 2007). As can be seen from table 1.1, about 75% of firms report they have an operating license for their business, indicating the majority of sampled firms operate within a formal framework. Age and size of the firms are other potential determinants of a firm's access to credit. The variable 'age', captures the age of the firm, while, 'employment', which is the total number of both paid and unpaid individuals employed by the firm at the start of its activity[11], captures the size of the firm. With an average age of about nine years, most of the firms are relatively young. The firms are small in terms of employment, with an average of three individuals working in a firm at its start time. Indeed, 90% of them had actually five or less employees at the start of their operation. In terms of the location, about 30% are located in Oromia regional state, 25% in the capital city (Addis Ababa) and half of the sample are distributed over the other three regional states, (viz., Tigray, Amhara and Southern Nation Nationalities and People (SNNP)). The firms in the sample are classified into three broad activity sectors (viz., services, trading and manufacturing) depending on their main type of business. As can be seen from the table, the sample of firms appear evenly distributed across the manufacturing (36%), services (38%) and trading (26%) sectors.

Possessing an asset that can be posted as collateral and maintaining an accounting record are other potentially important determinants of a firm's access to external credit. We construct the variable 'collateral' to proxy for collateral, which takes a value of 1 if the firm has a title deed over any property that financial institutions

[11]This may not be a very good measure of size, especially if the initial firm size does not predict its current size. However, given the nature of the dependant variable as noted in footnote 10, initial employment is the best measure of size we have available in the dataset.

consider as collateral, and 0 otherwise. About 60% of the firms own such assets. As regards the accounting record, 44% of the firms report they maintain some form of accounting information. Finally, we also use membership of a business association to capture the network and potential for information sharing among similar firms on their access to credit. About 8% of firms are members of at least one formal business association.

1.5 Methodology

The dependent variable in this application assumes either a value of 1 or 0 depending on whether a firm has access to credit or not. A probit model is used in estimation given the binary nature of the dependent variable. The binary probit is generally motivated by reference to a latent (or unobservable) dependent variable ($y_i^\star$) and usually expressed as a linear function of a set of explanatory variables as follows:

$$y_i^\star = x_i^{'}\beta + \varepsilon_i \tag{1.1}$$

where $\varepsilon_i \sim N(0, \sigma^2)$ $i = 1, ...n$, x_i is a column vector of realizations on k explanatory variables including a constant for firm i and β is a column vector of k unknown parameters. The values of the latent dependant variable are measured on the real line and in this case reflect the underlying propensity of a firm to have access to credit. The error term is assumed normally distributed with a mean of zero and a constant variance σ^2. A threshold (assumed zero in this case) is used to delineate whether the firm has access to credit or not. The probability of the event occurring can be linked to the latent dependant variable as follows:

$$P[y^\star > 0] = P[y_i = 1] = \Phi(z_i) \tag{1.2}$$

where y_i is the dichotomous realization of the latent dependent variable (and is either 'credit_1' or 'credit_2' in this study), $\Phi(\centerdot)$ denotes the cumulative distribution function operator for the standard normal, and $z_i = \frac{x_i^{'}\beta}{\sigma}$. For identification purposes

it is conventional to normalize $\sigma = 1$.

The log-likeihood function is defined as:

$$L = \sum_{i=1}^{n} y_i ln(\Phi(x_i^{'}\beta)) + (1 - y_i) ln(1 - \Phi(x_i^{'}\beta)) \tag{1.3}$$

The parameters are estimated using conventional non-linear optimization algorithms. The efficient score tests suggested by Chesher and Irish (1987) are undertaken to assess the reported specifications in terms of homoscedastic errors, and a normal distribution of the generalized residuals. In addition, appropriate functional form and/or omitted variables are tested using the RESET framework.[12]

The estimated probit coefficients can be interpreted by reference to their effect on the standardized probit index but it is generally more convenient to translate them into marginal and impact effects. The marginal effects are denoted for a continuous variables as $\phi(\bar{z}) * \beta_k$, where $\phi(\centerdot)$ denotes the probability distribution (or density) function for the standard normal, β_k is the estimated probit coefficient for the corresponding k^{th} continuous variable, and $\bar{z}$ is the standardized probit index computed at the sample mean values of the characteristics. The impact effects are computed as $\Phi(\bar{z} + \delta_j) - \Phi(\bar{z})$, where δ_j is the corresponding probit coefficient for the j^{th} dummy variable, and the remainder is as defined above. The asymptotic sampling variances for the marginal and impact effects are computed using the delta method.

1.6 Empirical Results

Table 1.2 provides the result of the probit estimation for both our measures of access to credit. Both models satisfy the econometric assumptions inherent in the

[12]The omitted variables or misspecified functional form are proxied by the predicted standardised probit indices from the original probit regression model raised to the powers of two, three and four.

probit model, thus providing confidence in the regression model estimates. Column 2 provides the results for our preferred measure of access to credit (credit_1), while column 4 reports estimates for access to credit measured by whether the firm has ever received a loan from a bank and/or MFI. We concentrate on the discussion of estimates using the former dependent variable as we believe this more accurately captures the access to credit concept. As can be seen, formality positively and significantly affects a firm's access to credit. Moving from being informal to formal (i.e., obtaining an operating license in this case) raises the standardized probit index by about 0.44 of a standard deviation. In terms of the impact effect, as given in column 3 of the table, having an operating license increases a firm's access to credit by about 17 percentage points, on average and *ceteris paribus*. Clearly, formality has an important effect on a firm's access to credit.

The gender of the owner is another important determinant of access to credit. Firms that are exclusively male-owned are found to have a lower access to credit than those that are owned by women. Male-owned firms are about 10 percentage points less likely to have access to credit than female owned firms. This may be attributable to the fact that MFIs usually target lending to female-owned enterprises. A closer look at the gender composition of those who have ever borrowed from formal financial institution indicates that female owned firms are more represented in borrowing from MFI. For instance, of the firms that report that they have ever received a loan from a bank, 75% are exclusively male owned while 22% exclusively female owned. For borrowing from MFI, however, exclusively male-owned firms constitute 55% while female owned ones constitute 36%, placing the latter gender group as more implicated in MFI borrowing than in the sample overall. Hence, MFIs seem to target their loans to female owned enterprises, thus making them less credit constrained than the largely male-owned ones. However, another possible explanation could perhaps be that female owned enterprises have limited demand for loans as compared to their male counterparts, perhaps reflecting a gender difference

Table 1.2: Results of Probit Estimation

This table provides the results of probit estimation for the two measures of access to credit. credit_1 is dummy variable constructed based on series of questions asked to firms to elicit their access to credit. It takes a value of 1 if the firm is not credit constrained and zero otherwise. credit_2 is a dummy variable that takes a value of 1 if the firm received a loan from either banks or microfinance institutions, and zero otherwise.

	Credit_1		**Credit_2**	
Variable	Probit	ME	Probit	ME
License	.444***[a]	.166***	.414***	.073***
	(0.108)[b]	(0.038)	(0.152)	(0.023)
Male	-.272***	-.107***	-.139	-.029
	(.102)	(.040)	(.123)	(.026)
Mixed ownership	-.239	-.090	-.023	-.004
	(.281)	(.101)	(.314)	(.061)
Southern Region	.366***	.145***	.504***	.122***
	(.165)	(.065)	(.187)	(.053)
Tigray Region	.663***	.259***	.297	.067
	(.164)	(.062)	(.193)	(.048)
Oromia Region	.528***	.207***	-0.194	-0.037
	(0.144)	(0.056)	(0.178)	(0.032)
Addis Ababa	.317**	.125**	-.388**	-.069***
	(0.148)	(0.058)	(0.192)	(0.030)
Motivation	.241***	.093***	0.089	0.018
	(0.089)	(0.034)	(0.111)	(0.022)
Collateral	.344***	.132***	.335***	.065***
	(0.095)	(0.036)	(0.125)	(0.023)
Employment	0.021	0.008	.040**	.008**
	(0.020)	(0.008)	(0.021)	(0.004)
Age	-0.003	-0.001	.018 ***	.004***
	(0.005)	(0.002)	(0.006)	(0.001)
Manufacturing	0.068	0.026	0.117	0.024
	(0.101)	(0.040)	(0.122)	(0.025)
Trading	0.133	0.052	-0.189	-0.036
	(0.108)	(0.043)	(0.142)	(0.025)
Accounting	.163**	.064**	-.190*	-.037*
	(0.090)	(0.035)	(0.114)	(0.022)
Vocational	-.221*	-.084**	0.025	0.005
	(0.126)	(0.047)	(0.160)	(0.032)
Business association	.467***	.185***	.458***	.112**
	(0.159)	(0.062)	(0.169)	(0.049)
constant	-1.268***		-1.883***	
	(0.191)		(0.237)	
Pseudo-R^2	0.0973		0.1253	
Loglikelihood-	-598.96		-361.51	
Sample Size	974		974	
	Diagnostic Score Tests			
Normality	$\chi^2_{(2)}$=3.436[0.179][c]		$\chi^2_{(2)}$=3.447[0.178]	
Functional Form	$\chi^2_{(3)}$=4.076[0.25]		$\chi^2_{(3)}$=3.479[0.324]	
Homoscedasticity	$\chi^2_{(16)}$=20.065[0.217]		$\chi^2_{(16)}$=17.564[0.350]	

[a] ***, **, * = significant, respectively, at 1% ,5% and 10%.

[b] values in parenthesis are standard errors.

[c] Values in square bracket are Prob-values for the diagnostics.

in risk aversion (Bluffstone and Yesuf, 2007; Borghans et al., 2009).

Firms located in Oromia, Addis Ababa, Tigray and SNNP regions have better access to credit than firms located in the Amhara regional state. For instance, a firm located in Tigray regional state is 26 percentage points less likely to be credit constrained than a similar firm located in the Amhara regional state. Hence, MSEs in this region are more credit constrained than their counterparts located in the rest of the country. This may be a reflection of the unequal regional distribution of the country's financial system. In line with the existing literature, having collateral assets raises a firm's access to credit. Hence, a firm that has some asset that can be used for collateral purposes is 13 percentage points more likely to have access to credit than a firm that does not possess such an asset. As discussed earlier, for firms like MSEs, collateral is the best available device to screen borrowers and align their interest with that of lenders.

Firms owned by more motivated entrepreneurs are more likely to have better access to credit than those owned by less motivated ones, indicating perhaps that motivated entrepreneurs are likely to develop mechanisms to circumvent the problem of access to credit (Buera, 2008). Access to finance does not appear to be affected by firm size, as captured by initial employment size, and the age of a firm.[13] Similarly, there is no systematic relationship between the sector in which the firm operates and its access to credit.

Membership of a business association appears to be an important determinant of access to finance for MSEs in Ethiopia. A firm that is a member of a business association is 18 percentage points more likely to have access to credit than firms that are not members of such organisations. This may be because membership of such associations facilitates information sharing and networking among firms. As such it

[13]The choice of initial, as opposed to current, employment level is motivated by the objective to reduce the endogeniety issue of the variable. However, employing current value of employment does not qualitatively change the results of the essay. For firm age, we tried different specification. For instance, we included a quadratic term and neither the coefficient of age nor that of our key variable – license – changes. The coefficient of age, however, becomes significant at 10% when used in log than in levels. Nevertheless, this does not change the results of other variables.

may increase the trust among firms, an important factor for the extension of supply and trade credits. And as firms have more trade credit and other arrangements, they are less likely to be credit constrained. This is particularly important for smaller firms that generally have less access to credit from formal financial institutions as it allows them to get supply and trade credit from larger firms that have better access to bank credit. Having accounting information significantly increases a firm's access to credit. Hence a firm that maintains an accounting record is six percentage points more likely to have access to credit as compared to those who do not have such a record, on average and ceteris paribus. This is to be anticipated given that maintaining such information increases a firm's transparency to lenders.

Another important variable is whether the owner had a vocational training background when starting the business. Those whose owners had vocational training are eight percentage point less likely to have access to credit than those who do not have such training. This is potentially problematic finding given that various studies on MSE growth reveal firms whose owners have vocational training are more likely to grow better than those whose owners lack such training (Nichter and Goldmark, 2009). The fact that they are more credit constrained casts doubt on the role of the country's financial systems in targeting MSEs that have high growth potential.

A brief examination of the estimates using the other measure of access to credit ('credit_2') are reported in column 4 and reveal a broadly similar pattern of results. In particular, formality increases the probability of obtaining a loan from a bank or MFIs. Unlike the first measure of access to finance, the gender of the owner is not a statistically significant determinant here. This may indicate that for these types of firms, the gender of the owner is perhaps not important for access to credit from banks and MFI, but is important for access to credit from other sources. This may be because female owned enterprises have better access to credit form, for instance, informal sources as compared to their male owned counterparts. The estimated effects for age and size of the firm are significant in the second measure of access to credit and insignificant in our preferred measure of access to credit. The estimated

result for membership of a business association remains significant and exerts a positive effect on a firm's access to credit, although having an accounting record yields a negative effect, albeit one that is only marginally significant.

A key assumption in the analysis conducted here is that informality is exogenous to a firm's access to finance. However, as noted in section 1.3, there are various reasons why this may not be the case. For instance, it may be that firms that can not get credit opt to operate informally so as to save money for investment through avoiding tax. As such, there can be a causation running from access to credit to informality. If that is the case, the regression model estimates above will be potentially biased and hence the results misleading. Another possible problem would be if there was an unobservable attribute, for instance the entrepreneurial talent of the owner (s), that affects both access to credit and informality. In such circumstances a correlation between 'license' and the latent dependant variable's error term exists, yielding a potential bias in the estimated 'license' coefficient.

In order to address the potential endogeneity of 'license' and assess whether the findings from table 1.2 are robust, we use instrumental variables(IV). Given that the 'license' variable is binary in nature (see table 1.1), it is tempting to use a probit (or even a logit) model to generate first stage predictions. However, this is unnecessary and may actually prove harmful if such a non-linear first-stage model is mis-specified (see Angrist and Krueger (2001, p.80)). Thus, we use a linear probability model (LPM) in the first stage regression. However, given that the LPM is inherently heteroscedastic, a correction to the estimated regression model's variance-covariance matrix for heteroscedasticity of unknown form is required.[14] In order to determine whether the selected set of instruments is relevant in the first stage equation we are guided by both the rough 'rule-of-thumb' that the transformed F-test for the joint significance of the identifying instruments in the first stage regression exceeds the value 10 and by reference to a set of critical values provided by Stock and Yogo

[14]Using the Cook-Weisberg test for heteroscedasticity, the null hypothesis of homoscedastic errors was decisively rejected for the reduced form LPM. The value of the estimated χ^2_1 is computed at 41.0.

(2005). It is also important to determine whether the instruments are exogenous and this requires their independence from the error structure in the key equation being modeled (i.e., access to credit). Hansen's J-statistic is used for this purpose as it is a consistent test when adjustments are made to the variance-covariance matrix for heteroscedasticity of unknown form. A test for under-identification suggested by Kleibergen and Paap (2006) is also used to assess the identification of the regression model's parameters.

In order to do this in the current application, we also estimate the second stage equation as a linear probability model to facilitate this aspect of robustness testing. Once we are satisfied that the set of instruments are relevant and orthogonal to the error process in the equation of interest, we then use the 'C' statistic[15] to determine whether the 'license' variable is exogenous or not. Finally, in order to complement the finding related to 'C' statistic we also estimate an IV probit to test for the exogeneity of the 'license' variable using the set of valid instruments obtained above.

Table 1.3: Testing the Exogeneity of the 'license' Variable

	credit_1	**credit_2**
F-test for instrument relevance F(3, 955) =	61.46 Prob-value=0.000	61.46 Prob-value=0.000
Kleibergen-Paap transformed F statistic	56.124[d]	56.124
Hansen J Statistic for Over-identifying Restrictions	$\chi^2_2 = 0.559$ Prob-value=0.7560	5.689 Prob-value=0.0582
Kleibergen-Paap LM Statistic for Under-identifying Restrictions	$\chi^2_3 = 99$ Prob-value=0.000	99.715 Prob-value=0.000
'C' test for exogeneity	$\chi^2_1 = 0.504$ Prob-value=0.4775	0.006 Prob-value=0.9390
IV Probit Exogeneity Test	$\chi^2_1 = 0.68$ Prob-value=0.409	$\chi^2_1 = 0.01$ Prob-value=0.930

[d] The critical value for the 5% maximal IV relative bias is 13.91 using the Stock and Yogo (2005) critical values.

There are three dummy variables that we use as identifying variables in the current application. These are 'price setter' (whether the firm sets its own price or not), 'produced by formal' (whether the firm's product is provided by other large formal enterprises or not), and 'business type' (whether the firm's ownership structure is sole proprietorship or not). On the basis of table 1.3 it is clear that these three variables are jointly relevant in the reduced form first-stage 'license' equation as the resultant F-test comfortably exceeds the required 'rule-of-thumb' value and

[15] See Baum et al. (2003) for discussion of the C-statistic.

the transformed F-test decisively rejects the null of weak instruments using the critical values reported in Stock and Yogo (2005). In addition, the three variables are also found to be orthogonal to the error process for both measures of access to credit used here on the basis of both the Hansen J statistic for over-identifying restrictions as well as the Kleibergen-Paap under-identifications LM test. Thus, the instrument set is deemed valid for the purpose of the current exercise. Given these findings we can now test for whether the 'license' variable is exogenous or not. In using the linear probability model, the 'C' test fails to reject the null hypothesis of exogeneity and this is also confirmed by the use of the IV probit model. Thus, for both credit access measures, we can conclude that the formality status of the firm is exogenous to the determination of access to credit. Therefore, on the basis of the findings in table 3 and the diagnostic test values reported at the bottom of table 2, we have some confidence that the probit model estimated is reasonably well specified and that our econometric findings are reasonably robust.[16]

1.7 Summary and Conclusions

The role of MSEs in development is controversial (de Mel et al., 2008b). The large size of MSEs in most developing countries is usually viewed in two different ways. To some, it is an indication of a healthy process, as it signifies the creation of new jobs and possibly lays the ground for the future diversification of the economy.

[16]We also construct a proxy for informality at the firm level using the average informality of the sub-sector instead of the 'license' variable itself. This type of variable has been used by various authors. For instance, Svensson and Fisman (2007) uses a sector-region average measure of bribery incidence to proxy for a firm level payment for corruption. The survey allows the classification of firms into 38 sub-sectors, and we use the average informality in each of these sub-sectors and assign these values to each of the firms in its respective sub-sector. This is defined as the proportion of firms in a given sub-sector who do not have a 'license'. Even if there is a possibility of causation from lack of access to credit to operating informally at firm level, it is less plausible for a firm's lack of access to credit to cause informality at sub-sector level. Informality of the sub-sector is mainly driven by sector-specific factors such as the ease with which firms operating in one sector can avoid being caught by regulatory agencies as compared to firms operating in another sector. Hence, we use sub-sectoral average informality as a proxy for firm informality. The variable enters with a negative and significant coefficient, confirming the results reported in table 1.2. This strengthens our finding in regard to the effect of formality (or conversely informality) on access to credit.

To others, it indicates the failure of an economy in providing gainful employment, forcing people to opt for an 'inefficient' and 'transient' sector.

However, various studies indicate that there are high as well as low growth MSEs (Nichter and Goldmark, 2009). Nevertheless, in view of their size, lack of assets for collateral and general opaqueness, both high as well as low growth MSEs are likely to be credit constrained. This paper identified factors that are important determinants of MSE access to finance in Ethiopia. For instance, informal firms are more likely to be credit constrained than their formal counterparts. Facilitating formalization of such firms can be a potentially beneficial policy. It increases their access to finance and therefore their growth and contribution to the overall economy and broadens the tax base (Perry et al., 2007). Further, informality is believed to constrain the process of industrialization by undermining the process of creative destruction (Perry et al., 2007). Hence, there is a need for detailed analysis to understand better the factors behind informality of MSEs in Ethiopia, an issue beyond the scope of the current paper given the limited nature of the data available to us.

Maintaining accounting information increases a firm's access to credit. Assisting firms to maintain better accounting information, therefore, helps both in improving their access to finance as well as assisting better tax assessments and collections. We have also found that there is a gender dimension to credit access, as MSEs owned by males are found to be more credit constrained than those owned by females. Location matters as well, indicating firms in the Amhara regional state have less access to credit than those in other regions. The fact that firms whose owners have vocational training prior to starting a business are more credit constrained is particularly worthy of comment. This may be an indication of the fact that vocational training may be enough to enable owners to spot good potential projects, but is insufficient to equip them with the skills required to go through the borrowing process with a financial institution. One area where intervention can help such firms is by equipping them with loan application and negotiation skills, through, for instance further training.

Another predictably significant effect is a firm's collateral. Collateral is particularly important for lending to less transparent firms like MSEs. However, MSEs generally do not have such assets. A policy intervention may be of assistance here. One option would be a partial credit guarantee for a loan to MSEs. Although designing credit guarantee schemes that do not undermine the incentive effect of lenders as well as borrowers is generally hard, there are encouraging schemes already in place elsewhere. The often cited example is the Chilean Fodo de Grantia para Pequenos Empresarios (FOGAPE), which is a public funded credit guarantee scheme for loans to micro and small enterprises (Benavente et al., 2006). Apart from some evidence of substitution of public for private guarantees, the scheme is generally interpreted as a successful one (Benavente et al., 2006). It is important to use the findings of such successful schemes and adapt or improve them for use in Ethiopia.

Although the regression models used in the paper pass various diagnostic tests and arguably yield fairly robust and reliable results, future research can improve on the analysis in a number of ways. A limitation of the dependant variable is that it is defined on the basis of demand-side responses alone in that it reflects only the view of firms and not that of lenders. An improved measure could exploit a firm's return on capital (for instance, generated as in de Mel et al. (2008b)) with a firm's reported credit constraint.[17] Secondly, some of the explanatory variables, such as that aimed at capturing entrepreneurial motivation, are crude proxies and can be improved on by using superior measures of entrepreneurial ability (see for instance those also used by de Mel et al. (2008b)). Thirdly, there is a potential for measurement error in the first constructed measure of access to credit. As noted, our key measure of access to credit is generated based on response to series of questions. One key drawback with such approach is that the classification of our dependent variable depends, among others, on the accuracy of the answers given

[17]Nevertheless, the return to capital is generally higher among MSEs. For instance, de Mel et al. (2008b) finds it to be 20-30% per annum, and can be as high as 80% for credit constrained MSEs in Sri Lanka; Kremer et al. (2011) finds a per annum return to capital of 113% for retail firms in rural Kenya.

to each of the series of questions used to generate the variable. A recall error in one of the questions, for instance, would result in the dependent variable to wrongly classified. In conventional linear regression, this is essentially a measurement error of the dependent variable and hence does not affect the consistency of the parameter estimated, but just its efficiency. With non-linear estimation techniques such as one used in this paper, however, the consequences of misclassification error can be serious (Hausman et al., 1998). In particular, they show that parameters maybe biased and inconsistent as well as in efficient under this scenario, with the size of bias and inconsistency depending on the size of the misclassification error. Employing a Monte Carlo simulation, they show that for a small probability of misclassification, say 2%, the estimates can be biased by as high as 25% (pp.245). Various options have been suggested to deal with such issue. However, our efforts to model theses effects proved difficult as the likelihood function failed to converge. This is clearly an issue requiring further investigation, but is currently beyond the scope of this thesis.

Chapter 2

Access to Credit and Innovation among Micro and Small Enterprises (MSEs) in Ethiopia

2.1 Introduction

The question of how to kick-start and sustain economic growth is no where as important as in Africa. An important insight from modern theories of economic growth is that the key to this process is technological progress, itself primarily determined by innovation. An important consensus is also that technological progress is the result of deliberate undertakings by firms to adopt and adapt existing technologies and/or innovate new ones (Acemoglu, 2009). Therefore, it is not a surprise that exploring factors behind the differences in the level of innovation attracts huge research attention.

For developing regions like Africa that are located far-off the technological frontier, technological progress is largely determined by adoption and adaptation of existing technologies. In view of the dominance of small and medium scale firms, innovation in these regions is synonymous with adopting and adapting technologies developed in highly industrialized nations. Such incremental innovation is central

to the growth and survival of these firms and hence in their role in the process of industrialization of the region.

Various empirical studies have explored firm level determinants of innovation and technology adoption. The overwhelming proportion of these studies, however, have been on large firms in developed countries. There are few studies on less developed countries. This is particularly so for micro and small enterprises (MSEs), despite the fact that these firms constitute a large fraction of business enterprises in most developing countries. In Ethiopia, for instance, as noted in essay one, MSEs are estimated to generate a means of livelihood for about 2.3 million people (CSA, 2002, 2003).[1]

The limited emphasis on innovation by MSEs is understandable given that major innovation is undertaken by large firms and that innovation is usually construed as the introduction of products, methods of production or marketing that are new to the country and usually to the world. However, this view of innovation misses large innovative activities by medium scale and smaller firms. The notion of innovation need not be restricted to radical innovations. As is emphasized by the Oslo manual (OECD, 2005), innovation ought to be viewed from various points - the world, country, region and the firm. For an activity to be regarded as innovation, at the minimum, it needs to be new to the firm, not necessarily to the country or world. SMEs do engage in these types of innovation, and such innovation may play a critical role in their survival and growth (Gebreyesus, 2009). It is, therefore, important to know the factors that determine innovation among such firms.

A well developed financial systems plays key role in facilitating innovation, both by directing resources to promising new ideas and by diversifying risk faced by potential innovators. Therefore, given the rudimentary state of the country's financial development and the resultant pervasiveness of credit rationing, access to credit is potentially a key determinant of firm innovation and hence growth. This essay aims at exploring the firm level link between access to finance and innovation. Such

[1]Figure relates to estimate for 2002

information may help in designing better mechanisms to encourage innovation by these firms. Besides its policy importance, information provided by this study also contributes to the finance growth literature. An important finding is that financial development plays a key role in the process of economic growth. However, little is known about the empirical channels through which this works. And one possible channel would be through its effect on innovation and hence productivity growth (Levine and King, 1993). Therefore, a study of the impact of access to credit on innovation may shed some light on this theme.

This essay provides an empirical study of the effect of access to credit on firm innovation using a firm level data on SMEs in Ethiopia. Employing various estimation methods, we show that access to credit has a positive and significant effect on innovation by SMEs in Ethiopia. We use a simple probit model of innovation and access to credit, where access to credit does not appear to have a significant effect on innovation. This is likely to be the result of possible endogeneity of access to credit in innovation equation. As a result, we employ various estimation techniques aimed to correct for possible endogeneity of access to credit. We use single equation instrumental variable estimation methods and show that access to credit has, in fact, a positive and statistically significant effect on firm innovation. In order to make sure that our result is not driven by weak instruments, we employ various estimation methods to correct for this, and show that our result, by and large, holds. Finally, we provide estimation result based on recursive bivariate probit model and Linear Probability Model(LPM) simultaneous equations model. The results remain robust and access to credit has a significant and positive effect on innovation.

The rest of the paper is organised as follows. Section 2.2 provides the conceptual framework, wherein the concept of innovation and technology adoption is detailed. The section also provides key determinants of innovation, with emphasis on the role of access to credit. Section 2.3 provides the description of data used and some descriptive statistics. Section 2.4 discusses the econometric methods used in the paper. Besides discussing the probit model and recursive bivariate probit model,

this section provides an in detail discussion of some of the estimation problems associated with simultaneous probit models, in particular the issue of coherency. Section 2.5 provides the analysis of the results. We provide the result of simple probit model, followed by result of instrumental variable probit model with and without correcting for possibly weak instruments. This section ends with the discussion of estimation result based on recursive bivariate probit model and LPM simultaneous equation. Section 2.6 concludes and provides some policy implications. The section also provides possible limitations of the study, suggesting future works to remedy them.

2.2 Innovation and Access to Credit: Conceptual Framework

2.2.1 The concept of Innovation

Although innovation is an old concept, there is some vagueness around its usage in the literature. Hence, it is useful to start with some conceptual ground clearing. A good starting point would be the distinction between invention, which refers to the creation of something new, and innovation, which relates to the introduction to the market of new good or services. Innovation and invention can coincide in certain circumstances. Often, however, there are lags between invention to innovation. Further, although invention can take place anywhere (such as research institutions, universities, business enterprises, etc.,) innovation is usually carried out by business enterprises (Fagerberg, 2004).

Innovation has different dimensions and is better understood by the various distinctions made. One such is along Schumpeterian line of distinction, where five different types of innovation are identified. These are, the introduction of new product, new ways of producing goods, new sources of supply of factors of production, exploration of new market sources, and introduction of new organisation structures.

The second distinction is made between radical and incremental innovation. The former relates to the introduction of totally new product or process, while the latter relates to a continuous improvement of existing products, processes, etc. A third distinction is based around the context of the innovation itself. We noted that one dimension of innovation is that it is the introduction of new product or process. This begs the question: new to whom? Should it be new to the world, a country, region or just to the firm?

In effect, there is some element of subjectivity in what constitutes innovation. The conventional view, particularly in the economics literature, is that innovation ought to be something radical and new to the world. Hence, it is usually understood in the context of large firms with large research and development (R&D) expenditures. Much of the theoretical and empirical studies, therefore, are devoted to understanding determinants of firm R&D investments. As any economic activity, it is guided, by and large, by incentives, and the ability of firms to appropriate the return is central. These studies shed important light on factors that underlie technological progress in highly industrialised nations.

Innovation and technological progress in developing countries, however, is largely determined by their ability to absorb the existing world stock of technological capital, mainly through adopting readily available technologies or by tweaking them to fit into their particular circumstance. Hence, incremental innovation is the dominant and important type of innovation to firms in most developing countries. In view of this, the conventional characterisation of innovation misses most of the innovative activities in developing countries. Such an omission can be serious in view of the importance of incremental innovation in setting the stage for radical innovation, as is evidenced by experience of the newly industrialised Asian economies, where firms first started as passive imitators, then progressed to incremental innovation, finally leapfrogging the original innovators. To the extent that key determinants of incremental innovation differ from that of radical innovation, the almost exclusive emphasis on the study of radical innovation leaves an information gap of policy

importance to many developing countries.

In this paper, therefore, we adopt the concept of innovation as outlined in an OECD document for innovation, also called the Oslo Manual 2005 (OECD, 2005). According to this document, innovation is "...the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations."(OECD, 2005, p.46). The manual distinguishes between four different kinds of innovations.[2] One is *product innovation*, which relates to the introduction of a new or substantially improved product. Second is *process innovation* which relates to the introduction to the firm of new or significantly improved method of production or delivery of existing or a new product. The third and the fourth types of innovations are *marketing* and *orgnisational innovations*, relating respectively to the introduction of new marketing practices and organsational methods to the firm. An important departure from the conventional characterisation of innovation is that innovation does not have to necessarily be novel to the world. It is sufficient that it be new to the firm.

2.2.2 Innovation and Access to Credit

Theory

In a world of perfect financial markets with no asymmetric information, transaction costs and taxes, capital structure is not important for firm investment (and innovation) (Modigliani and Miller, 1958). Known as the 'irrelevance theorem' in the finance literature, this implies that what matters for firm investment (including in innovation) and hence growth is its ability to spot promising projects. That is, a promising idea never dies due to a lack of finance. Subsequent research, however, questioned most of the crucial assumptions of the theory, both stated and implicit ones. First, different types of financing are subject to differing level of taxes, thus

[2]The boundaries between the different types of innovation is not always clear.

making capital structure important. For instance, in some countries internal financing is subject to higher tax than external equity financing which in turn is subject to higher tax than debt financing.

Second and importantly, financial transactions are mainly trade in promises, where a borrower obtains finance today on the promise that the lender will be paid back in the future. The lender, therefore, should be able to know that the borrower is able and willing to pay when the loan is due. Among other things, this require that the lender knows, as much as the borrower does, about the risk and return of the project and of the effort exerted by the borrower toward the realisation of the project. Hence, the distribution of information between the two market participants is central. However, information asymmetry, (i.e., the unequal distribution of information between the market participants) is the fact of life in financial markets. In particular, borrowers are generally more informed about the risk and return of their project than creditors.

Akerlof (1970), using a market for used cars, shows how information asymmetry can lead in the extreme to the collapse of a market. Unable to distinguish between better quality and 'lemons', a buyer of used cars is forced to offer an average price, which is inevitably lower than the reservation price of sellers of better quality cars, forcing these types of sellers to withdraw from the market. As a result, the market is populated by sellers of 'lemons', and buyers are therefore forced to once more reduce the price they offer. This again forces better quality car sellers out of the market. This vicious cycle can lead to the collapse of the market in the extremes.

Stiglitz and Weiss (1981) study the implications of asymmetric information in the credit market. In view of the fact that borrowers are generally more informed than lenders, creditors face similar problem as a car buyer above. Lenders therefore ask for an average interest rate, and this certainly is higher than the reservation interest rate of investors with low risk projects. As a result, these category of investors drop out of the market, worsening the pool of borrowers lenders face. In response, lenders revise their interest rates up once more. Besides further reducing the quality of the

pool of potential borrowers, this gives a perverse incentive to actual borrowers. In particular, it increases the financing cost and hence reduces the borrower's/owner's stake in the firm/project. Owners therefore exert less effort towards the success of the project. Stiglitz and Weiss (1981) show that in order to avoid these problems, lenders resort to rationing credit, a circumstance where firms are unable to borrow the amount they want at the prevailing interest rate and/or where firms can not borrow even if they are willing to pay above the prevailing interest rate. Therefore, credit rationing is an equilibrium outcome in credit markets owing to asymmetric information.

Stiglitz and Weiss (1981) analysis is not specifically about credit constraints faced by innovating firms, but by ordinary firms. If firms are credit constrained for ordinary investment such as expansion of existing plant and production, the problem would potentially be more serious for innovating firms. To fully appreciate this, it is important to look at the output of innovation– that it is a production of some thing that is less known. Hence, the outcome is much more uncertain even to the firm undertaking the project, and the uncertainty is likely to be worse for creditors. The information asymmetry between the innovating firm and creditors is compounded by the fact that the former has a strong incentive not to share the limited information about the project out of concern that the idea may be copied by other firms. This uncertainty makes potential creditors less interested in the project, or force them to ask for a high cost of capital.

The problem of moral hazard, arising from the fact that firms may use the fund for something else than is originally intended (e.g. for innovative activities with high risks) and that they may exert less effort toward the success of the project, worsens the uncertainty faced by creditors. This problem, however, can potentially be reduced through collateral (Bester, 1987). The problem is that lenders generally prefer assets that are tangible and easy to re-deploy, the opposite of the assets of innovating firms. Therefore, be it from the point of view of adverse selection or moral hazard, the credit market imperfections and hence credit constraints are worse for

innovating firms than for an average firm. The problem is all the more magnified for small firms, who anyways face substantial credit constraint owing to their general opaqueness.

Compounding the problem, innovating firms are also more likely to require external financing than an average firm. First, exploiting technological opportunities may require large investment, and firms, specially smaller ones, may not have the required resources to implement these technologies unless they have access to some form of external finance. Even if the firm has sufficient internal funding, in view of the fact that the outcome of the project is much more uncertain than an ordinary investment, investing one's resource in the project can be a quite risky undertaking. As a result, firms need some form of risk-sharing to engage in the project, one mechanism being through diversifying the source of financing of the project.

Empirical Studies

The theoretical studies on the implications of credit market imperfection inspired the empirical study of the effect of credit constraints on firm behavior. Fazzari et al. (1988) pioneered the debate in their study on the impact of access to credit on firm investment. They exploit the argument that if markets are frictionless, investment is determined solely by its expected profitability, and, therefore, a firm's financial variables will have no effect. Therefore, one approach to see whether credit constraints matter is to regress firm investment on the return to the project[3] and some measure of financial constraint. The problem, however, is that the measures of both the return to investment and credit constraint are not easy to obtain. Fazzari et al. (1988) argue that if one can categorize firms based on their level of financial constraint, information about the sensitivity of investment to cash flow can be used to infer something about the impact of credit constraint on investment. If a credit constraint is an important determinant of a firm's investment, the cash-flow sensitivity of investment is higher for a financially constrained firm than for unconstrained

[3]Return to project is often proxied by Tobin's Q.

one. On the assumption that credit constrained firms payout less or no dividend as compared to less constrained ones, they use a dividend payment to categorize firms as financially constrained or not. Running a separate regression for the two categories, they find cash-flow sensitivity of investment is higher for credit constrained firms, indicating the importance of financial constraints for firm investment. Studies for various countries reveal broadly similar results.[4]

A similar methodology has largely been followed to explore the impact of credit constraints on innovation, mainly on research and development (R&D). Most of the empirical studies find that financial constraints have a significant effect on firm investment in R&D.[5] Hall (1992) uses panel data of a sample of publicly traded US firms during 1973 to 1987 and finds that R&D is sensitive to firm liquidity, although not as much as ordinary investment. Bougheas et al. (2003) finds similar results for Irish firms. Similarly, but using a non-random sample of manufacturing firms from Germany, Harhoff (1998) finds that cash flow sensitivity is higher for ordinary investment than it is for R&D investment. He also reports that the cash-flow sensitivity, both for investment and R&D expenditures, is driven largely by smaller firms. On the other hand, using data for German firms, (Czarnitzki and Hottenrott, 2011) find higher cash-flow sensitivity for R&D investment than for capital investment.

Brown et al. (2009) uses a panel data of large US firms to study the impact of financial development on boom and bust of R&D investment over the period 1990 to 2004. They find that R&D investment by younger, and hence plausibly more credit constrained firms account for the larger share of the boom in aggregate research and development investment. They further find that R&D investment is sensitive both to internal cash flow and external equity issues for these firms while the effect is insignificant for older firms, suggesting access to finance plays a key role in innovation for younger firms. In a related study, Brown and Peterson (2009) provide the trend

[4] Hubbard (1998b) provides an excellent summary of the debate following the themes of this paper.

[5] Hall and Lerner (2010) provides a stock of the existing literature.

in cash flow sensitivity for both R&D expenditure and ordinary investment. They find a substantial decline in cash flow sensitivity of ordinary investment over the years, ascribing this to the decline in its share in the aggregate investment. On the other hand, cash flow sensitivity of R&D investment remained fairly constant. In view of the rise in this investment in aggregate capital expenditure during the period, one would have expected its cash flow sensitivity to have increased. They attributed this to the shift in the supply of external sources of finance during the period, driven by a boom in stock market investment. In general, the overwhelming proportion of studies investigating this theme confirm the importance of financial constraints for innovation.[6]

However, inferring the impact of a credit constraint from cash-flow sensitivity has been criticized on various grounds (Hubbard, 1998b; Kaplan and Zingales, 1997). As firms are *a priori* divided based on the degree of credit constraint, it is important that the classification reflects the inherent degree of asymmetric information associated with the firms. However, the classification may just capture the inherent degree of riskiness of these firms and not necessarily their degree of credit constraint. It may also be that the change in net-worth (cash flow) is related to investment opportunities, in which case cash flow sensitivity does not imply the impact of credit market imperfection but the role of the demand side factors. Further, it is possible that cash-flow sensitivity of investment is due to the non-value maximization behavior of the managers and not necessarily due to information friction.

These methodological problems render the results less persuasive. Much of the current research on the finance-innovation relationship tries to rectify these problems. The growing interest to understand the impact of credit market imperfections and the flaws of studies based on cash-flow sensitivity necessitated the need to directly capture the extent of credit constraints from firm level surveys (Claessens, 2006). Therefore, if available, one approach is to use a direct measure of

[6]Nevertheless, there are some studies (see, for instance, Blass and Yosha (2003)) that indicate lack of cash flow sensitivity among R&D intensive firms.

credit constraint and see its impact on innovation. Savignac (2008) follows this approach. Using data on French firms, the paper finds that the presence of a credit constraint has a significant and negative effect on firm innovation, with an impact effect of about 20 percentage points. The paper shows that firm size and technological opportunity have significant and positive effects on innovation.[7] In a similar study using data for Sri Lankan MSEs, de Mel et al. (2009) finds that firms that have bank loan are more likely to innovate than those without.[8] Gebreyesus (2009), using the same dataset as used in the current paper, shows some important determinant of innovation by MSEs in Ethiopia. [9] Similarly, Gorodnichenkoy and Schnitzerz (2009) uses a direct measure of access to credit to study its impact on innovation and R&D investment. They find that access to credit has a significant positive effect on innovation.

2.3 Data and Description

2.3.1 Data and Sampling Method

The paper utilizes the same dataset used in essay one. The data contains detailed information on about 1000 micro and small scale enterprises with employees of less than or equal to 10, selected from six major towns spread over the various regions of the country. As noted in essay one, a multi-stage sampling procedure was followed in selecting the sample of firms, where in the first stage, the sample size and number of towns to be covered was fixed. The second stage involved selecting towns based on three considerations, viz., their population density, their population of

[7]Further, Savignac (2008) and Hajivassiliou and Savignac (2008) discuss possible methodological issues arising in studies that use direct measures of innovation and access to credit. In particular, they show that simultanety is an important issue that needs to be addressed. We return to this in section 2.4 of the paper

[8]Nevertheless, endogeneity is likely to be an issue as the paper does not control for this.

[9]As noted in section 2.4, although Gebreyesus (2009) employs the same dataset as in this paper, our paper differs in that his emphasis is on the traditional determinants of firm innovation and the impact of innovation on firm growth while our main interest is in the role of access to credit on innovation.

microenterprises and in order to achieve a fair regional representation. Accordingly, Addis Ababa, Awassa, Bahirdar, Jimma, Mekele and Nazreth were selected. In the third stage, the total sample size is partitioned among the towns based on the number of microenterprises located there. A random sample of firms were selected from each sector in each town from a sample frame generated for each town. Data were collected on 974 firms, distributed over each town as follows: Addis Ababa (240), Jimma (147), Awassa (141), Bahirdar (145), Mekelle (150), Nazreth (151).

The data contains detailed information on various aspects of MSEs, including the background of the owner (s) (gender, education, entrepreneurial motivations, etc.,); firm attributes (e.g., age, location, whether it was started from scratch or inherited, whether it is formal or informal, etc.,); business environment (e.g., the legal and regulatory framework, taxation, availability and access to public services, infrastructure, etc.,). The questionnaire also contains information on key variables of interest to us, innovation and access to credit. In particular, firms are asked whether they have made an important improvements/changes to their products or services in the last fiscal year of the survey year. As such, the question essentially captures whether a firm has made a product innovation in the last fiscal year. The questionnaire also contains a detailed section on finance, our central explanatory variable, aimed to elicit information on access to formal as well as informal finance sources for investment, the availability and extent of supply credit, etc. Therefore, the data are rich enough to enable a study of the determinants of MSEs' innovation in Ethiopia and the role of credit constraint in this process.

2.3.2 Definition of Variables and Summary Statistics

A measure of innovation is constructed based on a question in the survey that asks a firm whether it 'made important improvement/change to its product/service in the last one year [i.e., in the fiscal year 2001/2002]'. Based on this, a dummy variable

is constructed that takes a value 1 if the firm responds yes and 0 otherwise.[10] A subsequent question asks firms the types of improvements they made. Most of them cite an improvement that can be regarded as incremental innovation per our definition, such improving the quality of existing products, starting to produce new products, introducing modern machinery, etc. A very small fraction of them report improvements that may be regarded as expansions, such as hiring additional or training existing workers, extending working hours, etc.

A comprehensive measure of our key explanatory variable, access to credit, is in general hard to come by. In this chapter, we use the same measure of access to credit discussed in essay one, i.e., 'credit_1'. To recap, the survey question asked firms whether they had ever received credit from banks or Microfinance Institutions (MFI). For firms that replied 'yes' to this question, a follow-up question was asked as to whether the loan secured was of the requested size, was disbursed on time, and was of the requested type of maturity. If the loan obtained by the firm fails in regard to any of these three criteria, the firm is treated as credit constrained and 'credit_1' takes a value of 0. For those that never received a loan from either of these institutions, there is again a follow-up question that asked whether they have ever applied for one. Those that have applied for a loan but did not get one were treated as if their loan application was rejected and hence 'credit_1' takes a value of 0. This leaves those firms that neither applied for a loan nor ever received one. For these, there is a further question that asked why they did not apply. Among the replies to this question is: 'because the firm did not need a loan', or 'because it had better source of financing'. This sub-group are treated as having no problem in their access to credit and the variable assumes a value of 1. The remaining respondents, those who said they did not apply for a loan because they thought they would not get it or because they did not have the collateral required or because the application process

[10]It is important to note in passing that although the question appears to be asking firms whether they have made a product innovation or not, the answer list in the questionnaire and hence the response of the firms has all the four types of innovation discussed in section 2.2.1 above. Hence, the innovation refers to overall innovation, and not just product innovation.

was deemed cumbersome, are treated as credit constrained and hence assigned a value of 0.

Table 2.1 provides a description of the variables included in the regression analysis alongside summary descriptive statistics. The measures constructed here are strongly motivated by the findings in the existing literature on innovation as reviewed in section 2.2. As can be seen, about 34% of the firms have engaged in product innovation.[11] Regarding our key explanatory variable on credit constraint, about 42% of the firms reported having access to credit.

In addition to our key variable, we control for various explanatory variables, designed to capture firm as well as owner(s) attributes believed to affect innovation. Among the attributes of the owner(s) are gender, education and a measure of entrepreneurial motivation. About 6% of the sample of firms are owned by more than one individual. Hence, the gender variable used in this paper ('Male') takes a value of 1 if the firm is exclusively male owned and zero otherwise. As can be seen, 74% of the firms are exclusively male owned. The variable, 'vocational', is a measure used to capture the owner's level of education. Since a firm can have more than one owner, this variable takes a value of 1 if one of the firm's owners had vocational level training before joining the business and 0 otherwise. About 13% of the firms have at least one of the owners with vocational level training.

A proxy for entrepreneurial motivation is also included among the explanatory variables. In particular, we utilize a question in the survey that asks why the owner (at least one of the owners in the case of multiple owners) is in this business. One manifestation of motivation is the perception of the person about his/her capability in achieving their objectives. If the respondent says s/he is in the business because s/he has the skill required to run the firm or because s/he was confident it would be profitable, then this variable takes a value of 1, and zero otherwise. Using this measure, 57% of the firms are owned by motivated entrepreneurs as defined in this way.

[11] But essentially overall innovation, in view of the issue noted in footnote 10.

Table 2.1: Description of Variables and Summary Statistics

Variable	Description	Mean
innovation	Dummy of 1 if the firm has introduced important improvement/change to its product/service in the year 2002, and 0 otherwise.	0.344
Credit_1	As is defined in the text	0.42
Started	Dummy of 1 if the firm is started from the scratch by its current owners, and 0 otherwise.	0.87
Vocational	Dummy of 1 if the owner of the firm has vocational training, and 0 otherwise.	0.13
Male	Dummy of 1 if a firm is exclusively male-owned and 0 otherwise.	0.74
Employment	Natural log of the initial employment.	1.25[0.47][a]
ln(age)	Natural log of the age of the firm.	1.78[0.91]
ln (age) squared	Square of natural log of age.	4.00[3.38]
Manufacturing	Dummy of 1 if the firm is categorized as manufacturing and 0 otherwise.	0.36
Trading	Dummy of 1 if the firm is categorized as trading activities and 0 otherwise.	0.26
$service$§ [b]	Dummy of 1 if the firm is categorized as rendering services and 0 otherwise	0.38
Addis Ababa	Dummy of 1 if the firm is located in Addis Ababa and 0 otherwise.	0.25
Southern Region	Dummy of 1 if the firm is located in Southern Nation Nationalities and People (SNNP) regional state and 0 otherwise.	0.141
Amhara Region	Dummy of 1 if the firm is located in Amhara regional state and 0 otherwise.	0.15
Oromia Region	Dummy of 1 if the firm is located in Oromia regional state and 0 otherwise.	0.31
$TigrayRegion$§	Dummy of 1 if the firm is located in Tigray regional state and 0 otherwise.	0.15
Produced by formal	Dummy of 1 of the goods the firm produce or services it render is also provided by large business enterprises.	0.84
Information from customer	Dummy of 1 if the firms' main source of information for business is customers and 0 otherwise.	0.58
License	Dummy variable of 1 if the firm has operating license and 0 otherwise.	0.75
Accounts payable	The proportion of a firm's outstanding debt that is overdue.	9.4[21.5]
Accounting	Dummy of 1 if the firm maintains accounting record and 0 otherwise.	0.44
Collateral	A dummy of 1 if the firm's machineries and equipments are modern to advanced and 0 otherwise.	0.21
Specific name	Dummy of 1 if the firm has specific name which is posted somewhere as an advert, and 0 otherwise.	0.54
Motivation	This variable is meant to capture the entrepreneurial motivation of the owner. It is constructed based on the response to the question why the person is in this business. The variable takes a value of 1 if the respondent says s/he is in because s/he has the skill required or because s/he thinks it will be profitable. And it takes a value of 0 otherwise.	0.57
Business association	Dummy of 1 if the firm is a member of business association and 0 otherwise.	0.08

Sample Size=974

[a] Value in square bracket is standard deviation and is reported only for continuous variables.

[b] § indicates that the variable is a base category in the estimation.

We also control for set of firm attributes. Age and size of the firms are other potential determinants of a firm's innovation. The variable 'ln(age)', which is the natural log the firm's age, captures the age of the firm, while 'ln(age) squared' is the square of 'ln(age)'. The variable 'employment' is the natural log the total number of both paid and unpaid individuals employed by the firm at the start of its activity[12] captures the size of the firm. With an average age of about nine years, most of the firms are relatively young. The firms are small in terms of employment, with an average of three individuals working in a firm at its start time. Indeed, 90% of them had actually five or less employees at the start of their operation. In terms of the location, about 30% are located in Oromia regional state, 25% in the capital city (Addis Ababa) and the remaining firms distributed over the other three regional states, (viz., Tigray, Amhara and Southern Nation Nationalities and People (SNNP)). The firms in the sample are classified into three broad activity sectors (viz., services, trading and manufacturing) depending on their main type of business. As can be seen from the table, the sample of firms appear evenly distributed across the manufacturing (36%), services (38%) and trading (26%) sectors.

The survey also asks firms about their main source of information for their overall business. The variable 'information from customer' takes a value of 1 if the firm's main source of information is customers and zero otherwise. As can be seen, about 58% of our firms cite customers as their main source of information. The variable 'produced by formal' captures competition between MSEs and large enterprises. It takes a value of 1 if the firm's product is produced/provided by large enterprises, and zero otherwise. As can be seen about 84% of the MSEs face competition from large formal enterprises.

Informality is potentially an important determinant of a firm's innovation as well as a credit constraint. The variable 'license' captures this status. It is constructed such that it takes a value of 1 if the firm has an operating license (i.e., the firm is classified as a formal sector firm) and 0 otherwise. As table 2.1 reveals, about 75%

[12] As noted in footnote 11 of essay one, this just a proxy and not an ideal measure of firm size.

of the firms report they have an operating license for their business, indicating the majority of sampled firms operate within a formal framework. We also use membership of a business association to capture the network and degree of information sharing among similar firms on their innovation. About 8% of firms are members of at least one formal business association.

Apart from covariates that feature in the innovation equation, three variables are also included to act as identifying instruments for access to credit. As discussed in chapter one, possessing an asset that can be posted as collateral is another potentially important determinants of a firm's access to external credit. We construct the variable 'collateral' to proxy for collateral, which takes a value of 1 if the firm's current state of machinery or equipment is modern to advanced and zero otherwise. About 20% of the firms own such machinery and equipments. Another important determinant of access to external credit is the firm's outstanding debt. We capture this by 'accounts payable', which is the percentage of a firm's total credit from supplier that is overdue. About 10% of an average firm's credit from supplies is an overdue. Whether a firm has specific name posted outside is also included as another determinant of access to credit. Accordingly, about 54% of the firms report that they have a name of their company posted somewhere.

2.4 Econometric Method

The main dependent variable in this application assumes either a value of one or zero depending on whether or not a firm has 'made important improvement/change to its product/service in the last year'. Assume the latent (or unobservable) propensity to innovate ($y_i^\star$) is expressed as a linear function of a set of explanatory variables as follows:

$$y_i^\star = \beta x_{1i}^{'} + \varepsilon_i \tag{2.1}$$

where $i = 1, ...n$, x_i is a column vector of realizations on k explanatory variables for firm i and β is a column vector of k unknown parameters. The values of the latent variable are measured on the real line and in this case reflect the underlying propensity of a firm to innovate. The error term, ε_i, is assumed normally distributed with a mean of zero and a constant variance $\sigma^2 = 1$. A threshold (assumed zero in this case) is used to delineate whether the firm has undertaken some form of innovation or not.

The probability can be linked to the latent variable as follows:

$$P[y^{\star} > 0] = P[y_i = 1] = \Phi(\beta x_{1i}^{'}) \tag{2.2}$$

Among these explanatory variables is our key variable, access to credit, which is also a binary. However, access to credit is likely to be endogenous with respect to the innovation equation for various reasons (Hajivassiliou and Savignac, 2008). First, both the firm's access to credit and its decision to engage in innovation may be determined by common firm-specific unobservables. For instance, the level of uncertainty about the outcome of the innovation activity may affect the firm's decision to undertake the innovation while at the same time affecting the willingness of external creditors to finance the project. Similarly, the time it takes for the project to start bearing fruit, which may again be firm specific, determines the decision of the firm to engage in the innovation activity while at the same time affecting the willingness of lenders to extend credit for the project. Secondly, the decision to engage in innovation and the financing constraint may be simultaneously determined (Gorodnichenkoy and Schnitzerz, 2009). Therefore, it is plausible that the latent variables of innovation and credit constraint are correlated. As is well known, under this scenario, a simple probit estimation of the innovation equation produces a biased and inconsistent estimate of the effect of a credit constraint on innovation.

The general approach of dealing with the problem of endogeneity is to use the instrumental variable (IV) method. As discussed in chapter one, the idea is to use

variables that are important determinants of credit constraint but do not influence the innovation equation to identify the causal effect of access to credit on innovation. We use three variables to instrument access to credit. One is 'collateral', a dummy variable designed to capture whether a firm has asset that can be used as a guarantee for a loan. Having such an asset, all things remaining the same, raises a firm's probability of being able to secure a loan. However, there is no reason why having collateral increases the propensity of a firm to innovate. Hence, we believe this variable *a priori* meets the two requirements of a valid instrument, i.e., relevance and the exclusion restriction. The second among the sets of instruments is 'specific name'. As defined in section 2.3.2, this variable is meant to capture the extent to which the firm is known to the wider public including potential lenders. So long as posting a specific name somewhere in the area increases the popularity and consumer awareness of the company, it may improve its access to credit. However, it is not clear why it raises the propensity of the firm to engage in innovation directly. The third variable in the set of potential identifying instruments is 'accounts payable'. In line with the debt-overhung theory, we expect that lenders are less likely to extend credit to already leveraged firms. Hence, all else the same, firms that have an outstanding debt are likely to be credit constrained. As for the issue of excludability, it is not clear how having an accounts payable affects the propensity to engage in innovation. Similarly, we use three variables to instrument for innovation. These are, 'information from customer', meant to capture a firm's main source of business information; 'started', whether the firm is started from scratch or not, and 'produced by formal', whether the firm's products are produced by large business enterprises at the same time.

Once we have determined the right set of identifying instruments, estimation can be done in two different ways. One approach is to estimate a single equation using the instrumental variable method. Although not prone to the problem of misspecification, this involves loss of information. A systems equation estimation on the other hand makes use of the possible correlation between the error terms

of the two variables, but requires careful specification as estimation is prone to specification bias.

As a single equation approach, we use instrumental variable probit (IV probit) model, as well as a simple IV using the Linear Probability Model. A system equation based estimate where both the variables are binary is not straight forward. Assuming the error terms follow a joint normal distribution, potentially we have the following simultaneous probit model to estimate:

$$y_i = \begin{cases} 1, & \text{if } y_i^{\star} \equiv \beta x_{1i}^{'} + \gamma F_i + \varepsilon_i > 0; \\ 0, & \text{otherwise.} \end{cases} \tag{2.3}$$

$$F_i = \begin{cases} 1, & \text{if } F_i^{\star} \equiv \varphi x_{2i}^{'} + \lambda y_i + \nu_i > 0; \\ 0, & \text{otherwise.} \end{cases} \tag{2.4}$$

where y_i and F are the dichotomous realizations of the latent dependent variable of innovation and access to credit, respectively.

Estimating these types of equations, however, poses a 'coherency problem' (Tamer, 2003). Gourieroux et al. (1980) categorises an econometric model as coherent if it predicts a unique value of the dependant variable for various values of the explanatory variables, parameters and the error terms. In effect, a coherent model will have a well-defined reduced form. It needs to be noted that this is distinct from identification, which deals with recovering structural parameters from the parameters of reduced form equation. As such, coherency is a pre-requisite for a model to have a well defined likelihood function and *ipso facto* a key issue to be settled before the question of identification is even taken up.

To have a clear idea of the coherency issue, revisit the simultaneous probit model given in equations 2.3 and 2.4, which, with a bit of modification, can be given by:

$$\begin{aligned} F_i^{\star} &= \varphi x_{2i}^{'} + \lambda y_i + \nu_i \\ y_i^{\star} &= \beta x_{1i}^{'} + \gamma F_i + \varepsilon_i \end{aligned}$$

As per our definition of innovation and access to credit in the text, we assume λ to be negative and γ to be positive. With this and using the notions of Dagenais (1997), define the following:

$$U_{1i} = -\varphi x_{2i}^{'}$$
$$L_{1i} = -\varphi x_{2i}^{'} - \lambda$$
$$U_{2i} = -\beta x_{1i}^{'} + \gamma$$
$$L_{2i} = -\beta x_{1i}^{'}$$

We know that the probability that both innovation and access to credit take a value of 1 is given by,

$$Pr(F = 1, y = 1|..), = \int_{L_{1i}}^{\infty} \int_{U_{2i}}^{\infty} \phi_{12}(.) d\varepsilon d\nu$$

, where ϕ_{12} is the bivariate normal distribution. From figure 2.1, this corresponds to the upper right of the diagram shaded in gray. Similarly, the probability that both innovation and access to credit take a value of 0 is given by,

$$Pr(F = 0, y = 0|..), = \int_{U_{1i}}^{-\infty} \int_{L_{2i}}^{-\infty} \phi_{12}(.) d\varepsilon d\nu$$

. This corresponds to the bottom left, shaded in a horizontal stripe, of the diagram given in figure 2.1. The probability that innovation takes a value of 1 while access to credit takes a value of 0 is given by,

$$Pr(F = 0, y = 1|..) = \int_{-\infty}^{L_{1i}} \int_{L_{2i}}^{\infty} \phi_{12}(.) d\varepsilon d\nu$$

, and this corresponds to the blue shaded area in the upper left of figure 2.1. Finally,

the probability that innovation takes a value of zero and and access to credit take values of one is given by,

$$Pr(F = 1, y = 0|..), = \int_{U_{1i}}^{\infty} \int_{-\infty}^{U_{2i}} \phi_{12}(.) d\varepsilon d\nu$$

, and is given by the area shaded in brown, located at the bottom right of the diagram.

One normally expects these four joint probabilities to sum to 1, i.e.,

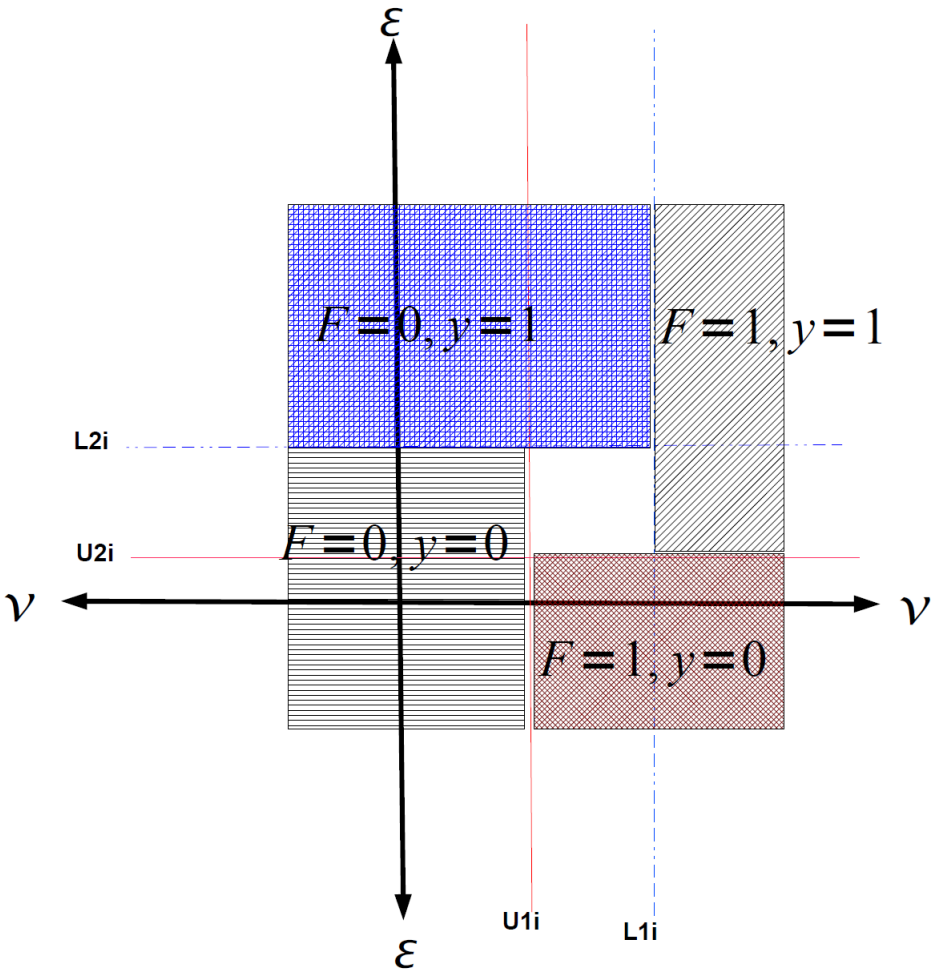
$$Pr(F = 1, y = 1|..)+Pr(F = 1, y = 0|..)+Pr(F = 0, y = 1|..)+Pr(F = 0, y = 0|..) = 1$$

. However, this is not the case in our case, as there are observations (i.e., those for which the values of ν and ε fall in the unshaded square in the middle of the diagram) where the model predicts neither 0 nor 1 for both F_t and y_t. In this particular case, the sum of the probabilities of the four events is less than 1. Hence, the model does not provide a unique value of the dependant variables for these observations and is, therefore, incoherent. Put it other, the model does not have a distribution function of the dependant variables given the observable variables and the parameters. As a result, the likelihood function is not well behaved as there are discontinuities due to those observations.

One common approach to deal with these types of problem is to put a zero product restriction on the parameters (i.e., $\gamma * \lambda = 0$) by either setting $\gamma = 0$, in which case one is assuming that innovation is exogenous, or $\lambda = 0$ in which case one is assuming that access to credit is exogenous. With this assumption, the above model becomes a recursive bivariate probit model and the parameters can be estimated by maximum likelihood method and the marginal effects easily computed. This approach has however been criticized on various grounds. First, it is *ad hoc* as it is not always possible to find intuitive justification for such assumptions. Second and importantly, by imposing either of these assumptions the model is devoid of its interesting aspect – simultaneity.

Figure 2.1: Coherency of Simultaneous Probit models

The diagram depicts the predictions of a simultaneous probit model where the two key variables are negatively related. The unshaded area corresponds to where the model fails to predict neither 0 nor 1 values for the dependent variable. Consequently, the shaded areas do not sum (as they should) to one, indicating that such models are incoherent.



Various approaches have been suggested to render the model coherent without imposing this stringent requirement. For instance, Dagenais (1997) and Tamer (2003) imposes a sign restriction on λ and γ and show how the parameters can be estimated using a quasi-maximum likelihood method. Similarly Hajivassiliou (2008) and (in a study more related to the current one) Hajivassiliou and Savignac (2008) use a sign restriction and show that parameters can be estimated by conditional maximum-likelihood method. In the particular case discussed in this essay, the coherency problem lies in the fact that there are observations for which the model

fails to predict unique values of the dependent variable, i.e., observations in the unshaded area of the above diagram. One option is to estimate the equation by excluding these observations, i.e., by using maximum likelihood and restricting the estimation to the four shaded areas in figure 2.1. However, as the sum of the probabilities is less than one, one needs to adjust the likelihood function such that the predicted probabilities sum to one. That is the gist of an approach proposed by Dagenais (1997). However, to our knowledge, there is no software that implements this procedure and our attempt to implement it in Stata proved unsuccessful due to non-convergence of the likelihood function. Therefore, we estimate a simultaneous equation model using a three stage least square method and situate the analysis within a linear probability model (LPM) framework. We also employ a recursive bivariate probit model, by imposing the 'zero-product' restriction on the coefficients.

The likelihood equation for recursive bivariate probit model has four cells, given as follows:

$$\begin{aligned} P_1 = P(y_i = 1, F_i = 1) &= \Phi_{2i}(\beta x_{1i} + \gamma; \varphi x_{2i}, \rho) \\ P_2 = P(y_i = 1, F_i = 0) &= \Phi_{2i}(\beta x_{1i}; -\varphi x_{2i}, -\rho) \\ P_3 = P(y_i = 0, F_i = 1) &= \Phi_{2i}(-\beta x_{1i} - \gamma; \varphi x_{2i}, -\rho) \\ P_4 = P(y_i = 0, F_i = 0) &= \Phi_{2i}(-\beta x_{1i}; -\varphi x_{2i}, \rho) \end{aligned}$$

$\Phi_{2i}()$ is the bivariate normal distribution of the two error terms and ρ is the correlation between them.

The log-likelihood equation then is given by:

$$l(\beta, \gamma, \varphi, \rho) = \sum_{i=1}^{n} \{z_{11} \ln P_1 + z_{10} \ln P_2 + z_{01} \ln P_3 + z_{00} \ln P_4\} \tag{2.5}$$

where $z_{11} = (y_{1i})(F_{1i})$, $z_{10} = (y_{1i})(1 - F_{1i})$, $z_{01} = (1 - y_{1i})(F_{1i})$, and $z_{00} = (1 - y_{1i})(1 - F_{1i})$.

Maximizing equation 2.5 using appropriate simulation method gives the estima-

ted parameters of the model. Various marginal and impact effects can be computed for these types of models (Greene, 1996). Our main interest is in the marginal effect based on the partial probability, i.e., the effect of a variable on the probability of innovation. The computation of this type of marginal effect depends on whether the variable enters both the innovation and access to finance equation or not. For variables that are in both equations, the total marginal effect is composed of the direct effect of the variable on innovation and the indirect effect through its effect on access to credit.[13]

Consider a continuous variable that enters both equations. Our main interest is the effect of a variable on the conditional mean of innovation, the latter being given as follows:

$$E(y_i|F_iX) = Prob(F_i = 1) * E(y_i|F_i = 1, X) + Prob(F_i = 0) * E(y_i|F_i = 0, X)$$

$$Prob(y_i = 1, F_i = 1)+Prob(y_i = 1, F_i = 0) = \Phi_{2i}(\beta x_{1i}+\gamma; \varphi x_{2i}, \rho)+\Phi_{2i}(\beta x_{1i}; -\varphi x_{2i}, -\rho)$$

The marginal effect of this variable, say z, is given by the following equation.[14]

$$\begin{aligned}\frac{dE(y_i|F_i, X)}{dz} = &\left[\phi(\beta x_{1i} + \gamma)\Phi\left(\frac{\varphi x_{2i} - \rho(\beta x_{1i} + \gamma)}{\sqrt{1-\rho^2}}\right) + \phi(\beta x_{1i})\Phi\left(\frac{\rho(\beta x_{1i}) - \varphi x_{2i}}{\sqrt{1-\rho^2}}\right)\right] * \beta_1 \\ &+ \left[\phi(\varphi x_{2i})\Phi\left(\frac{\beta x_{1i} + \gamma - \rho(\varphi x_{2i})}{\sqrt{1-\rho^2}}\right) - \phi(-\varphi x_{2i})\Phi\left(\frac{\beta x_{1i} - \rho(\varphi x_{2i})}{\sqrt{1-\rho^2}}\right)\right] * \varphi_z\end{aligned} \quad (2.6)$$

The first line of equation 2.6 gives the direct effect of z on innovation. The second line of the equation, on the other hand, provides the indirect effect of z on innovation through its effect on access to credit.

For a discrete variable, D, that enters both the innovation and access to finance

[13] We are interested in the overall effect and hence do not report the components of the effects.
[14] See Dong et al. (2008) for the detailed derivation.

equations, the impact effect is given by the following equation:

$$\frac{dE(y_i|F_i,X)}{dD} = [\Phi_{2i}(\beta x_{1i}+\gamma;\varphi x_{2i},\rho)+\Phi_{2i}(\beta x_{1i};-\varphi x_{2i},-\rho)]\Big|_{D=1} - [\Phi_{2i}(\beta x_{1i}+\gamma;\varphi x_{2i},\rho)+\Phi_{2i}(\beta x_{1i};-\varphi x_{2i},-\rho)]\Big|_{D=0} \tag{2.7}$$

Finally, the impact effect of access to credit on innovation can be computed as follows:

$$\frac{dE(y_i|F_i,X)}{dF_i} = \frac{\Phi_{2i}(\beta x_{1i}+\gamma;\varphi x_{2i},\rho)}{\Phi(\varphi x_{2i})} - \frac{\Phi_{2i}(\beta x_{1i};-\varphi x_{2i},-\rho)}{\Phi(-\varphi x_{2i})} \tag{2.8}$$

For all the marginal and impact effects, the standard error can easily be computed using the delta method.

2.5 Result and Discussion

2.5.1 Baseline results

Table 2.2 provides the result of a simple probit estimation for the innovation equation. The second column of the table gives the probit estimate while the third column provides the estimates of the marginal/impact effects. As can be seen, access to credit does not have a significant effect on innovation.[15] However, as discussed in section 2.4, access to credit is possibly endogenous in this regression. And ordinary least square(OLS)/probit estimate with endogenous explanatory variable is biased and inconsistent. Hence, this result should be taken with a grain of salt.[16]

Most of the other control variables are, however, estimated with the expected sign and are in line with the findings in other studies. For instance, firms that

[15]The presence of heteroscesdasticity poses problems for the consistency and efficiency of the probit estimates. Therefore, we use the robust standard errors to address the efficiency problem, though acknowledging that this does little to address this issue of potential inconsistency. However, we take some comfort in the fact that the rejection of homoscedasticity in this case is not decisive.

[16]Gorodnichenkoy and Schnitzerz (2009), in a similar study using cross-country firm level data, finds that access to credit does not have significant effect on innovation without controlling for the endogeneity of the regressor.

are exclusively male owned are about ten percentage points more likely to innovate than those that are either exclusively female owned or are jointly owned by male and female owners. Gebreyesus (2009) reports similar results using the same data used in this paper. The intuition for this result is not immediately apparent. One explanation, however, could be risk-aversion. Various studies document that females are generally more risk averse than male (Borghans et al., 2009; Bluffstone and Yesuf, 2007). And risk taking is a key in determining the propensity to engage in innovative activities. Since we did not control for a measure of risk aversion, the positive effect for male ownership potentially captures this particular effect.

Similarly, firms that are started from scratch are about fourteen percentage points more likely to innovate than those that are inherited. In a study of MSEs in Sri Lanka, de Mel et al. (2009) find that owner's attributes play more important role than other factors for innovation by such firms. They find that firms owned by able entrepreneurs are more likely to engage in innovation than those owned by less able ones, and that once entrepreneurial ability is controlled for the estimated effect for many of the other explanatory variables become insignificant. In view of the importance of an owner's attribute, the fact that firms started from scratch have a higher propensity to innovate than those that are inherited is perhaps an indication of a limited intergenerational transfer of entrepreneurial skill among owners of MSEs in Ethiopia. This corroborates the casual observation that, even for the medium sized enterprises, firms often die with their founders. In a way, this maybe positive in that it indicates some sort of entrepreneurial dynamics is in operation and that wealth maybe less intergenerationally persistent. A measure meant to capture entrepreneurial motivation, 'motivation', however, is not significant. However, this is just a crude measure of motivation and as such would suffer from the problem of measurement error, with the usual consequence of attenuation bias in the estimate.

In line with human capital theory, firms whose owners have vocational training are about 18 percentage points more likely to innovate than those whose owners do not have such training. Perhaps as a further indication of the importance of human

Table 2.2: Estimates of Simple Probit Model of Innovation

The table provides estimates of simple probit regression of the dummy of innovation on access to credit and host of other explanatory variables. The dependent variable is dummy taking a value of one if a firm undertook some form of innovation and zero otherwise.

	Probit estimate	Marginal Effect
Cedit_1	0.0551	0.0197
	(0.59)	(0.59)
Motivation	0.0736	0.0262
	(0.78)	(0.79)
Started	0.419***	0.137***
	(2.98)	(3.32)
Male	0.269**	0.0928***
	(2.49)	(2.59)
Mixed ownership	0.0123	0.00441
	(0.04)	(0.04)
Business association	0.149	0.0545
	(0.92)	(0.90)
Vocational	0.468***	0.177***
	(3.64)	(3.52)
License	0.207*	0.0718*
	(1.75)	(1.80)
Employment	0.224**	0.0798**
	(2.22)	(2.22)
ln(age)	0.436**	0.156**
	(2.40)	(2.41)
ln(age) squared	-0.0766*	-0.0273*
	(-1.65)	(-1.65)
Manufacturing	-0.178*	-0.0629*
	(-1.65)	(-1.68)
Trading	0.107	0.0385
	(0.96)	(0.95)
Addis Ababa	-0.296**	-0.102**
	(-2.04)	(-2.14)
Southern Region	0.619***	0.236***
	(3.88)	(3.79)
Amhara Region	-0.964***	-0.274***
	(-4.92)	(-7.06)
Oromia Region	0.171	0.0620
	(1.25)	(1.23)
Produced by formal	-0.394***	-0.147***
	(-3.02)	(-2.94)
Information from customer	0.319***	0.112***
	(3.38)	(3.45)
N	974	974
$Pseudo - R2$	0.127	
Normality	$\chi^2_{(2)}$=4.288[0.117][a]	
Functional form	$\chi^2_{(3)}$=4.469 [0.215][b]	
Homoscedasticity	$\chi^2_{(19)}$=31.03[0.04][c]	

Marginal effects; t statistics in parentheses

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[b] p-value under the null of normality.

[a] p-value under the null of proper functional form.

[c] p-value under the null of homoscedasticity.

capital, the experience of a firm, captured by its age, has a positive and significant effect on innovation. However, the negative coefficient of the quadratic term reveals that the positive effect of age diminishes as the firm grows older. The estimate of the turning point for the age variable reveals that the propensity to innovate starts to decline at 15 years of age.

The size of the firm is another important determinants of innovation as a small increase in size increases its probability of engaging in innovation by about eight percentage points. The sector of the firm is also an important determinant of innovation. Firms in the manufacturing sector are about seven percentage points less likely to innovate than those in the service sector. Since we are dealing mainly with product innovation, this finding may not be a surprise as starting to produce a new product is much harder than starting, for instance, to trade a new or significantly improved product. Producing a new product may require fixed investment in machineries and equipment, increasing the need for some form of external financing. On the other hand, product innovation in the service sector, which, for the types of firms in our sample, is mainly starting to sell a product or services a firm has not been selling before, may not always require such investment. For instance, new product could be sold on the same shelf as the old ones. It may be that the firm replaces retailing old by new product, which means the firm probably may not need extra capital to do so.

Location of the firm is found to be an important variable. Firms located in Tigray regional state are more likely to engage in innovation than those located in Amhara and Addis Ababa regional states. Nevertheless, there is no significant difference between firms located in Oromia regional state and those located in Tigray in their propensity to innovate. Location may capture various factors that are important to firm innovation, such as demand for the product, better infrastructure and better access to technological opportunities. In view of the fact that we have not controlled for these variable, the regional differences could be a reflection of this. It could possibly be due to differing level of demand, which, again, we could not capture

given lack of data.

Whether the product is produced/provided by large enterprises has an important effect on SMEs innovation. Firms whose goods/services are produced/renderred by large formal enterprises are about 15 percentage points less likely to innovate than those who do not have to compete with large firms. It may be that MSEs that operate alongside large firms believe that they do not have long-term competitive advantage relative to the large established ones. Hence they may be wary of committing resource to an activity that they are probably into it for the short-term. Or, it could also be that they are informally operating alongside these large firms and engaging in innovation may raise the probability of them being noticed by regulatory institution. However, since we have controlled for license that may not be the factor in the current case. In fact as can be seen, having an operating license does appear to be important determinant of innovation by a firm in our sample at 10%. Similarly, membership of a business association does not appear to be an important determinant of firm innovation.

Information plays a key role in facilitating innovation. Among others, a firm may need information about the future market of the product, or relating to the existence and possibility of producing such a product. Such information can be acquired from various sources. For instance, producers may learn from their customers about the adjustment needed to the existing product, or existence of new product that has a potential market. They may also learn about this from their suppliers. We try to capture these using a firm's identified source of information. As can be seen, firms that cite customers as their main sources of information are about ten percentage points more likely to innovate than those who cite some other source. Hence, innovation by firms in our sample appears demand driven, partly at least.

2.5.2 Instrumental Variable Estimation Results

As noted above, in view of the possible endogeneity of access to credit the probit estimate of its effect reported above is unlikely to be reliable. We now discuss a

number of estimates obtained using instrumental variable methods. As discussed in section 2.4, three variables are used to instrument for access to credit. Table 2.4 gives diagnostic tests of the three instruments (and another three variables used to instrument innovation, as we need this when we report the result of simultaneous equation model in the last part of this section).

The second column of the table gives IV test for access to credit while the third one gives results of instruments for innovation. As can be seen from the table, the resultant F-test for access to credit, although slightly lower, is close to the required 'rule-of-thumb' value of 10 as suggested by Stock and Yogo (2005). Similarly, the Kleibergen-Paap transformed F-test rejects the null of weak instruments at 10% using the critical values reported in Stock and Yogo (2005). Although not decisively, the null of weak instrument can be rejected. In addition, the three variables are also found to be orthogonal to the error process of innovation on the basis of the Hansen J statistic for over-identifying restrictions. The under-identification is also rejected using the Kleibergen-Paap under-identifications LM test. Thus, the instrument set is again deemed valid for the purpose of the current exercise. Nevertheless, one should be cautious of the possible weakness of the instruments as can be noted from the relevance test reported above. Given these findings, we can now test for whether the 'credit_1' variable is exogenous or not. In using the linear probability model, the 'C' test rejects the null hypothesis of exogeneity at 10 percent and this is also confirmed by the use of the IV probit model. Thus, including access to credit in the innovation equation without controlling for endogeneity is problematic.

Although the test results are again marginal, instruments of innovation too are relevant as well as exogenous. As can be seen, innovation is itself not endogenous, which means that it can be included in the regression of access to credit without concern of it being correlated with the error term.

Table 2.3 provides estimates of single equation instrumental variable method. Column 2 of the table gives the IV probit estimate while column 3 gives the corresponding marginal effect. Column 4 gives instrumental variable estimate based

on a linear probability model. Looking at the marginal/impact effect, access to credit is significant determinant of innovation. Furthermore, the magnitude is much larger than that obtained using the simple probit estimation. A firm with access to credit is about 34 percentage points more likely to innovate than one without, on average and ceteris paribus. In a similar study, Gorodnichenkoy and Schnitzerz (2009) reports a marginal effect of 18 percentage points for product innovation and 24 percentage points for process innovation. Savignac (2008) reports a marginal effect of 20 percentage points.

Interestingly, the IV probit as well as LPM based IV estimates of other control variables is generally similar to the probit estimates. The coefficient of access to credit, however, increased substantially using the IV method, indicating that a simple probit estimate heavily underestimates the impact of access to credit on innovation. This result could possibly be due to a combination of various factors. As noted in chapter one, one of the main weakness of the measure of access to credit used in the paper is that it is based mainly on a demand side conceptualisation, while a better measure would combine both demand and supply side factors. As such, measurement error is a potential issue, and we know that simple probit estimate with measurement error results in attenuation bias. It could also be due to omitted variables that are correlated with access to credit. For instance, a variable that has a negative effect on innovation but with positive correlation with access to credit may be excluded from the regression. Similar effect would result if a variable that has a positive effect on innovation but with negative covariance with access to credit is excluded from the regression equation. The consequence of this would be to underestimate the effect of access to credit just like the measurement error. [17]

[17]However, it is hard to ascribe the result to simultaneity bias. Recall a simple simultaneous equation bias given by:

$$plim(\hat{\beta}) = \beta + \frac{1}{1-\beta}\left(\frac{\sigma^2}{\sigma^2_{credit}}\right) \tag{2.9}$$

where $\hat{\beta}$ is the OLS estimate of the impact of access to credit, β is the true population parameter, σ^2 is the error term of the innovation equation and σ^2_{credit} is the error term of the access to credit equation. For OLS estimate to underestimate the true effect of the coefficient, one would expect the $\beta > 0$. However, in our case that is less plausible.

Table 2.3: Estimate of Single Equation IV Method for Innovation

The table provide estimates of instrumental variable probit model of innovation on host of explanatory variables. Access to credit is instrumented by three variables, a measure of whether the firm has asset to be posted as a collateral, a proportion of a firm's debt that is overdue, and a measure of the extent to which a firm is known to the public. The dependent variable is a dummy taking a value of one if a firm undertook some form of innovation, and zero otherwise.

	Probit Estimate	Marginal Effect	LPM
Credit_1	0.947**	0.343**	0.320*
	(1.95)	(1.97)	(1.62)
Motivation	-0.0167	-0.00608	-0.00494
	(-0.16)	(-0.16)	(-0.14)
Started	0.444***	0.148***	0.135***
	(3.37)	(3.80)	(3.30)
Male	0.322***	0.113***	0.112***
	(3.10)	(3.18)	(2.81)
Mixed ownership	0.0342	0.0125	0.0185
	(0.13)	(0.13)	(0.19)
Business association	-0.0348	-0.0126	-0.00188
	(-0.18)	(-0.18)	(-0.03)
Vocational	0.486***	0.186***	0.179***
	(3.87)	(3.80)	(3.64)
License	0.00328	0.00119	-0.00606
	(0.02)	(0.02)	(-0.11)
Employment	0.168	0.0613*	0.0589*
	(1.58)	(1.61)	(1.64)
ln(age)	0.514***	0.187***	0.165***
	(2.92)	(2.90)	(2.76)
ln(age) squared	-0.0949**	-0.0346**	-0.0306*
	(-2.08)	(-2.07)	(-1.95)
Manufacturing	-0.193*	-0.0695*	-0.0619*
	(-1.88)	(-1.91)	(-1.73)
Trading	0.0532	0.0195	0.0228
	(0.48)	(0.48)	(0.58)
Addis Ababa	-0.110	-0.0394	-0.0444
	(-0.59)	(-0.60)	(-0.70)
Southern Region	0.661***	0.254***	0.254***
	(4.32)	(4.28)	(3.99)
Amhara Region	-0.615**	-0.198***	-0.170**
	(-2.05)	(-2.59)	(-2.22)
Oromia Region	0.194	0.0717	0.0698
	(1.50)	(1.48)	(1.37)
Produced by formal	-0.330**	-0.125**	-0.113**
	(-2.42)	(-2.40)	(-2.55)
Information from customer	0.316***	0.113***	0.113***
	(3.43)	(3.53)	(3.50)
N	974	974	974
$Pseudo - R2$	0.129		
Normality	$\chi^2_{(2)}$=4.566[0.102]^a		
Functional form	$\chi^2_{(3)}$=4.579[0.205]^b		
Homoscedasticity	$\chi^2_{(19)}$=32.893[0.025]^c		
$WaldChi2[P > Chi2]$	167.11[0.00]		
$F - val[P > F - val]$			10.3[0.00]

Marginal effects; t statistics in parentheses

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2.4: Testing the Exogeneity of the access to Credit and Innovation

	Credit_1	innovation
Instrument Relevance	F(3,955) = 8.5 Prob-value=0.000	F(3,955) = 9.86 Prob-value=0.000
Kleibergen-Paap transformed F statistic	9.3[a]	9.86[b]
Hansen J Statistic for Over-identifying Restrictions	χ^2_2=2.33 Prob-value=0.312	χ^2_1= 2.24 Prob-value=0.33
Kleibergen-Paap LM Statistic for Under-identifying Restrictions	χ^2_3=26.18 Prob-value=0.0000	χ^2= 29.64 Prob-value=0.0000
'C' test for exogeneity	χ^2_1=2.61 Prob-value=0.10	χ^2_1=1.04 Prob-value=0.30
IV Probit Exogeneity Test	χ^2_1 =2.64 Prob-value=0.10	χ^2_1 = .95 Prob-value=0.33

[a]The critical value for the 10% maximal IV relative bias is 9.08 using the Stock and Yogo (2005) critical values.

[b]The critical value for the 10% maximal IV relative bias is 9.08 using the Stock and Yogo (2005) critical values.

As noted above, our instrument may be weak in view of the fact that the first-stage F-test falls short of the conventionally used rule of thumb. However, weak instruments pose two key challenges, finite sample bias of the estimate and difficulty of applying conventional hypothesis test (Stock et al., 2002). The two stage least square (2SLS) estimate, although consistent, can be biased in finite sample like ours. Hahn and Hausman (2002) provides approximation of 2SLS bias, given as follows:

$$BIAS_{2SLS} = \frac{K\sigma_{ev}}{n.\pi_2^{'}R\pi_2 + K.\sigma_v} \tag{2.10}$$

where, K is the number of instruments,e is the error term of structural equation, v is the error term of the first-stage equation, π is the coefficient of the the first-stage equation, n is sample size, R is the square root of the R^2 obtained from the first-stage regression, σ_{ev} is the correlation between the error-terms of the endogenous variable and the dependant variable, and σ_v is the standard deviation of the error term of the endogenous regressor.

Therefore, among others, the bias increases with the correlation between the error terms of the endogenous regressor and the regressand and with the number of instruments. In particular, it decreases with the size of association between the instrument and the endogenous regressor (i.e., with instrument strength, as well as with the sample size). Hence, with weak instruments, 2SLS estimates are biased in the direction of OLS estimate. Not surprisingly, in the extreme case where the instruments are irrelevant, estimates of 2SLS is centered on the biased

and inconsistent OLS estimate. Various options have been suggested to correct the 2SLS estimates for bias (Angrist and Pischke, 2009). Among these are the bias-adjusted 2SLS by Donald and Newey (2001), the Jackknife IV method suggested by Angrist et al. (1999) and the Limited Information Maximum Likelihood estimation (LIML). A comparison between the various correction methods based on Monte-Carlo simulation result shows that LIML performs as well with other estimates (Flores-Lagunes, 2007). In fact, LIML is median unbiased for the case of an over-identified equation. A further benefit of LIML is that most statistical software packages implement it. In this paper, we report bias correction based on LIML, Jackknife IV method and estimates using Generalised Method of Moments (GMM).

The second problem associated with weak instrument is that it distorts conventional hypothesis test. Hypothesis test is based on the normal approximation of the 2SLS estimator. For such approximation to be reasonable, among others, the instruments need to be strong. With weak instruments, the 2SLS estimators are non-normally distributed. In the extreme case where the instruments are irrelevant, 2SLS estimates are actually bi-modally distributed. As a result, the standard test statistics have distorted size. This is further worsened by the fact that the standard errors of 2SLS is downward biased with weak instruments. Hence one can not rely on conventional test statistics for hypothesis test. Various tests have been proposed that are robust to weak instrument (see Stock et al. (2002)) for discussion). We use a conditional likelihood test to correct for possible size distortion of weak instruments as is suggested in Moreira (2003).

Table 2.5 provides estimates corrected for both potential problems associated with a weak instrument. Column two of the table gives estimates with tests robust to weak instruments. As can be seen, access to credit retains a positive and significant effect on innovation, and the size of the coefficient is not substantially different from the impact effect of the instrumental variable probit estimate.[18] Results reported

[18]Not surprisingly in view of the fact that the estimate is based on LPM, the coefficient of access to credit is the same as that of LPM reported in column 4 of table 1.3.

in column 2 through 4 are meant to provide bias corrected estimates of the effect of access to credit on innovation. Apart from the Jackknife IV estimate where the coefficient of access to credit reduced in magnitude and become insignificant, estimates based on both LIML and the GMM IV produce results that are broadly the same as the IV estimates without adjustment for small sample bias. This is reassuring given that our instruments are probably not so weak as to distort the key findings reported here. Further, the estimates of the other control variables are roughly similar to ones reported in table 1.3.

We wrap-up this section by presenting the results of systems instrumental estimation methods. Table 2.6 provides this. We use the same three variables, 'collateral', 'specific name' and 'accounts payable' to identify access to credit. The second and third columns of the table gives the recursive bivariate probit estimates and the marginal effects, respectively. We concentrate on the estimates of the marginal and impact effects, as they lend themselves to a meaningful interpretation. As can be seen, access to credit enters with a positive and statistically significant coefficient, indicating the importance of access to credit for SMEs innovation in the country. Reassuringly, the size of the coefficient is fairly similar to estimates obtained from single equation instrumental variable method. Specifically, the estimate indicates that firms with access to credit are about 30 percentage points more likely to innovate than firms without, clearly a large economic effect. The correlation coefficient between the error terms of access to credit and innovation, ρ, is negative and statistically significantly different from zero. The size of the correlation indicates a fairly strong association between the two error terms. In particular, the sign of the correlation indicates that unobservables that increases the propensity of innovation by a firm reduces its access to credit, in line with our discussion in section 2.4. The estimates of the coefficients of the other covariates is similar to the ones based on single-equation IV method.

The last column of the table provides estimates of linear probability simultaneous

Table 2.5: IV Estimate of Innovation model Corrected for Weak Instruments

The table provides estimates of instrumental variable probit model of innovation by correcting for the potential weakness of the instruments. Access to credit is instrumented by three variables, a measure of whether the firm has asset to be posted as a collateral, a proportion of a firm's debt that is overdue, and a measure of the extent to which a firm is known to the public. The dependent variable is dummy taking a value of one if a firm undertook some form of innovation and zero otherwise

	IV-Cond	IV-Jackknife	IV-GMM	IV-LIML
Credit_1	0.320*	0.297	0.318*	0.347*
	(1.70)	(1.47)	(1.61)	(1.60)
Motivation	-0.00494	-0.00242	-0.00334	-0.00734
	(-0.14)	(-0.07)	(-0.10)	(-0.20)
Started	0.135***	0.132***	0.136***	0.137***
	(2.84)	(3.07)	(3.33)	(3.30)
Male	0.112***	0.109***	0.113***	0.114***
	(2.78)	(2.70)	(2.83)	(2.79)
Mixed ownership	0.0185	0.0223	0.0112	0.0193
	(0.19)	(0.22)	(0.12)	(0.20)
Business association	-0.00188	0.00626	0.00157	-0.00694
	(-0.03)	(0.09)	(0.02)	(-0.09)
Vocational	0.179***	0.178***	0.180***	0.181***
	(3.83)	(3.51)	(3.67)	(3.63)
License	-0.00606	-0.000124	-0.00650	-0.0115
	(-0.11)	(-0.00)	(-0.12)	(-0.20)
Employment	0.0589*	0.0605*	0.0594*	0.0578*
	(1.65)	(1.64)	(1.66)	(1.60)
ln(age)	0.165***	0.159***	0.166***	0.168***
	(2.67)	(2.68)	(2.79)	(2.74)
ln(age) squared	-0.0306*	-0.0294*	-0.0310**	-0.0314*
	(-1.93)	(-1.88)	(-1.97)	(-1.95)
Manufacturing	-0.0619*	-0.0610*	-0.0570*	-0.0628*
	(-1.68)	(-1.63)	(-1.60)	(-1.73)
Trading	0.0228	0.0246	0.0245	0.0215
	(0.57)	(0.61)	(0.62)	(0.54)
Addis Ababa	-0.0444	-0.0500	-0.0455	-0.0397
	(-0.73)	(-0.78)	(-0.72)	(-0.60)
Southern Region	0.254***	0.250***	0.251***	0.257***
	(4.21)	(3.84)	(3.95)	(3.97)
Amhara Region	-0.170**	-0.179**	-0.171**	-0.163**
	(-2.17)	(-2.34)	(-2.24)	(-2.01)
Oromia Region	0.0698	0.0684	0.0658	0.0708
	(1.42)	(1.32)	(1.29)	(1.38)
Produced by formal	-0.113**	-0.115**	-0.113**	-0.112**
	(-2.44)	(-2.54)	(-2.55)	(-2.51)
Information from customer	0.113***	0.112***	0.112***	0.113***
	(3.50)	(3.33)	(3.47)	(3.48)
N	974	974	974	974
R-Square	0.0596	0.0252	0.0609	0.0438
$F-val[Prob > F]$	7.93[0.00]	10.37[0.00]	10.26[0.00]	10.09[0.00]

Marginal effects; t statistics in parentheses

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2.6: Estimates Recursive Bivariate Probit and Linear Probability (LP) Simultaneous Equations for Innovation

The table provides estimates of a recursive Bivariate probit model (by assuming innovation is exogenous in the access to credit equation) and a simultaneous LP model. The dependent variable is dummy taking a value of one if a firm undertook some form of innovation and zero otherwise

	Bivariate Probit(BP)	Marginal effect	Simultaneous LPM Model
credit_1	0.846**	0.307**	0.321*
	(2.480)	(2.480)	(1.730)
Motivation	-0.002	-0.001	-0.005
	(-0.020)	(-0.020)	(-0.130)
Started	0.387***	0.130***	0.129***
	(2.800)	(3.120)	(2.760)
Male	0.321***	0.112***	0.112***
	(3.010)	(3.130)	(2.820)
Mixed ownership	0.024	0.009	0.017
	(0.090)	(0.090)	(0.180)
Business association	-0.015	-0.006	-0.002
	(-0.090)	(-0.090)	(-0.040)
Vocational	0.495***	0.189***	0.180***
	(4.010)	(3.910)	(3.890)
License	0.039	0.014	-0.004
	(0.280)	(0.280)	(-0.070)
Employment	0.175*	0.064*	0.059*
	(1.720)	(1.740)	(1.670)
ln(age)	0.512***	0.185***	0.165***
	(2.980)	(2.970)	(2.700)
ln(age) squared	-0.095**	-0.035**	-0.031**
	(-2.140)	(-2.140)	(-1.960)
Manufacturing	-0.194	-0.069	-0.062
	(-1.860)*	(-1.890)*	(-1.710)*
Trading	0.059	0.022	0.023
	(0.530)	(0.530)	(0.570)
Addis Ababa	-0.127	-0.045	-0.043
	(-0.780)	(-0.800)	(-0.720)
Southern Region	0.666***	0.256***	0.255***
	(4.310)	(4.260)	(4.280)
Amhara Region	-0.666***	-0.210***	-0.169***
	(-2.800)	(-3.550)	(-2.180)
Oromia Region	0.196	0.072	0.071
	(1.480)	(1.460)	(1.450)
Produced by formal	-0.384***	-0.145***	-0.121***
	(-3.000)	(-2.930)	(-2.650)
Information from customer	0.294***	0.105***	0.111***
	(3.270)	(3.360)	(3.500)
Constant	-2.034***		-0.217
	(-7.010)		-1.550
ρ	-0.500		-0.133
$\chi^2(1)$	3.389		
P-val	0.066		0.000
N	974	974	974

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

ρ for the LPM simultaneous equation model is the pairwise correlation between the predicted values of the error terms after estimation.

equation model. Interestingly, the estimate of access to credit is again of roughly the same size as the one obtained from single equation IV models. Further, it is significant, at least at 10%, indicating the importance of access to credit for firm innovation. The estimates of the coefficients of the other covariate variables is similar to the ones based on single-equation IV method. The correlation coefficient between the error terms of access to credit and innovation, although small in magnitude, is negative and statistically significantly different from zero, again indicating that unobservables that increases the propensity of innovation by a firm reduces its access to credit.

In view of the importance of innovation for firm growth [19], this results appear to indicate that any policy aimed at relaxing credit constraints can have strong effect on innovation and hence growth.

2.6 Summary and Conclusion

The thorny issue of causality aside, empirical studies show financial development has a positive effect on economic growth (Levine, 2005). Various theories have been proposed as to the possible channels through which financial development enhances economic growth. For instance, financial development democratizes entry to business and as a result business ownership is determined by ability and nothing else. As business is largely owned by able individuals, overall productivity and hence economic growth increases. Levine and King (1993) argue that the key channel is through the role of financial development on firm innovation and hence sustained economic growth. As per this view, a well developed financial system directs resources to promising new ideas, and as a result, genuinely innovative ideas do not die for lack of finance. Our study provides some empirical evidence in support of this channel.

An important policy question in developing countries is the role of MSEs in the

[19]Using the same data, Gebreyesus (2009) shows the importance of firm innovation in their growth.

industrialization and growth process. Some argue that these firms are ephemeral and therefore can not be a reliable means toward industrialization. However, empirical studies show that one can not make such a generalisation as there are both high and low growth MSEs (Nichter and Goldmark, 2009). In fact, as per our notion of innovation, we have seen about 34% of the MSEs in Ethiopia engaged in some form of innovation, indicating the extent of dynamism among these firms. In view of the dominance of these firms in most developing countries, a policy that enhance their innovation, therefore, has strong ramifications for the overall growth and industrialisation of a country.

This paper informs on these two issues. First, we provide evidence that a significant number of these firms actually engage in some form of innovation. Secondly and importantly, we study the key determinants of innovation by these firms, with a particular emphasis on the role of access to credit. Access to credit is found to be one of the key determinants of product innovation by MSEs in Ethiopia, as firms with access to credit are about 34 percentage points more likely to innovate than those with without access to credit. On the basis of our measure, 56% of firms in our sample are credit constrained. Hence, one can imagine the welfare consequence of a slight reduction in the number of firms that are credit constrained.

Older firms and larger firms are more likely to innovate. MSEs whose owner have vocational training are more likely to innovate than those whose owners do not have such training. This is mainly because vocational training emphasises practical training that fits well for incremental types of innovation. Firms exclusively owned by male owners are more likely to innovate than those that are exclusively owned by female or are jointly owned by male and female owners. The location of the firm also plays an important role, as firms in SNNP(Amhara) regional state are more(less) likely to engage in product innovation than those located in Tigray. Manufacturing firms are less likely to innovate than firms that are in retail business, indicating the manufacturing MSEs lack dynamics. Competition with large established firms reduces a firm's propensity to innovate.

In view of the importance of access to credit in firm innovation, the key question is how to improve a firm's access to credit? Suggesting policy options obviously requires a clear understanding as to the sources of the problem. The fact is that financial intermediaries are not able or willing to lend to small and medium enterprises. Two key factors underlie this: credit market imperfections, emanating from the problem of asymmetric information, and contract enforcement problems. Financial intermediaries try to reduce the problem of asymmetric information by screening, monitoring and by requiring firms to post collateral. So one needs to understand what makes it difficult for intermediaries to use these mechanisms for SMEs. The screening cost per loan size is generally higher for smaller firms. First, these firms generally lack detailed information that allows intermediaries to better assess firms creditworthiness. As this information has to be generated from scratch, it is generally more expensive to screen these firms than those with better information such as those with an accounting record and credit history. Secondly, these firms generally borrow smaller loan sizes, thus making the cost per loan higher. These, therefore, reduce the incentive of intermediaries to engage with these firms. In addition, smaller firms are generally regarded as riskier in view of their higher exit rate. This further depresses the interest of lenders in these types of firms. The latter could potentially be overcome if the firms have enough resources to post as collateral. However, they generally luck such assets.

Even assuming the main source of the problem is information asymmetry and not contract enforcement, different policies are implied depending on whether the problem is limited interest by intermediaries to screen these firms or their inability to post the required collateral. The first problem my require interventions to encourage firms to maintain better accounting information and/or encourage intermediaries to engage with these firms. Screening subsidies or tax benefits could potentially help to incentivise intermediaries to screen these firms. The obvious problem with this, however, is that although it may increase the incentive to screen it may not increase lending to these firms; intermediaries may just screen and reject all the

loan applications by these firms.[20] Therefore, the role of policy is in incentivising firms to maintain better information. In fact, the finding in essay one shows that maintaining accounting information is an important determinant of a firm's access to credit.

With regard to collateral, various ways of dealing with this has been suggested. One option is to encourage firms to join groups of firms so that intermediaries use joint liability to lend to member firms. Another option is to increase networking among firms. For instance, a better known firm can serve as a guarantor for its supplier. The common option by far is the partial credit guarantee scheme. Although designing credit guarantee schemes that do not undermine the incentive effect of lenders as well as borrowers is generally hard, there are encouraging schemes. The often cited example is the Chilean Fodo de Grantia para Pequenos Empresarios (FOGAPE), which is a public funded credit guarantee scheme for loans to micro and small enterprises (Benavente et al., 2006). The agency was provided with a seed capital to use as a guarantee for loans to micro and small enterprises by financial institutions. Its main source of revenue is the commission collected from financial institutions that participate in the scheme. Apart from the concern that it substituted public for private guarantees, the scheme is generally interpreted as a successful one. In particular, the default rate of loans backed by this guarantee is remarkably similar to that of loans backed by conventional collateral (Benavente et al., 2006, p.15). The design of the scheme explains its success. The agency announces the total loan to be backed in a given year, and asks financial institutions to bid by posting the maximum coverage and the total loan they want to extend. The bid goes to the institution requesting the lowest coverage. This way the risk of default is shared between the bank and the agency, and, therefore, lenders have the incentive to screen borrowers effectively, thus reducing the default rate. It is important to use the findings of successful schemes and adapt or improve[21] them for use in Ethiopia.

[20] On the other hand, conditioning the subsidy on the actual granting of loan may not change the incentive of intermediaries to engage in screening these firms.

[21] For instance, by making sure that the scheme minimizes the substitution of public for private

Although our key result is robust to various estimation methods, it is, however, important to note some of the possible key limitations of the essay, where future research can remedy. The importance of access to credit for innovation arises only in the instrumental variable regression. Although the various diagnostics indicate that the instruments are generally valid, it may be the case that some of them are actually a manifestation of innovation. Therefore, the results of this essay and the policy implications that follow should be interpreted with some caution. This is so particularly given the fact that some of the firms may report as innovation activities that constitute simple expansion. Except for the results based on LPM simultaneous equation, and to some extent the recursive bivariate probit, model, most of our results are based on single equation instrumental variable estimation. This, however, entails loss of potentially enriching information. However, as noted, employing appropriate system estimation that fully utilizes the available information is bedeviled by the coherency issue. Employing such an estimation method requires developing a computer routine that implements conditional likelihood estimation, by restricting the likelihood function to the four shaded areas presented in figure 2.1. Our initial attempt did not succeed and exploring this further is beyond the scope of the current essay. An interesting future work would examine if our key result changes by employing such methodology. It would also be interesting to compare the efficiency and consistency gain from employing these various ways of dealing with coherency problem. This may involve some form of horse-race between these approaches, using a Monte Carlo simulation types of study. This would be an interesting future work as there is generally limited information on this.

In view of the nature of our dependent variable, measurement error and issue of classification error applies to this essay as well. More importantly, in this case, the key explanatory variable is also potentially susceptible to misclassification error. There are generally limited information on the consequence for estimation and test

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guarantee and that lenders do not excessively extract the surplus of such borrowers by charging a high lending rate.

when both the dependent and explanatory variables are misclassified. A future interesting work, which is beyond the current essay, would explore theses issues and see how these may affect the key findings of the essay.

It is also important to note the issue of instrument weakness. Although our key result does not indicate a seriously weak instrument, it is important to explore this further. A potential future work would examine this in the context of randomised control trial (RTC) type of study, and this again is beyond the reach of the current essay. Finally, it may also be interesting to explore the impact of access to credit by decomposing innovation into different components, which our current data does not allow us to do.

Chapter 3

Opening a Stock Exchange and Economic Growth in Sub-Saharan Africa

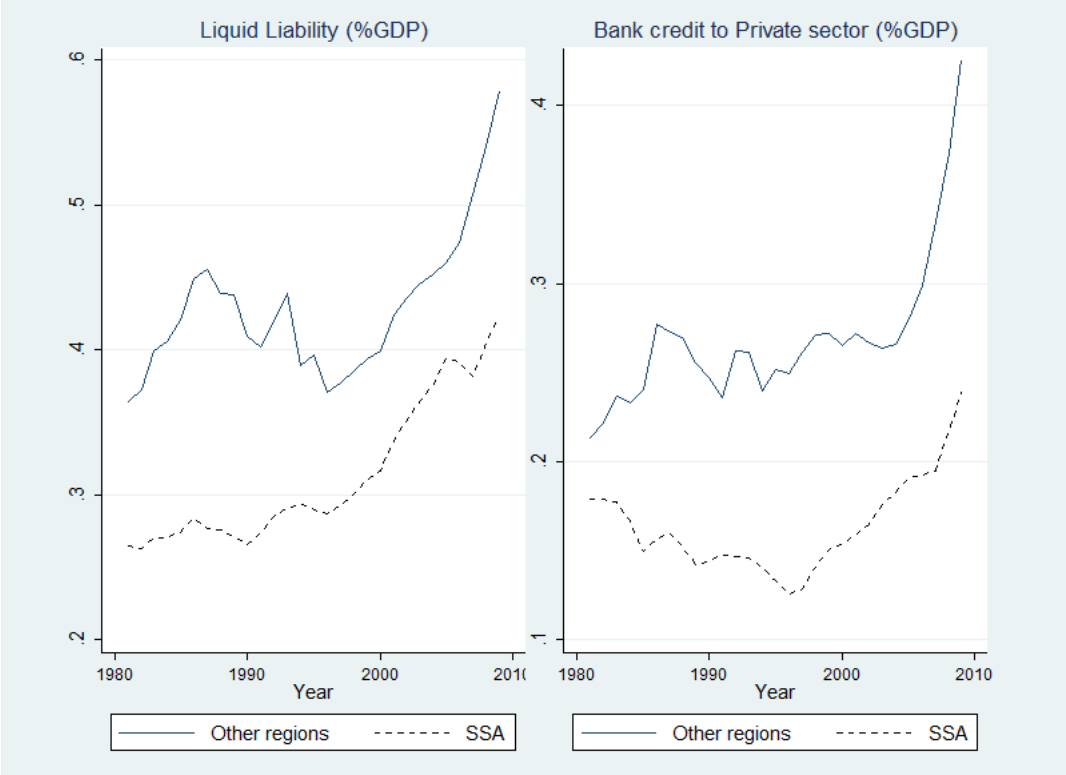
3.1 Introduction

Theoretical and empirical studies reveal that a well-developed financial sector is a key to economic development (Levine, 2005). Nevertheless, the extent of financial development in SSA countries is considerably low. The financial system in the region is bank-dominated, and mainly by state-owned institutions. Key aggregate proxies for financial development show a poorly functioning financial system. As of 2005, for instance, liquid liability to GDP is 32%, as compared to 49% for Asian economies and 100% for OECD countries; the private credit to GDP ratio for the same region is 18% as compared to 30% for Asian and 107% for OECD countries (WorldBank, 2006). Figure 3.1 compares the trend in financial intermediation (liquid liability and credit to private sector both as percentage of GDP) in the SSA countries (excluding South Africa) with other regions (excluding high income countries). As can clearly be seen, SSA substantially lag behind lower and middle income countries in other regions. This is particularly so for bank credit to private sector, where the figure

for SSA countries is almost half that of other regions.

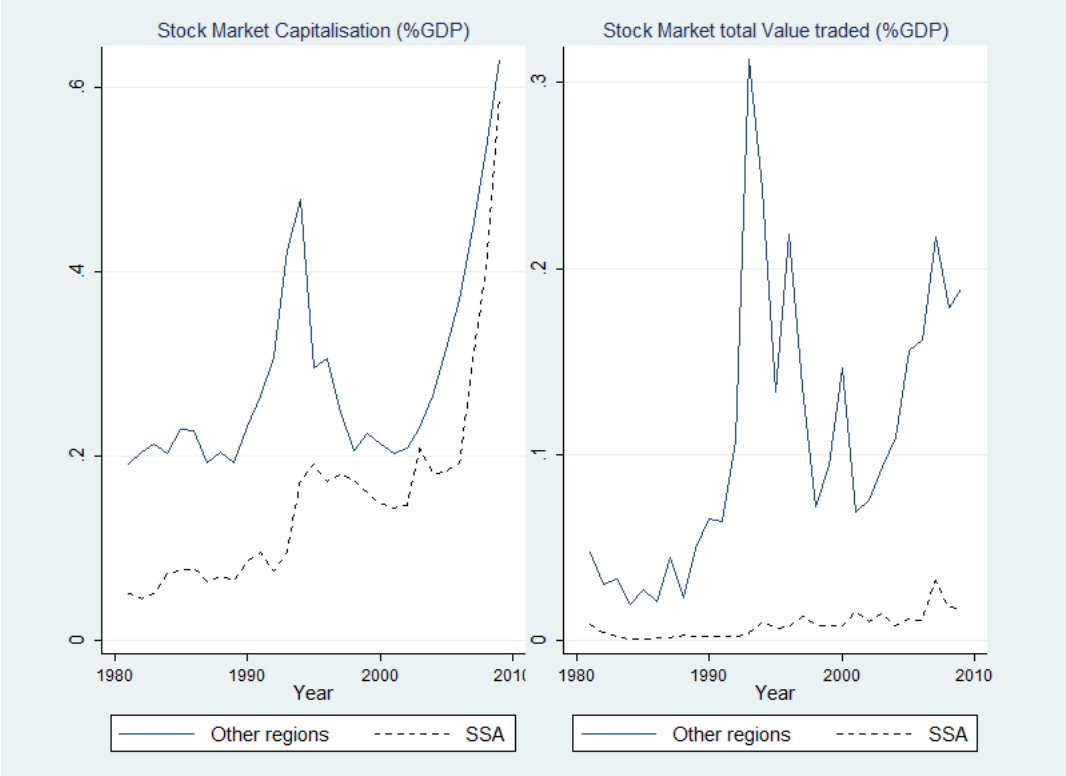
The cost of intermediation, as proxied by the interest rate margin, are higher in Africa than in other parts of the world. Nevertheless, banking profitability is higher in this region than in other parts of the world, both for domestic and foreign owned banks. Perhaps more revealing is the endemic excess liquidity of banks alongside excess demand for funds, especially from small scale enterprises, which is a typical example of credit rationing. Lending is not only limited, but is also largely short-term, mostly less than two or three years in duration (WorldBank, 2006, p.66).

Figure 3.1: Liquid liability and Bank credit to private sector (%GDP)



Although the SSA region has weak (but a growing number of) stock exchange markets, proxies for stock market development indicate that it has one of the least developed stock market systems in the world. Figure 3.2 provides trends in stock market capitalisation and liquidity for SSA (excluding South Africa) and low and middle income countries in other regions. SSA seems to be closing on other countries in terms of market capitalization. However, stock market liquidity is woefully low in SSA. Unfortunately, however, stock market liquidity is what many empirical studies

Figure 3.2: Stock Market Capitalisation and Liquidity (%GDP)



confirm to be strongly associated with economic growth (Levine and Zervos, 1998). The dismal state of stock market development in the region can further be seen from figure 3.3, which depicts the trend in the number of companies listed on stock exchange per 10,000 people. As of 2009, there are about five companies listed on stock exchange per one million people in SSA compared to 12 for lower and middle income countries in other regions.

Since Sub-Saharan Africa countries lag in other measures of development, the region's poor state of financial development is perhaps a reflection of its broader economic underdevelopment. However, Allen et al. (2010) argue that it is more than just a manifestation of this overall malaise as financial development in the region is well below what it ought to be. For instance, they report that in a typical country in the region, liquid liability (and bank credit to private sector) as a fraction of GDP falls 13 (12) percentage points below its potential (Allen et al., 2010, p.2). This points to a systemic underdevelopment of the financial sector in the region.

This is a cumulative effects of a host of separate factors, chief among them

Figure 3.3: Number of firms listed on stock Exchange per 10,000 people

being policy failures. Africa has been a laboratory for various policy experiments. Undoubtedly, this has played a key role in charting the state of financial development in the region. Immediately after independence, many countries in the region viewed state intervention as a key to their speedy development. In particular, financial systems were regarded as an integral channel through which states could execute these policies. As a result, many pursued a heavy state intervention in the financial system to direct credit to preferential sectors, limit the level of interest rate primarily through state ownership of the financial institutions. In line with the then generally accepted view, governments were hostile to private ownership of key resources and in particular to the idea of stock markets.

The policy pendulum swung in the opposite direction by the end of 1980s. The disappointing economic performance and waning alternative sources of foreign aid forced these countries to seek assistance from International Financial Institutions (IFIs), particularly the World Bank and the International Monetary Fund(IMF). As a condition for assistance, these countries were asked in return to implement a com-

prehensive array of market oriented reforms, known as the 'Structural Adjustment Policy' (SAP). Financial sector reform was among the key components of country-specific SAPs. To a large extent, this encompassed a restructuring of the banking sector and other existing financial institutions. To an extent, and particularly in the initial years of the SAP, it also consisted of introducing new institutions, chief among them being stock exchanges. Hence, mainly as part of the SAP, but also for other reasons, many countries in the region (and also other developing country regions (see for instance, Weber et al. (2009))) formed[1] their national stock exchanges or joined an existing stock exchanges. The total number of countries with at least one (or a country member within a regional) stock exchange has steadily grown in the SSA region, particularly since the late 1980s. The region had just six stock exchanges before 1989, and the number has grown to 26 as of 2010. Among these is one regional stock exchange that caters for eight countries, the only of its type in the world, and most of these markets are formed at the behest of government initiatives. Thus, the financial system in the region is diversifying to more than just one type of banking system.

It is argued that stock market formation can play a key role in the region's financial development and hence provide a finance-growth link in the region (Senbet and Octchere, 2008). Empirical as well as theoretical studies reveal that stock market development can foster economic growth. It provides long-term, large size and relatively cheap finance to firms, all of which are lacking in Africa's banking sector; it provides alternative and more flexible savings instruments and hence may potentially raise savings; it exercises corporate governance through take-over disciplining; and more importantly it may improve the efficiency of the banking sector by serving as a competitor. Indeed, there is some evidence showing a positive link between stock market development and economic growth in SSA countries as well (Senbet and Octchere, 2008; Adjasi and Biekpe, 2006). Firm level anecdotal evidence also

[1]Throughout this chapter, forming, opening and creating a stock exchange are used interchangeably, all referring to the formal establishment of a country's first stock exchange.

points in a similar direction. For instance, the stock market in Ghana financed about 12 percent of the total asset growth of listed companies between 1995 and 2002, 16 percent in South Africa between 1996 and 2000, and 8 percent in Zimbabwe between 1994 and 1999 (Yartey and Adjasi, 2007, p.11). More importantly, in all these countries, the stock markets were the single most important source of long-term external finance for these firms (Ibid).

However, there are some researchers who are sceptical of whether it is worthwhile for SSA countries to promote stock market formation and development (Singh, 1999). As per this view, given the current state of institutional and economic development in the region, stock markets are less likely to boost access to finance, and at worse their side-effects may outweigh their benefits. First, the access to finance is more problematic among small scale and medium sized firms, and stock market cater less for such firms. The type of firms that benefit from stock markets are ones that have easy access to bank loans. In fact, most of the firms listed on African stock exchanges are also cross-listed on the New York or London Stock Exchanges (WorldBank, 2006). As such, stock markets are thus less likely to bring about a larger access to finance and economic expansion. Secondly, most of the theoretical benefits of stock market are less likely to work in Africa; they can indeed be counter-productive. For instance, stock price fluctuation is more exaggerated in developing countries than it is in advanced economies. Given the presence of takeover threats, this may force managers to aim at short-term profitability to the neglect of long-term investment. It may also force risk-averse firms to shun equity finance and decide not to list their firm on the stock exchange. Stock markets, when coupled with capital account liberalisation, render already weak economies more exposed and exacerbate the economic fluctuations they are subject to and may increase financial fragility. (Singh, 1999, p.361) thus warns: "For many of these countries such a development would be a costly irrelevance which they can ill afford; for a number of others it is likely to do more harm than good".

From a policy perspective, particularly for those countries who have not ope-

ned one yet, an important question is whether opening a stock market improves economic performance. There are generally limited information on this and, to our knowledge, there is no study that examines this issue for SSA countries. Most of the received wisdom that opening a stock exchanges improves economic growth in SSA is based on the positive association between stock market development and economic growth. However, because of the selectivity issue, such findings cannot be used to infer that stock market formation improves economic growth in the region. This essay attempts to fill this gap. In particular, we seek to answer the following two key research questions: (i)Does opening a stock exchange boost per capita income growth in SSA? (ii) How does the growth impact of stock exchange formation in SSA compare to that of other developing regions of the world? To that end, we employ a semi-parametric Difference-in-Difference (DiD) technique, (i.e., a DiD on set of matched countries). In addressing these two questions, we first present results based on a set of low and middle income countries for all regions, and then provide the results for a sample of SSA countries. To anticipate our key result, we find that opening a stock exchange does not appear to have a significant impact on economic growth in the SSA countries. We also show that this is not an issue specific to SSA countries, as stock market formation does not have a significant effect on the per capita income growth on other developing countries in our sample.

The rest of the paper is organised as follows. Section 3.2 discusses the possible channels through which opening a stock exchange affects economic growth. Section 3.3 provides the discussion of the estimation technique used in this chapter, wherein we detail the DiD-*cum*-matching estimation method. This section also provides discussion of the equation used to estimate propensity scores. Section 3.4 provides the empirical results and discussion, where the estimation result based on all sample countries is first presented, followed by the results for SSA sample. Section 4.5 concludes and provides the limitations of this chapter and suggests possible improvements that future research agenda could pursue.

3.2 Theoretical Framework

3.2.1 Opening a Stock Exchange and Economic Growth

To have a clear idea of the channels through which stock market formation affects economic growth, it is first important to know, at least, the proximate causes of growth. A good framework would be growth accounting, which decomposes the source of output growth to growth in factors of production and technological progress. Despite the methodological controversy, an important insight from this literature is that technological progress is the main source of economic growth, at least in developed countries. For many developing countries, particularly for East Asian countries, capital deepening stands out to be the primary source of economic growth.[2] Financial development, and hence stock market formation, affects economic growth through both factor accumulation and technological progress. For countries on the technological frontier, the main channels through which finance affects economic growth would be innovation and technological progress, while for those within the technological frontier the main channel would be capital accumulation. Much of the finance-growth literature, however, emphasizes the former channel. In this section, we discuss possible ways through which stock market formation can affect both channels.

Forming a stock exchange can affect growth through mobilizing and availing long-term and large-scale capital for investment. Many growth enhancing projects require long-term investment, while investors generally dislike tying their resources to such projects due to a liquidity risk. In the absence of insurance to liquidity shocks, savers generally prefer an investment that allows easy access to their capital. A liquid stock market provides such a platform where investors can transfer the ownership right to other buyers and get access to liquid assets when they need. Consequently, the firm will have access to the capital for unlimited periods of time. Further, stock markets

[2]Many other studies find that capital accumulation plays key role in growth of output in developing countries.

perform a key role in mobilizing large-scale funds through diversifying cross-sectional risk. Many growth-enhancing projects require large-scale funds, while this may involve a large risk for investors. Stock markets provide investors with a platform to diversify risk, facilitating the flow of large scale funding to high-risk high-return projects (Acemoglu and Zilibotti, 1997). Besides agglomerating and availing of long-term and large size funding, stock market may also raise real savings by households, as it provides an alternative and a flexible saving instrument.[3]

Stock markets produce information and hence facilitate the flow of resources to productive sectors, as investors are incentivised to engage in producing information in order to make informed investment decision. Some, however, question the extent to which a stock market is better suited to do this. In particular, a stock market reveals information through stock prices and hence encourages free-ridding in information production. Allen and Gale (1999) provide a particular case where a stock market is better suited than banks to producing information and the financing of high-risk high-return projects. They show that markets are better suited in financing projects where investors have diversity of opinion, emanating from their priors. This is particularly the case for innovation type projects. Stock markets allow investors with common opinions to pool themselves together and finance projects. Hence stock markets play a key role in pushing out the frontiers of growth through innovation and technological progress.

Not only does stock market permit the flow of resources to their most profitable activities, it also makes sure, through the presence of a take-over threat, that existing

[3]Financial development, and hence stock markets formation, has theoretically ambiguous effects on real savings. By offering a higher return to savings, it encourages individuals to substitute away from consumption to saving and, therefore, may raise real savings. The income effects (i.e., the increase in wealth of an investor), however, increases consumption, and hence may reduce savings. Inspired by behavioural economics, various studies have examined the impact of providing alternative saving/investment instruments (e.g., simple saving accounts for people with previously no bank account) to poor households and its impact on their saving behaviour. These studies, by and large, show that providing these instruments raise the level of real savings by households, and sometimes substantially so (see, among others, Ashraf et al. (2006), Prina (2011)). Mullainathan and Shafir (2009) provide a good summary of the possible channels through which providing alternative forms of saving/investment and commitment devices can raise real savings by individuals, chief among them being that it secures resources from compulsive expenditure and other temptations.

capital is used most profitably (Singh, 1999). Hence, a stock market raises both the productivity of existing capital as well as facilitating the process of innovation and hence technological progress.

Finally, the stock market can affect economic growth through its complementary (competitive) role with other forms of financial institutions. For instance, it is widely documented that venture capital plays a key role in nurturing potentially high-growth start-up firms (Samila and Sorensen, 2011). However, for these types of institution to exist, there must be a mechanism that allows them to unload their investment whenever it is time for them to exit the firm. Although venture capital can exit a successful firm in various ways, such as Initial Public Offerings (IPOs), selling to other companies and through buy-back by the entrepreneur him/herself, IPO is shown to be a value maximizing approach and is the preferred mechanism by entrepreneurs as it grants them back control over the company once the firm goes public (Gilson and Black, 1998). Herein, therefore, comes the key role of stock markets as it provides venture capitalist to easily exit mature firms and move on to invest in new ventures.

So far we have concentrated on the discussion of the positive effect of stock markets on economic growth. There are, however, those who question the importance of the stock market for economic growth, particularly in developing countries (Singh, 1999). Much of the countervailing view is based on the fact that the necessary conditions for stock markets to properly function fails to hold in developing countries. As noted above, the flow of resources to their best use requires investors obtaining the necessary information. However, the inherent problem of free-riding means that investors have less incentive to do so, rendering the stock market fit more to the "beauty contest" characterization of Keynes (Keynes, 1936) than being a serious information producer and allocator of resources to their best use.

One key mechanism through which a stock market ensures that existing capital is put to their best use is through a take-over threat. However, a take-over may be ineffective and can at worse be counter-productive. First, the simple asymmetric

information between existing owners and potential buyers may make it difficult for the later to outbid the former. Secondly, managers often collude with the boards of the company to pass life-saving decisions to fend-off a take-over. In fact, a possible indication of the ineffectiveness of a take-over is that it is systematically biased against small firm since it is small firms that are often taken over and not the other way around (Singh, 1999). Further, instead of helping the process of economic growth, a take-over can even harm it by forcing managers to excessively concentrate on short-term performance at the expense of long-term goals such as R&D and innovation that could potentially have large national welfare consequences.

A liquid stock exchange can also be a double-edged sword in that it may encourage a myopic investor, who can leave the market at any time and hence may not have a long-term interest in the company. Hence, in developing countries such as SSA, not only can a stock market fail to have a significant positive effect on growth, it can in fact be detrimental to growth. As Singh (1999) warns, "for many countries, such a development could be a costly irrelevance which they can ill afford; for a number of others it is likely to do more harm than good", p343.

3.3 Empirical Strategy and Data

3.3.1 Empirical Strategy

As noted, our main objective is to estimate the causal effect of forming a stock exchange on economic growth. Denote Y_{it}^{d} as the *potential* per capita income growth of country i. $d \in (0,1)$ is an indicator of whether the country has opened a stock exchange (d=1) or not (d=0). Assume t=1 indicates a period after the country has opened a stock exchange and t=0 a period before opening of the stock exchange. The parameter we seek to estimate is:

$$\tau = E(Y_{i,1}^{1} - Y_{i,1}^{0} | X_{it}, D = 1). \tag{3.1}$$

The parameter, τ, is a measure of the impact of opening a stock exchange on

economic growth of countries that have opened an exchange. In the context of causal inference, τ captures the average treatment effect on the treated, ATT.

As is well-known, the fundamental problem in estimating τ is that $Y^0_{i,1}$, in equation 3.1, is not observable. In effect, one needs an appropriate counterfactual - the average per capita income growth of countries with a stock exchange had they not opened a stock exchange. Various estimators of τ present themselves depending on the restrictions and assumptions one is willing to impose.

One such option is to replace $Y^0_{i,1}$ by the actual average per capita income growth of the country prior to opening a stock exchange. For concreteness, denote the observed average per capita income growth of country i prior to its opening a stock exchange (i.e., t=0) by Y_{i0}, so that Y with the superscript denotes the potential average per capita income growth while ones without the superscript denote the observed average per capita income growth. The impact of opening a stock exchange on per capita income growth of a country i is then given by:

$\tau_i = Y^1_{i,1} - Y_{i0}$

The average impact of opening a stock exchange, is, therefore, given by taking the average of τ_i over all countries with a stock exchange. This is, of course, the well known before-after estimator. This is one of the estimators used by Baier et al. (2003) to study the impact of opening a stock exchange on economic growth and total factor productivity, finding that forming a stock exchange has a positive and, albeit weakly, significant effect on both outcome measures. Minier (2009) studies the same issue using a related methodology, finding some evidence supporting the notion that opening a stock exchange has a positive and significant effect on economic growth. The demanding assumptions required for the validity of the before-after estimator is well-known in the literature. For instance, identification of τ, among others, require that all potential factors that affect per capita income growth remain unchanged between t=0 and t=1 and that all the change is attributable to the formation of a stock exchange.

The other approach to estimating τ is to employ the Difference in Difference(DiD)

method, with the following estimable (growth) equation:

$$y_{it} = \tau D_{it} + \alpha_i + \eta_t + \beta X_{it} + \varepsilon_{it} \tag{3.2}$$

where, y_{it} is (annual) growth in per capita income of country i over the year t, α_i is country specific effects while η_t is time specific effects. D_{it}, as noted, is a dummy variable taking a value of 1 if the country has a stock exchange in year t and 0 otherwise, ε_{it} is time varying and country specific error term, and X_{it} is other observable covariates that affect economic growth.

The parameter τ can be estimated using a first differenced panel method, or the fixed effect method. The fixed effect model (3.2) allows the estimation of τ even when opening a stock exchange and country-specific-time invariant unobservables, α_i, are correlated. The identification of τ, however, rests on the assumption that opening a stock exchange is not correlated with the country-specific transitory shock, ε_{it}. This implies two crucial conditions (Persson and Tabellini, 2008). First, it means that in the absence of stock exchange, all countries would have followed a parallel growth path. Put another way, it means that conditional on observable covariates, X_{it}, countries follow a common growth path. Secondly, it implies that either *i*) the growth effect of opening a stock exchange is not heterogeneous, or *ii*) that the heterogeneity is not correlated with the propensity to open a stock exchange, D_{it}. In other words, the assumption about heterogeneity implies that opening a stock exchange, for instance, has the same impact on growth in Tanzania as it has in Botswana. Or, if the potential growth impact of opening a stock exchange is higher in Botswana, then that should not translate into a higher propensity of opening a stock exchange in Botswana than is Tanzania.

These are indeed strong assumptions. The growth dynamics of both groups of countries can differ due to factors other than a stock exchange formation. For instance, it may be that countries that open a stock exchange are those that could have grown anyway, say, because they had a visionary leader by that time, making the common trend assumption less tenable. The assumption relating to heterogeneity

is even stronger. Many studies show that stock markets start to have a significant effect on growth only after the economy reaches some critical level of development.[4] For instance, the impact of a stock market on growth is likely to be higher in countries with large corporate firms (e.g., large mining firms) by virtue of the fact that such firms are more likely to list than smaller ones. Further, a country that suffered a transitory negative shock to growth may be required to open a stock exchange as a conditionality for foreign aid, or decides to do so on the assumption that opening a stock exchange may help improve economic growth. Hence, heterogeneity is bound to exist. Not only is stock market formation likely to have an heterogeneous impact on growth, but it is likely that countries that expect a strong impact on growth are the ones that open stock exchanges. [5]

One approach of rendering the parallel growth path assumption more tenable is to make the two groups of countries look as similar as is possible. On the assumption that the growth dynamics of countries is the function of some observable set of attributes, this can be done by including as many observable covariates in equation (3.2) as is possible.[6] A key problem with this approach, however, is dimensionality, as controlling for a large number of covariates consumes large number of degrees of freedom. Similarly, the problem arising from heterogeneity can potentially be dealt with by specifying τ as a function of some of the observable covariates that are believed to drive the heterogeneity. Practically, this is usually done by interacting the dummy of stock exchange formation with observable covariates that are assumed to determine the heterogeneity. However, this again raises the dimensionality issue.

[4]For instance Adjasi and Biekpe (2006) finds that the growth effect of stock market development varies with the country's level of per capita income.

[5]It is important to note that the heterogeneity of the impact of opening a stock exchange would be a problem to the estimation of τ when it affects selection into stock market formation. Consider equation (3.2) above, modified in the following way: $y_{it} = \tau D_{it} + \alpha_i + \eta_t + \beta X_{it} + (D_{it}(\tau_i - \tau) + \varepsilon_{it})$, where τ_i is a parameter that captures the heterogeneous effect of a stock exchange. τ_i is treated as part of the error term in equation (3.2). Hence, as long as opening stock exchange is driven by its expected country-specific impact, ε_{ti} is correlated with D_{it}, making τ in equation (3.2) biased.

[6]Note that this is akin to selection on observables as in a matching method. It is also important to note that time-invariant unobservables will be washed out and that the time varying unobservables can be ignored as long as their impact on growth dynamics does not change or change in the same pattern in both treated and control countries (Lechner, 2010).

Besides, it presupposes that one knows and can observe the variables that drive the heterogenous effect of stock market formation and the functional forms.

Herein comes the role of a semi-parametric DiD, i.e., DiD combined with propensity score matching (Heckman et al., 1998; Abadie, 2005). This methodology is better discussed in the context of the potential and actual outcome as in the impact evaluation literature (Rosenbaum and Rubin, 1983). Revisit equation (3.1) given by:[7]

$\tau = E(Y^1_{i,1} - Y^0_{i,1}|X_{it}, D = 1)$.

As noted, the problem is that the counterfactual, $Y^0_{i,1}$, is not observable. Hence, the parameter is not estimable without further assumptions. We use the identifying assumption invoked in the literature, so the parallel growth path noted above, given by:

$$E(Y^0_{i,1} - Y^0_{i,0}|X_{it}, D = 1) = E(Y^0_{i,1} - Y^0_{i,0}|X_{it}, D = 0) \tag{3.3}$$

The right hand side of the equation (3.3) is the change in average per capita income growth for countries with no stock exchange while the left hand side of the equation is the same for countries with a stock exchange. The only unknown from the equation is $E(Y^0_{i,1}|X_i, D = 1)$ and it can be approximated by $E(Y^0_{i,1}|X_i, D = 0)$.[8]

Since the dimension of the co-variate matrix X can be large, the use of propensity scores become handy. This allows the comparison to be made on a single metric, and using a theorem in Rosenbaum and Rubin (1983), equation (3.3) becomes:

$$E(Y^0_{i,1} - Y^0_{i,0}|p(X_i), D = 1) = E(Y^0_{i,1} - Y^0_{i,0}|p(X_i), D = 0) \tag{3.4}$$

where $p(X_i)$ is the estimate of the propensity score.

The implementation of the DiD-cum matching procedure is as follows. First, a propensity score is estimated, using a cross-sectional probit regression of a stock

[7] We following the same denotation of variables as above.
[8] Appendix 4.5 provides details of required sub-assumptions for identification.

exchange dummy on relevant variables that determine the decision to open a stock exchange. Then countries with a stock exchange are matched to comparable countries without a stock exchange based on their similarity in the propensity score values. For each country with a stock exchange, we then calculate the before-after average per capita income growth. Similarly, we do the same for corresponding control countries. Our parameter of interest is, therefore, given by the former less the propensity score weighted value of the latter.

More specifically, consider a country that opened a stock exchange in year k. Denote by g_s^k the before-after average per capita income growth of this country.[9] Similarly, denote by g_c^k the corresponding figure for control countries that are matched with country s. Note that we can have more than one control country being matched with country s, depending on the matching technique used. This is in fact so in our case since we use kernel matching, where all control countries are matched with a treated country. The DiD for country s, τ_s, is given by the following equation:

$$\tau_s = g_s^k - \sum_c w_c g_c^k \tag{3.5}$$

where w_c the weight for country c, constructed using the estimated propensity score.[10]

We calculate τ_s for all the countries with a stock exchange. Averaging this over all the s countries gives the average impact of opening a stock exchange on economic growth of these countries with a stock exchange, and is given by:

[9] That is,

$$g_s^k = \frac{1}{B}\sum_{t>k} y_{st} - \frac{1}{A}\sum_{t<k} y_{st},$$

where y is the annual per capita income growth, B is the total number of years after opening the stock exchange while A is the total number of years before opening the stock exchange.

[10] More specifically, w_j, the weight assigned to a country j, is given by the following equation:

$$w_j = \frac{\exp\left(-0.5*\left(\frac{p_i - p_j}{h}\right)^2\right)}{\sum_{k\in c}\exp\left(-0.5*\left(\frac{p_i - p_k}{h}\right)^2\right)}$$

. p is the estimates of the propensity score, i is countries with stock exchange, c is set of countries without stock exchange, and h is the band width parameter.

$$\bar{\tau} = \frac{\sum_s \tau_s}{S} \tag{3.6}$$

where S is the total number of treated countries, i.e., total number of countries with a stock exchange.

Abadie and Imbens (2006) provides the asymptotic properties of the matching estimator while Heckman et al. (1998) provides asymptotic properties of DiD matching of the type used in this paper. Operationalizing the variance estimate provided has, however, been problematic given the intricate nature of the equation. Persson and Tabellini (2008) provides an implementable estimate of the variance for this estimator, first derived by (Lechner, 1999). We borrow notation from Persson and Tabellini (2008). Expanding equation (3.6) and taking its variance, we have the following expression for the estimable variance:

$$Var(\bar{\tau}) = \frac{1}{S} Var(\sum_s g_s) - \frac{1}{S^2} Var(\sum_s \sum_c w_c g_c) \tag{3.7}$$

We still need to make assumptions about the variables g_s and g_c to provide a specific estimable quantity. Following the literature, we assume all treated countries have the same variance, and that control countries also have the same variance. Since we use kernel matching, a control country can be matched with more than one treated country. This further complicates the estimation of the standard error. Hence, one needs to make an assumption about the correlation of these variables. Denote the before-after average per capita income growth of country c when it is matched with country s by g_c^s. Persson and Tabellini (2008) provide two versions of the variance in equation (3.7), depending on the assumptions about the correlation between g_c^s.

$$Var(\bar{\tau}) = \frac{1}{S}\sigma_s^2 - \frac{1}{S^2}\sigma_c^2 \sum_s \sum_c (w_c^2) \tag{3.8}$$

$$Var(\bar{\tau}) = \frac{1}{S}\sigma_s^2 - \frac{1}{S^2}\sigma_c^2 \sum_s (\sum_c w_c)^2 \tag{3.9}$$

Equation (3.8) gives the lower bound estimate of the variance and is based on the assumption that the g_c^s terms are not correlated. Equation (3.9), on the other hand, provides the upper bound estimate of the standard error and is based on the assumption that the g_c^s terms are perfectly correlated.

It is important to reiterate issues with the estimation of the standard error, since the above estimates of variance make strong assumptions. First, as noted, countries with a stock exchange are assumed to possess a common variance, as are countries without a stock exchange. Secondly, we assume that the weights, w_c, are known and hence are not estimated. However, it is possible that the two variances – variance of control and treated countries – are heteroscedastic. As is known, the fact that we are using an estimated value w_c is also likely to bias our estimate of the sampling variance. These are, therefore, fairly strong assumptions. Hence, the standard error and hypothesis tests of the paper should be viewed with some caution. Interestingly, however, bootstrap standard errors can also be estimated and are shown to work well with matching estimates where a control country is used more than once in matching (Abadie and Imbens, 2008). We therefore provide a bootstrapped standard error as a robustness check.

3.3.2 Estimating the Propensity Score

An important step in estimating τ is to obtain a proper value for $p(X_{it})$. To that end, the following probit model is estimated:

$$p(X_{it}) = \beta X_{it}^{'} + \sigma_{it} \tag{3.10}$$

where $i = 1, ...n$, X_i is a column vector of realizations on k explanatory variables for country i and β is a column vector of k unknown parameters. The values of the latent variable are measured on the real line and in this case reflect the underlying propensity of opening a stock exchange. Assuming the error term, σ_{it}, follows a normal distribution, equation (3.10) can be estimated using conventional maximum

likelihood estimation technique.

A key issue is the decision as to which covariates to include in equation (3.10). By controlling for relevant covariates, we make sure that the countries are well matched. In general, the guiding principle of which variables to include should be motivated by economic theory, but socio-political and legal variables believed to determine stock exchange formation are also included in the regression model.

Cross-country as well as country level historical studies show that equity market development comes later in the process of economic development. At the early stage of economic development, debt financing is the main source of financing for capital formation. Boyd and Smith (1998) provides a microfoundation of the evolution of stock markets along this particular line.[11] In their model, households (lenders) face two investment projects, one with a return observable only to the borrower and another whose return is observable both to lenders and borrowers. The former has higher gross return, but involves a verification cost, while the later has a lower return but no verification cost. Although a return is paid in capital, the verification cost, borne by lenders, is in consumption goods and services. At the early stage of economic development, debt financing commands a comparative advantage over equity financing.[12] As the economy develops and accumulates more capital, lenders find the unobservable return technology less interesting compared to the observable return. Hence, the economy starts to see a growing equity market relative to debt financing in the later stage of development.

The formation of stock exchange, however, is not determined just by economic factors. In fact, most of the stock exchanges in SSA are formed by government initiatives, and their early phase of operation is often subsidized by the government (Moss, 2003). An important question is then why some governments take the initiatives to open a stock exchange and even subsidize its operation while others do not and may even go to the extent of discouraging the private sector from taking

[11] Blackburn et al. (2005) provide a similar model in their study.

[12] They also show that debt is the optimal financing contract for unobservable return technology while equity financing is the optimal contract for observable return technology.

the initiative to forming such exchanges.[13] Various explanations can be offered for this. However, an appealing theory is the political economy of financial development (Rajan and Zingales, 2003a). As per this view, financial development has distributional consequences. In particular, barriers to entry confer economic rent on certain economic groups. Lack of access to finance is an important entry barrier. Therefore, in so far as it eases access to entrepreneurial finance, stock exchange formation reduces barrier to entry and hence threatens incumbent firms' rents. Therefore, these incumbents are likely to oppose the formation of such exchange. Whether they succeed in blocking the formation ultimately rests on their political power. Thus, all things remaining the same, countries where the industrial or financial elites control the policy making are less likely to open a stock exchange. [14] Some of these variables are hard to capture adequately in an empirical study. However, we try to proxy it by the nature of government, i.e., whether it is democratic or otherwise on the assumption that non-democratic regimes are more prone to capture than democratic ones (Girma and Shortland, 2008).[15] The importance of a political system in stock market formation can further be justified by the fact that opening a stock exchange may mean embracing a dominant paradigm and hence more likely to buy support from international powers. That is, it can be regarded as a form of legitimacy, and it is non-democratic states that often seek such legitimacy.

Another important determinant of financial development (and hence stock market formation) is the legal system of a country (Porta et al., 1998). Financial contracting is a trade in promises. Hence, institutions protecting and enforcing

[13]For instance, private sector's initiative to open a stock exchange in Ethiopia has been met with a negative response form the government on a number of occasions. The organizers have been constantly discouraged from pursuing this.

[14]Benmelech and Moskowitz (2010) provide interesting empirical evidence from the study of usury in the 19th century US. They show that usury inhibits financial development and access to credit for firms. A question then is why did some states adopt usury - is it because they are concerned for the welfare of the society or to protect the interest of the industrial elites from competition? They provide evidence in support of the latter, in line with the political economy of financial development. Similar empirical evidences have been provided (Rajan and Zingales, 2003a; Girma and Shortland, 2008).

[15]It is, important to note that democracy and private interest's influence can coexist. That is, democracy is not a proof of capture of the legislative process by private interest.

these contracts are key to the development of financial systems. Therefore, the role of the a country's legal infrastructure assumes a key importance. The legal theory of finance argues in particular that the protection of property rights, the rights of investors, and of private contracting is crucial for financial development. Further, the adaptability of the legal system to a changing contracting requirement is also an important issue. Legal systems, however, differ in the degree to which they do this and the degree to which they are adaptable. The conventional view in this literature is that a Common Law legal origin gives more protection to private property and private contracting over state power as compared to Civil law. Furthermore, Common Law is more adaptable as it gives more discretion to judges than the Civil law. The existing view, therefore, is that countries with Common Law are more pro financial development than countries with Civil law. Extending this to stock market formation, we expect countries with Common Law are more likely to open a stock exchange than those with Civil law.[16]

Opening a stock exchange can be regarded as adopting or adapting existing institutional forms of financing. Hence, it is plausible to appeal to theories of institutional or policy diffusion and adoption. Weber et al. (2009) employs this approach. One view, borrowed from the dependency theory, is that opening a stock exchange is imposed on developing countries since it serves the interest of investors in developed countries. Stock markets enable these investors to possess existing assets in developing countries and make a 'quick profit' without undertaking foreign direct investment. As per this view, the 'core countries use both multilateral (e.g., international financial institutions) and bilateral relations to induce the peripheries to open the stock exchange. In particular, some argue that it was imposed directly by Multilateral financial institutions and was part of the general reform package

[16]Various empirical studies show the positive impact of Common law on financial development, and that the main mechanism is not mainly through protecting private property and private contracting, but because Common law is more adaptable to changing contracting needs of the economy than Civil law. This literature is marked with strong disagreements, however. For instance, there is no consensus between legal scholars as to whether Common law is more adaptable and better protects private contracting than Civil law. Some even argue whether the legal origin is the fundamental determinant of financial development, as compared to, for instance, culture.

adopted by most SSA nations during early 1990s. All things remaining the same, therefore, countries that are more dependent on 'core countries' are more likely to open a stock exchange even if it is not warranted by their prevailing economic circumstances (Wayland, 2005; Weber et al., 2009).

3.3.3 Data and Sample Selection

Table 3.4 provides the list of variables used in the propensity score modeling, along with their summary statistics and data sources. As noted in section 3.3.2, the stage of economic development and the structure of the economy are among the potential determinants of the formation of stock exchanges. We use three variables to capture a country's stage of economic development, viz., initial value of per capita income, initial population size and the initial value of per capita income growth. We also try to capture the impact of the structure of the economy on the propensity to open a stock exchange using initial values of the share of urban population and the share of agriculture in total value added. The efficiency of the legal system and contract enforcement is another determinant of the formation of a stock market. We capture this using a dummy for Common Law legal origin as well as a dummy of Civil law legal origin. We employ the Polity2 variable from the Polity IV project to proxy a country's political regime. The Polity IV project provides various variables designed to capture the level of democratic development, among them being an index of institutionalized democracy and of autocracy. The former is an 11 point scale index, obtained by weighting the competitiveness of political participation, the degree of openness and competitiveness of the selection process of a country's leader, and the institutional constraint on the leader. Similarly, institutional autocracy is an 11 point scale index obtained by weighting the extent of the (un)competitiveness of political participation, the extent of lack of competition and participation in selecting a country's leader, and the extent of lack of institutional limit on the country's leader. A Polity variable is constructed by subtracting the value of the institutionalized autocracy less democracy. The variable is a 21 point scale index

with values ranging from 10 (strongly democratic) to -10 (strongly autocratic). The Polity2 variable is the same as the Polity variable except that its missing values are replaced by some imputed values (Marshall et al., 2009). To capture the impact of external dependence on the formation of a stock exchange, we include the initial value of the ratio of total external debt to Gross National Income (GNI). To capture for the possible impact of exposure to other countries on stock market formation, we also include the distance between the country's capital city and London.

Data used in the paper come from various sources. The key independent variable, a dummy for whether the country has a stock exchange or not, is collected from various sources. The primary source is the websites of respective stock exchanges. Where such information is not available, we rely on published sources (e.g., Minier (2009), Baier et al. (2003), Weber et al. (2009)) and unpublished sources and various websites.[17] Most of the other variables come from the World Bank's World Development Indicators. Data on per capita income growth, initial per capita, population, share of urban population, share of agriculture in total value added, external debt as a share of Gross National Income (GNI) are all obtained from World Bank's World Development Indicator 2011. The proxy for democracy, Polity2, comes from Polity IV project[18], while data on the legal origin comes from The Quality of Government Institute at University of Gothenburg (Teorell et al., 2011).[19] The data source for distance between a country's capital city and London is obtained from Centre d'Etudes Prospectiveset d'Informations Internationales (CEPII).[20]

As noted, we first report results for a broader set of countries and then provide the result for the SSA sub-sample. It is, therefore, important to be clear about the justification for the sample selection. The prime determinant of countries to include in our sample is the availability of data. The nature of some of our variables entail imposing some restriction that impacts sample selection. First, for a meaningful

[17]For instance, www.MBedi.com provides a wealth of information on stock market in Africa, including the total list of the stock exchanges in the region and the date of their formation.
[18]http://www.systemicpeace.org/polity/polity4.htm
[19]http://www.qog.pol.gu.se
[20]http://www.cepii.fr/anglaisgraph/bdd/gravity.htm

analysis, a treated country needs to have enough data span for per capita income growth both before and after opening a stock exchange. Specifically, we require a country with stock exchange to have at least five years of non-missing data on per capita income growth both before and after the opening of a stock exchange to be part of our sample. The World Bank's WDI data on per capita income growth is available from 1960 onwards. This means that countries that opened a stock exchange before 1965 are dropped from our sample due to lack of data. Similarly, we do not have sufficient span of per capita income growth data on post-stock market formation for countries that formed their first stock exchange on or after the year 2005.[21] Hence, for countries with a stock exchange, our sample is limited to those that opened their first exchange between 1965 and 2005. Secondly, the nature of the explanatory variables included in the propensity score equation also requires us to impose further restrictions on the countries for inclusion in the analysis. As noted, most of the explanatory variables are initial values, where *initial* refers to the value corresponding to the first year in which the variable has a non-missing data for the respective country. Hence, for countries with a stock exchange, initial values of all the variables should pre-date the formation of the first stock exchange. For instance, if a country opened a stock exchange in 1990 and its initial value of Polity2 corresponds to the year 1991, that country is dropped from the sample.[22] This leaves us with a total of 73 (51 treated and 22 untreated) countries for the analysis. Table 3.5 provides the list of countries with stock exchanges that are included in our sample.

[21] We deal with the latter category of countries by treating them as control countries, i.e., assuming as if they do not have a stock exchange. Instead of including them in the control group, we have also dropped them altogether from the analysis. Nevertheless, that omission does not alter the reported result.

[22] We didn't, however, impose such a restriction on the control countries.

3.4 Results and Discussions

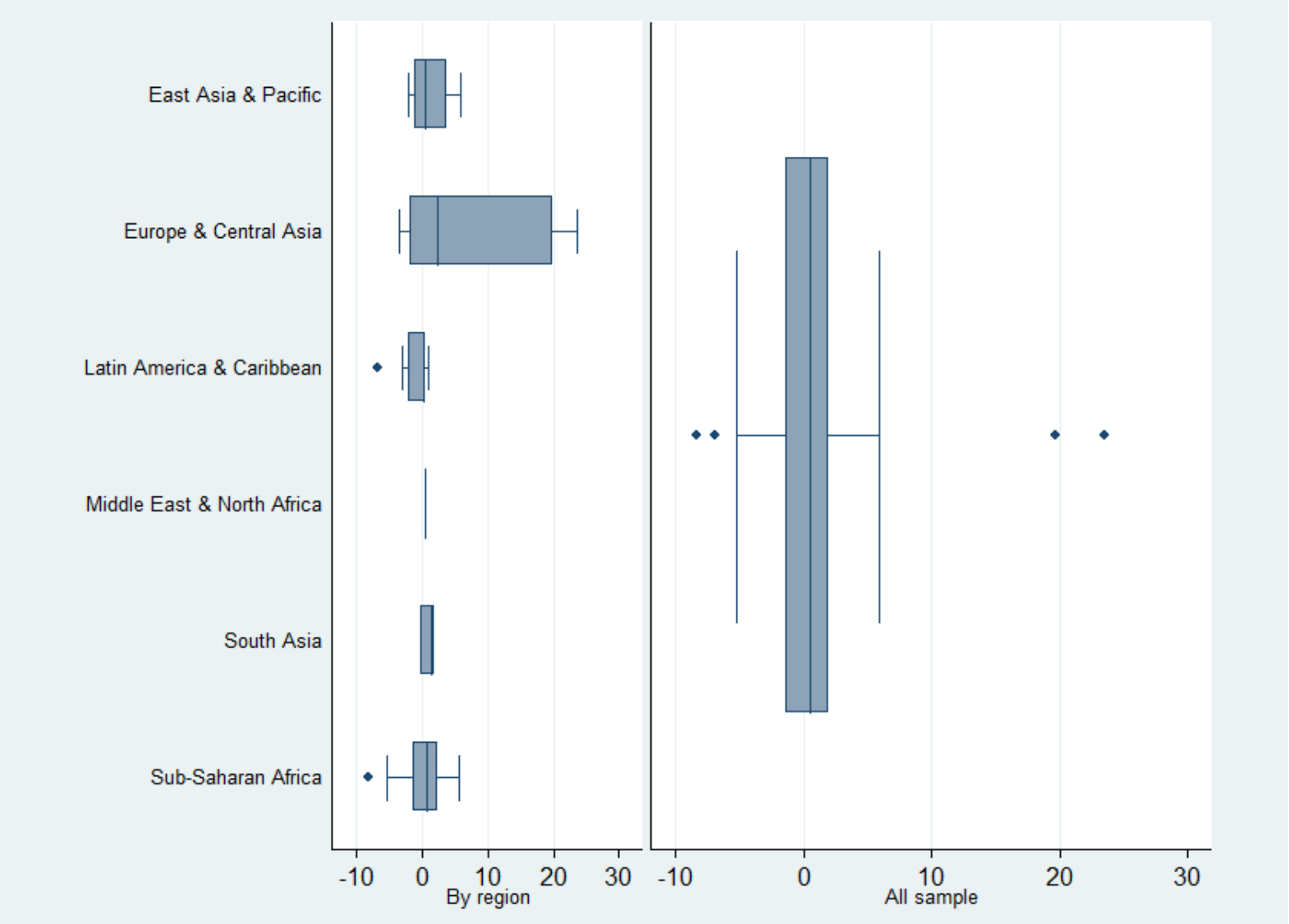
3.4.1 All Countries

We now turn to the results of the impact of opening a stock exchange on economic growth. A before-after type of analysis would be a good place to start. Figure 3.4 gives a Box plot of the before-after growth, constructed as the average per capita income growth after opening a stock exchange less the same before the formation of the exchange[23] for countries with a stock exchange. The first panel of the figure gives the before-after growth by region, while the second panel provides the same for all the countries in our sample. As can be seen, for the full sample countries, the centre of the distribution of the before-after growth is close to zero, with a median value of only slightly above zero. The plot for each region indicates a similar pattern. Except for countries in Europe and Central Asia – mainly the former Soviet countries – the median before-after growth is essentially zero. This is particularly so for SSA countries, indicating that per capita income growth did not perhaps improve after opening a stock exchange for countries in this region. The median value is in fact less than zero for Latin American and Caribbean countries in our sample. Overall, this suggests that opening a stock exchange does not appear to improve economic growth substantively.

[23]Note that the number of years before and after stock exchange are not necessarily balanced. Nevertheless, the span of years is restricted to a maximum of 10 years before and after stock formation in calculating the before-after per capita income growth.

Figure 3.4: Box plot of Before-After growth (countries with stock exchange)

The figure provides a Box plot of the before-after growth, constructed as the average per capita income growth after opening a stock exchange less the same before the formation of the exchange, for countries with a stock exchange. The left panel gives the values disaggregated by region while the right panel gives the result for the whole sample.



The before-after growth gives us the glimpse of some insight into what per capita income growth looks like following the opening of a stock exchange. However, it does not help us see if the change in per capita income growth is driven by, and hence attributable, to the opening of a stock exchange. This is so since the before-after analysis does not control for other variables that might have at the same time changed. We now discuss the estimates based on our regression analysis.

We start with the key ingredient of the DiD-cum matching estimate, the estimates of the propensity score. The second column of table 3.1 provides the probit estimates of the propensity score model based on all countries in our sample. As can be seen, most of the variables enter with the expected sign, but are not statistically significant at a conventional level. The initial population is the only variable that enters with a statistically significant coefficient. The positive coefficient is consistent with theory and this may indicate the importance of the initial size of the economy in determining the propensity to open a stock exchange. Many of the variables in the propensity score model enter with insignificant coefficients, partly because of the potential multicollinearity between the variables and because of the small sample size. However, as the main aim of estimating this equation is to predict the propensity score and not necessarily to study the determinants of forming a stock exchange, the absence of many well determined effects may not be an issue of much concern. What matters is whether the estimated propensity score achieves better balancing between the treated and control countries. Figure 3.5 provides the histogram of the balancing of the propensity score while figure 3.6 gives the kernel density for of the overlaps of the propensity scores of the the two groups.[24] Both figures indicate a good, certainly by the standards of macroeconomic data, overlap in the estimated propensity scores for the two groups, though there is a scope for an improvement of in the balance.

Table 3.2 reports the estimation results for the full sample. As a baseline result,

[24] Lechner (2010) indicates that it is often suffice to look at the overlap of the two distribution to see if balancing test is met.

Table 3.1: Estimates of Probit Model for Propensity Score

The dependent variable is a dummy variable taking a value of one if the country has a stock exchange and zero other wise. All explanatory variables are initial values.

	All sample	SSA sample
Per capita income growth	0.0232	0.0905*
	(0.89)	(1.73)
ln(Population)	0.306*	0.439
	(1.84)	(1.32)
Per capita income	0.187	-0.115
	(0.50)	(-0.21)
Urban population (% of total population)	0.0171	0.0167
	(0.81)	(0.39)
Agriculture value added as % GDP	0.00696	0.00160
	(0.46)	(0.09)
Polity2	-0.0233	-0.0475
	(-0.73)	(-0.72)
Distance from London	-0.0746	0.460
	(-0.20)	(0.47)
External debt as % GNI	0.000717	-0.0158
	(0.20)	(-1.20)
Dummy for Common law legal origin (d)	0.192	1.012*
	(0.25)	(1.84)
Dummy for Civil law legal origin	-0.693	
	(-1.08)	
sample year	0.0253	-0.0186
	(1.40)	(-0.52)
N	73	35
Pseudo-R2	0.149	0.167

Marginal effects; t statistics in parentheses

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

we present and start the discussion with the Ordinary Least Square (OLS) and panel estimation results. A key problem in economic growth empirics is the enormity of potential regressors to include and the lack of clear theoretical justification guiding which variables to include in a regression. We follow suggestions in the model specification searches using the Bayesian Model Averaging Approaches (see, for instance, SalaiMartin et al. (2004)), which consistently show capital formation and primary school enrolment as the two variables that are strongly associated with per capita income growth. We control for these two variables in the baseline regression. We also control for life expectancy, the share of government consumption in the total GDP, and the ratio of external debt to Gross National Income (GNI), another set of variables shown to be important determinants of economic growth. Finally, in order to see if the impact of forming a stock exchange depends on the level of economic development, we include the interaction term between the stock market dummy and per capita income. The baseline results are given in the upper panel of the table.

The second column of the table provides the result of a pooled cross-section estimation, controlling for time fixed effects. Standard errors are robust to unknown misspecification and are clustered at country level. As shown, the variable of interest, the dummy for the presence of a stock exchange, enters with positive coefficient and is significant, indicating that countries with a stock exchange grow faster than their counterparts without a stock exchange. Fixed capital formation enters with a positive and statistically significant coefficient, indicating the importance of capital accumulation for economic growth in this set of countries. Primary school enrolment, on the other hand, enters with an insignificant coefficient. In line with existing studies, life expectancy enters with a positive and significant coefficient. Perhaps ironically, the interaction term between dummy of a stock exchange and a country's per capita income enters with a negative coefficient and is marginally significant, indicating opening a stock exchange tend to have a lower impact on economic growth for countries with a higher income.

The third column of the table provides the result of random effect estimation,

controlling for time fixed effects. Standard errors are robust to unknown misspecification. The results are by and large similar to those in the OLS regression. The variable of interest, the dummy for the presence of a stock exchange, still enters with a positive coefficient and is significant at 10%. However, in this case, government consumption enters with a negative and significant coefficient, indicating that excessive government consumption undermines economic growth. Further, the interaction term between dummy of a stock exchange and a country's per capita income is not statistically significant, signifying that the impact of opening a stock exchange on economic growth does not depend on the country's level of development.

The fourth column of the table provides the result of fixed effect estimation. The standard errors are robust to unknown mis-specification and time fixed effects are controlled for. As can be seen, the variable of interest is positive, but is not statistically significant, indicating that there is no significant difference in per capita income growth between countries with and without a stock exchange. Except for fixed capital formation and government consumption as share of GDP, none of the other control variables enter significantly. The upshot, therefore, is that stock market formation does not appear to robustly affect per capita income growth in our sample of countries.

Employing DiD-*cum*-matching, our preferred estimation method corroborates the findings of the fixed effect estimation, as the second and third column of the bottom panel of the table reveals. The first column of the table provides the DiD estimate, where the *t-value* is based on the lower bound standard error, given by the variance equation (3.8). As can be seen, the coefficient of our key variable is negative, but is not significantly different from zero. As noted in section 3.3.1, a key issue with our preferred estimation strategy is the estimation of the standard error. The third column of the table provides results where the *t-value* is calculated based on upper, instead of lower, bound standard error, given by the variance equation (3.9). As can be seen, the coefficient of stock market variable is still not statistically significant, indicating that stock market formation does not appear to make a difference to per

Table 3.2: Baseline and Difference-in-Difference Estimates for whole sample Countries

For pooled and panel regression results, the dependent variable is annual per capita income growth, and all the explanatory variables are lagged by one year. For the Difference-in-Difference estimation results, the dependent variable is the average per capita income growth after opening a stock exchange minus the average per capita income growth before opening the exchange.

	All Sample		
	OLS	Random Effect	Fixed Effect
Stock exchange dummy	1.409**	1.033*	0.523
	(2.19)	(1.76)	(0.81)
Primary school Enrollment	-0.00594	-0.00164	0.0106
	(-0.76)	(-0.26)	(0.81)
Fixed capital formation (%GDP)	0.119***	0.102***	0.0618*
	(4.58)	(5.27)	(1.87)
Government consumption (% GDP)	-0.0325	-0.0540**	-0.116*
	(-1.23)	(-2.19)	(-1.83)
External debt (%GDP)	-0.00241	-0.000469	0.00105
	(-1.30)	(-0.28)	(0.55)
Life Expectancy at birth	0.0407**	0.0404**	0.0176
	(2.08)	(2.22)	(0.35)
Stock exchange*per capita income	-0.138*	-0.120	-0.0775
	(-1.67)	(-1.54)	(-0.89)
Constant	-5.290***	-4.830***	-2.741
	(-4.37)	(-4.04)	(-0.95)
N	2525	2525	2525
Overall R^2		0.161	0.134
R^2	0.164		0.129
Time Fixed effects	Yes	Yes	Yes
Country Fixed effects	No	No	Yes

	Difference-in-Difference Estimates	
	SE1	**SE2**
Stock	-0.52	-0.52
	(-.943)[-.683]	(-.492)[-.683]
$Stock_5$	-1.43	-1.43
	(-2.85***)[-.990]	(-1.40)[-.990]

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note:For OLS column, standard errors are robust and clustered at country level, while for the Random Effects (RE) and Fixed Effects (FE) columns standard errors are just robust. In the row 'Stock', the DiD estimates are based on all available number of per capita income growth, i.e., without imposing a restriction on the number of years in calculating the before-after growth. Estimates in the row '$Stock_5$' are based on where the number of years is restricted to 5 years both before and after the formation of stock exchange. SE1 is standard error based on variance equation 3.8, and is based on the assumption that the values of before-after per capita income growth of a control country matched multiple times are not correlated. SE2, on the other hand, is based on the variance equation 3.9 and assumes that these before-after growth differences are positively correlated.

capita income growth for those countries in our sample.

Further complicating the issue with the measures of standard error used here is the fact that it can in principle be lower than the lower bound itself. While calculating the upper bound, we assumed that the before-after growth of a control country is positively correlated. Denote g_i^k and g_i^l to be the before-after per capita income growth of country i when it is matched, respectively, with country k and l. In calculating the upper bound standard error, we assume that g_i^k and g_i^l are positively correlated.[25]. However it is possible that the actual correlation is instead negative, in which case the standard error is even lower than the lower bound. The upshot, therefore, is that the standard error is itself an issue. A better option would be, therefore, to use a bootstrap or Jackknife standard errors. We include the *t-value* based on bootstrap standard error, from 1000 replications, in the square brackets of columns 4 and 5 of table 3.2.[26] As can be seen, the coefficient remains statistically insignificant, again indicating that opening a stock exchange does not exert a statistically significant effect on per capita income growth.

As noted, countries enter our sample at a different point in time. Hence, the before-after growth is based on an unbalanced number of years. That is, it is possible, in calculating the before-after per capita income growth of a given country, that the average per capita income before the stock market formation is based on, say, 30 years while the average per capita income after the stock market formation is based on just five or so years of observations, or *vice versa*. A value obtained by averaging

[25]Note that when calculating the lower bounds, we are assuming that g_i^k and g_i^l are independent.

[26]It is, however, important to note some issues with the resampling method in our type of dataset. The conventional bootstrapping method is to resample based on observations. However, this may lead to cases where the entire observation is drawn from just treated or control countries, making it impossible to estimate the parameter of interest, τ. Therefore, we impose a condition during the resampling, by setting the bootstrapping such that a country is drawn independently from those with and without a stock exchange. Yet, it is important to note a further issue, in that we do not know whether the balancing test is met during every replication. It is possible that some of the bootstrapping estimates are done without first meeting the balancing based on propensity score. Unfortunately, a valid way of doing this is not apparent. One naive way would be to put a condition in the replication such that a sample be dropped if the balancing test is not meet. This, however, would amount to tampering with the integrity of the bootstrapping process and is not attempted. Incidentally, figure 3.7 gives the kernel density of the bootstrapped estimates overlayed with normal distribution. Not surprisingly, the distribution of the bootstrapped estimate is indistinguishable from normal.

over 30 years is less likely to be affected by outliers than one obtained from averaging over, say, just five years. Consequently, the before after based on these differently smoothed values can potentially be susceptible to the effects of outliers. Therefore, it may be important to check if our results change by imposing a common time span on the number of years both before and after the stock market formation. To that end, we consider the before-after calculated as the five year average per capita income growth immediately after the formation of stock exchange less the five year average per capita income immediately before opening a stock exchange. The result is given in the second row, i.e., row '$Stock_5$', of table 3.2. As can be seen, the coefficient of our key variable remains negative. Nevertheless, it is still insignificantly different from zero, except in the case of *t-value* based on lower bound standard error, corroborating our findings that forming a stock exchange does not appear to have a significant causal impact on per capita income growth in our sample countries.

Although the results of the DiD estimate is broadly similar to the baseline regression results, in particular to the fixed effect estimates, the two results are not strictly comparable. The DiD result controls for a host of variables through the propensity score equation. The baseline regression, on the other hand, is based on four additional key explanatory variables, and most of the variables controlled for in the propensity score regression are not included in the baseline regression since it does not make sense to do so. Further, the baseline regression is based on annual per capita income growth and therefore captures the short-run impacts of opening a stock exchange on economic growth. The DiD estimate is based on average per capita income growth over five or more years and hence captures, perhaps, a medium to long-term impact of opening a stock exchange on economic growth.

3.4.2 SSA Sample

We have seen in the foregoing analysis that opening a stock exchange does not appear to have a significant effect on economic growth using a broader set of sample

countries. In this section, we explore the effect of forming a stock exchange on economic growth using data from the SSA countries, with the view to see if the region is different from a broader set of countries in other regions in this regard. The third column of table 3.1 gives the estimation result of the probit equation for the SSA sample. As in the case for the results based on the whole sample, most of the variables in the probit equation are not statistically significant. Initial per capita income, however, is among two of the variables that enter significantly. As can be seen, the variable enters with a positive coefficients, indicating that countries that start with higher per capita income growth are more likely to open a stock exchange than their counterparts that start with lower per capita income growth. Similarly, a dummy of Common law legal origin enters with positive and statistically significant coefficient, indicating that countries with British legal origin are more likely to create a stock exchange than countries with a different legal origin. This is generally consistent with existing evidence that Common law legal origin is associated with the better development of a stock market (Levine and Demirguc-Kunt, 2008). Figure 3.5 provides the histogram while figure 3.6 gives the kernel density of the overlaps of the propensity scores of the two groups. Both figures indicate reasonable overlap, by the standard of the limited number of observation, of the estimated propensity scores of the two groups in the region.

Table 3.3 gives the estimates of our key equation for the Sub-Saharan African sample. The upper panel of the table gives the baseline regression results. The second column of the table gives the OLS estimate of the growth equation with a dummy for stock exchange as one of the explanatory variables. The standard error is clustered at country level and time fixed effects are controlled for. As can be seen, our key variable enters with a positive coefficient, but its corresponding estimate is not statistically significant. Most of the other control variables are not statistically significant either, except for fixed capital formation which enters with a positive and statistically significant coefficient, indicating the importance of capital accumulation for per capita income growth.

Table 3.3: Baseline and Difference-in-Difference Estimates for SSA Sample Countries

For pooled and panel regression results, the dependent variable is annual per capita income growth, and all the explanatory variables are lagged by one year. For the Difference-in-Difference estimation results, the dependent variable is the average per capita income growth after opening a stock exchange minus the average per capita income growth before opening the exchange.

	SSA Sample		
	OLS	Random Effect	Fixed Effect
Stock exchange dummy	0.646	0.510	-0.300
	(0.96)	(0.76)	(-0.39)
Primary school Enrollment	-0.00621	0.000281	0.0202*
	(-0.69)	(0.03)	(1.84)
Fixed capital formation (%GDP)	0.0995***	0.0982***	0.0982**
	(3.14)	(3.41)	(2.40)
Government consumption (% GDP)	-0.0131	-0.0279	-0.0341
	(-0.46)	(-0.82)	(-0.62)
External debt (%GDP)	-0.00283	-0.00207	-0.00786*
	(-0.64)	(-0.52)	(-1.81)
Life Expectancy at birth	0.0204	0.0136	-0.00253
	(0.45)	(0.38)	(-0.04)
Stock exchange*per capita income	-0.0664	-0.144	-0.218*
	(-0.74)	(-1.59)	(-1.88)
Constant	-0.523	-0.262	0.0569
	(-0.26)	(-0.14)	(0.02)
N	946	946	946
Overall R^2		0.160	0.132
R^2	0.165		0.164
Time Fixed effects	Yes	Yes	Yes
Country Fixed effects	No	No	Yes

	Difference-in-Difference Estimates	
	SE1	**SE2**
Stock	-1.27	-1.27
	(-2.30**)[-.839]	(-1.658)[-.839]
$Stock_5$	-0.94	-0.94
	(-1.063)[-.362]	(-.604)[-.362]

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note:For OLS column, standard errors are robust and clustered at country level, while for the Random Effects (RE) and Fixed Effects (FE) columns standard errors are just robust. In the row 'Stock', the DiD estimates are based on all available number of per capita income growth, i.e., without imposing a restriction on the number of years in calculating the before-after growth. Estimates in the row '$Stock_5$' are based on where the number of years is restricted to 5 years both before and after the formation of stock exchange. SE1 is standard error based on variance equation 3.8, and is based on the assumption that the values of before-after per capita income growth of a control country matched multiple times are not correlated. SE2, on the other hand, is based on the variance equation 3.9 and assumes that these before-after growth differences are positively correlated.

The third column of the table reports the random effects estimation result. Standard errors are robust to unknown mis-specification, and we control for time fixed effects. The results reveal a similar pattern as in the OLS case, in that our key variable enters with a positive but an insignificant coefficient, again indicating that opening a stock exchange does not significantly affect economic growth. Of the other control variables, only the fixed capital formation enters with a significant coefficient. The fourth column of the table reports the fixed effects estimation result. Standard errors are robust to unknown mis-specification, and we control for both country and time fixed effects. Our key variable enters with a negative but an insignificant coefficient, again indicating that opening a stock exchange does not significantly affect economic growth. Fixed capital formation enters with a positive and statistically significant coefficient, while external debt as share of GNI enters with a negative and statistically significant coefficient. Although it does not lend itself to a meaningful interpretation given that the stock exchange dummy is insignificant, the interaction term between the per capita income and dummy of a stock exchange enters with negative coefficient and is significant at 10%.

Columns two and three of the bottom panel of the table provide the estimation result of the DiD-cum-matching method. In column two, the *t-value* in the bracket is based on the lower bound standard error. As can be seen, the coefficient of our key variable is negative. Interestingly, it is also statistically significant at the 5% level based on the lower bound standard error. However, at the value in square bracket shows, the estimated effect is not statistically significant using the bootstrapped standard error.[27] As column 2 of the table reveals, the coefficient is still negative, but is not statistically significant based on the upper bound standard error.

Again, the fact that the before-after growth is based on possibly unbalanced length of years may bias our results. As we did for the whole sample, we provide DiD estimation result where the time span for per capita income growth is restricted

[27]Owing to the limited number of observation for SSA results, the bootstrapped standard error is based on about 300 replications.

to five years both before and after the opening of the stock exchange. That is, the DiD is applied on the before-after growth calculated as the average per capita income growth five years after the formation of stock exchange less average per capita income growth 5 years before the formation of stock exchange. The second row, i.e., row '$Stock_5$', of the table gives this result. As can be seen, our key variable enters with negative coefficient, but is generally not statistically significant. This is so based on the lower and upper bound standard error as well as based on the bootstrapped standard error, indicating that opening a stock exchange may not have a significant effect on short-term per capita income growth in the region.

Overall, therefore, we show that opening a stock exchange does not appear to have a significant effect on per capita income growth in the region. Interestingly, the result for SSA sample is not substantively different from the result for all set of countries in our sample, except for those based on OLS and random effect models. However, the overall result that stock market formation does not affect economic growth provides an interesting contrast with the findings of the limited empirical studies on this issue.

Although there has not been any study examining this issue for Sub-Saharan Africa, our result is, to some extent, in contrast with findings of Minier (2009) and Baier et al. (2003) who, using a broader sample of countries, find that opening a stock exchange has a positive, although generally weakly significant, effect on per capita income growth. Baier et al. (2003) study the effect of opening stock exchange on GDP growth by estimating three parameters. First, they provide a before-after estimate, comparing a country's GDP growth after opening a stock exchange with its GDP growth before opening of the stock exchange. Secondly, they compare the GDP growth after opening a stock exchange with the GDP growth of the rest of the world. Finally, they provide an estimate of non-parametric difference in difference by comparing the before-after GDP growth of a country with a stock exchange to the same for the rest of the world. In all the three parameters, inference is based on comparing the estimated parameter with the standard deviation and by

looking at the proportion of countries with higher GDP growth after opening a stock exchange than the comparison group. The before-after estimate shows that opening a stock exchange does not have a significant effect on economic growth, while the estimates based on the remaining two methods show that opening a stock exchange has a positive, albeit weakly significant, effect on growth. As discussed in section 3.3, a key issue with using a simple DiD is that it does not control for county specific heterogeneity of the impact of forming a stock exchange and as such estimates may be biased. Our results are based on a Difference-in-Difference based on matched countries and hence take care of this problem. Similarly, Minier (2009) studies the effect of forming a stock exchange on GDP growth by comparing the difference between the actual and predicted GDP growth after forming a stock exchange with similar estimate for comparable [28] countries without stock exchange. The results show that opening a stock exchange has generally no effect on GDP growth, except for a comparison based on five year growth which is marginally significant. In general, the methodologies employed in these papers do not control for the possibility that other factors might have changed and that the heterogeneity of the impacts may bias the results. Therefore, it is possible that economic growth is wrongly ascribed to stock market formation when in fact the underlying factors are due to the evolution of some other variable(s).

3.5 Conclusion

Theoretical as well as empirical studies reveal that stock market development has a positive link with economic growth. Using a broad and heterogenous sample of countries, (Levine and Zervos, 1998), for instance, provide empirical evidence showing that stock market liquidity is positively and significantly associated with economic growth, capital accumulation and productivity growth. Similar studies have shown

[28] Comparable based on similarity in per capita income before the formation of the stock exchange.

such a positive association between stock market development and economic growth for SSA sample countries (Senbet and Octchere, 2008; Adjasi and Biekpe, 2006). Interestingly, these findings are often used to draw the conclusion that opening a stock exchange raises the aggregate welfare of any country. Partly driven by such findings and conclusions, stock markets are mushrooming in many parts of the world, particularly in the SSA region.

However, many caution that the suitability of stock markets in promoting economic growth is dependent on the structure and stages of development of the economy. The nature of the institution render stock markets to better serve an economy at certain stages of development rather than at others (Lin et al., 2009). For instance, stock markets may play a key role in well-developed economies with comparative advantage in skill and capital intensive activities, and in particular in economies where the engine of growth is innovation and technological progress (Allen and Gale, 1999; Lin et al., 2009). Therefore, the positive association between stock market development and economic development does not automatically translate to the argument that opening a stock exchange helps promote economic growth in any particular country.

This essay explored the impact of opening a stock exchange on economic growth in a developing countries context, with a particular emphasis on the SSA. Using a Difference-in-Difference methodology with a matched set of countries, we show that opening a stock exchange in general does not appear to have a significant effect on per capita income growth in our sample of countries. Interestingly, our estimates show that the coefficient can even be negative, although not statistically significantly different from zero. Our analysis adds to the limited literature examining the impact of opening a stock exchange on economic growth. Our key findings, however, are, to some extent, contrary to those in the limited literature on this issue that show opening a stock exchange exerts a positive, although marginally significant, effect on economic growth (see for instance, Minier (2009) and Baier et al. (2003)).

However, that opening a stock exchange does not appear to have a significant

impact on economic growth in these sets of countries is perhaps not surprising, particularly for the SSA region, given the nature of the stock market and what it serves. As noted, a stock market is best suited to serve large firms that engage in R&D and long-term and large scale investment activities. These types of firm are simply absent in the SSA region, where the majority of the enterprises are small and medium scale in size.

It is important, however, to note some possible limitations of this essay. We view the limited sample size and the estimation of the standard error in our preferred methodology as two key issues that warrant our findings should be carefully interpreted. The limited sample size is the fact of life for many cross-country studies, and little can be done to address this constraint. Future research can possibly enhance this approach through use of a detailed country level study, in particular by comparing the patterns of financing, growth and performances of firms in countries with and without the presence of a stock exchange. The standard error of the DiD-cum-matching estimation we employed is what is currently provided at the frontier of the current research in this type of application. In view of the limitations with this method, there are, therefore, research opportunities for future enhancement and improvement. For instance, little is known about the theoretical implications for the standard error of using a control country multiple times. Exploring this provides an important part of the future research agenda in this area. Another potential future improvement for our preferred methodology would be to apply the DiD-matching on an evolving basis. For instance, consider Cote d'Ivoire which opened a stock exchange in 1974. In this paper, the controls are countries that did not have a stock exchange as of 2007. An interesting case, at least when using the five year span of data to calculate the before-after per capita income growth, would be to use any country that did not open a stock exchange until 1979 as a control country. Hence, although Uganda has a stock exchange, which opened in 1997, it could potentially be used as a control country for Cote d'Ivoire as long as its estimated propensity score is comparable to that of Cote d'Ivoire. This again is an approach that could

provide further enhancements to the methodology used in this chapter.

Table 3.4: Variables and Summary Statistics

variable	Description	N	Mean	Max.	Min.	Std.Dev.	Data source
Per capita income growth	Initial value per capita income growth.	117	1.75	25.50	-26.40	7.21	World Bank's WDI 2011
stock	Dummy variable taking a value of 1 if the country has stock exchange, and zero otherwise.	116	0.64	1.00	0	0.48	Various sources
External debt to GNI ratio	Initial value of external debt to GNI.	88	31.35	327	0	51.25	World Bank's WDI 2010
Population	Initial value of natural logarithm of the total population.	117	14.04	20.32	8.72	1.95	World Bank's WDI 2011
Per capita income	Initial value of the natural log of per capita income.	113	6.71	10.80	4.6	1.22	World Bank's WDI 2011
Urban population (% of total population)	Initial value of the share of urban population in a country's total population.	117	26.96	100	2.00	19.78	World Bank's WDI 2011
Agriculture value added as % GDP	Initial value of the share of agricultural in total value added.	113	30.14	93.00	.83	18.00	World Bank's WDI 2010
Polity2	Initial value of the Polity2 variable.	94	-2.03	10.00	-10.00	6.62	Polity IV version..
Distance from London	Natural log of distance between a country's capital city and London.	117	8.69	9.81	7.40	0.58	CEPII
Dummy for Common law legal origin	Dummy variable taking a value of 1 if the country's legal origin is Common law, and zero otherwise.	108	0.36	1.00	0.00	0.48	QOG
Dummy for Civil law legal origin	Dummy variable taking a value of 1 if the country's legal origin is Civil law, and zero otherwise.	108	0.42	1.00	0.00	0.50	QOG
Sample years	The total number of years for which the per capita income growth is non-missing.	116	37.26	49.00	4.00	12.90	
	Summary Statistics for Variables in the baseline Regression						
Per capita income growth (annual)	The annual per capita income growth.	2525	1.97	35.44	-30.69	5.22	World Bank's WDI 2011
Dummy of stock exchange	Dummy taking a value of 1 if the country has a stock exchange, and zero otherwise.	2525	0.61	1.00	0.00	0.49	
Primary school Enrolment	Gross Primary School enrolment ratio.	2274	96.00	163.71	18.48	23.86	World Bank's WDI 2011
Fixed capital formation (%GDP)	Fixed Capital Formation as a share of GDP	2496	21.52	76.69	2.25	8.06	World Bank's WDI 2011
Government consumption (% GDP)	Government consumption as a share of GDP	2460	11.97	69.83	1.11	7.96	Penn World Table 7.1
External debt (%GDP)	External Debt as a share of Gross National Income (GNI)	2456	72.12	1210.06	1.37	78.76	World Bank's WDI 2011
Life Expectancy at birth	Life expectancy at birth.	2494	62.36	79.32	26.82	9.79	World Bank's WDI 2011

Table 3.5: Countries with stock exchange that are included in the Analysis

Country	Region	Year Stock exchange is formed
Fiji	East Asia & Pacific	1979
China	East Asia & Pacific	1990
Vietnam	East Asia & Pacific	2000
Mongolia	East Asia & Pacific	1991
Thailand	East Asia & Pacific	1975
Papua New Guinea	East Asia & Pacific	1999
Albania	Europe & Central Asia	1996
Armenia	Europe & Central Asia	2001
Belarus	Europe & Central Asia	1998
Georgia	Europe & Central Asia	1999
Moldova	Europe & Central Asia	1994
Romania	Europe & Central Asia	1995
Bulgaria	Europe & Central Asia	1991
Azerbaijan	Europe & Central Asia	2001
Uzbekistan	Europe & Central Asia	1994
Kyrgyz Republic	Europe & Central Asia	1994
Peru	Latin America & Caribbean	1971
Guyana	Latin America & Caribbean	2003
Panama	Latin America & Caribbean	1989
Bolivia	Latin America & Caribbean	1990
Honduras	Latin America & Caribbean	1990
Paraguay	Latin America & Caribbean	1977
Guatemala	Latin America & Caribbean	1987
Nicaragua	Latin America & Caribbean	1990
Costa Rica	Latin America & Caribbean	1976
El Salvador	Latin America & Caribbean	1976
Dominican Republ	Latin America & Caribbean	1991
Jordan	Middle East & North Africa	1999
Algeria	Middle East & North Africa	1997
Nepal	South Asia	1993
Bhutan	South Asia	1993
Sri Lanka	South Asia	1985
Mali	Sub-Saharan Africa	1998
Togo	Sub-Saharan Africa	1998
Benin	Sub-Saharan Africa	1998
Ghana	Sub-Saharan Africa	1990
Niger	Sub-Saharan Africa	1998
Sudan	Sub-Saharan Africa	1994
Malawi	Sub-Saharan Africa	1995
Uganda	Sub-Saharan Africa	1997
Zambia	Sub-Saharan Africa	1994
Senegal	Sub-Saharan Africa	1998
Botswana	Sub-Saharan Africa	1989
Cameroon	Sub-Saharan Africa	2001
Tanzania	Sub-Saharan Africa	1998
Mauritius	Sub-Saharan Africa	1988
Swaziland	Sub-Saharan Africa	1990
Mozambique	Sub-Saharan Africa	1999
Burkina Faso	Sub-Saharan Africa	1998
Cote d'Ivoire	Sub-Saharan Africa	1974
Guinea-Bissau	Sub-Saharan Africa	1998

Figure 3.5: Balancing of Propensity Score

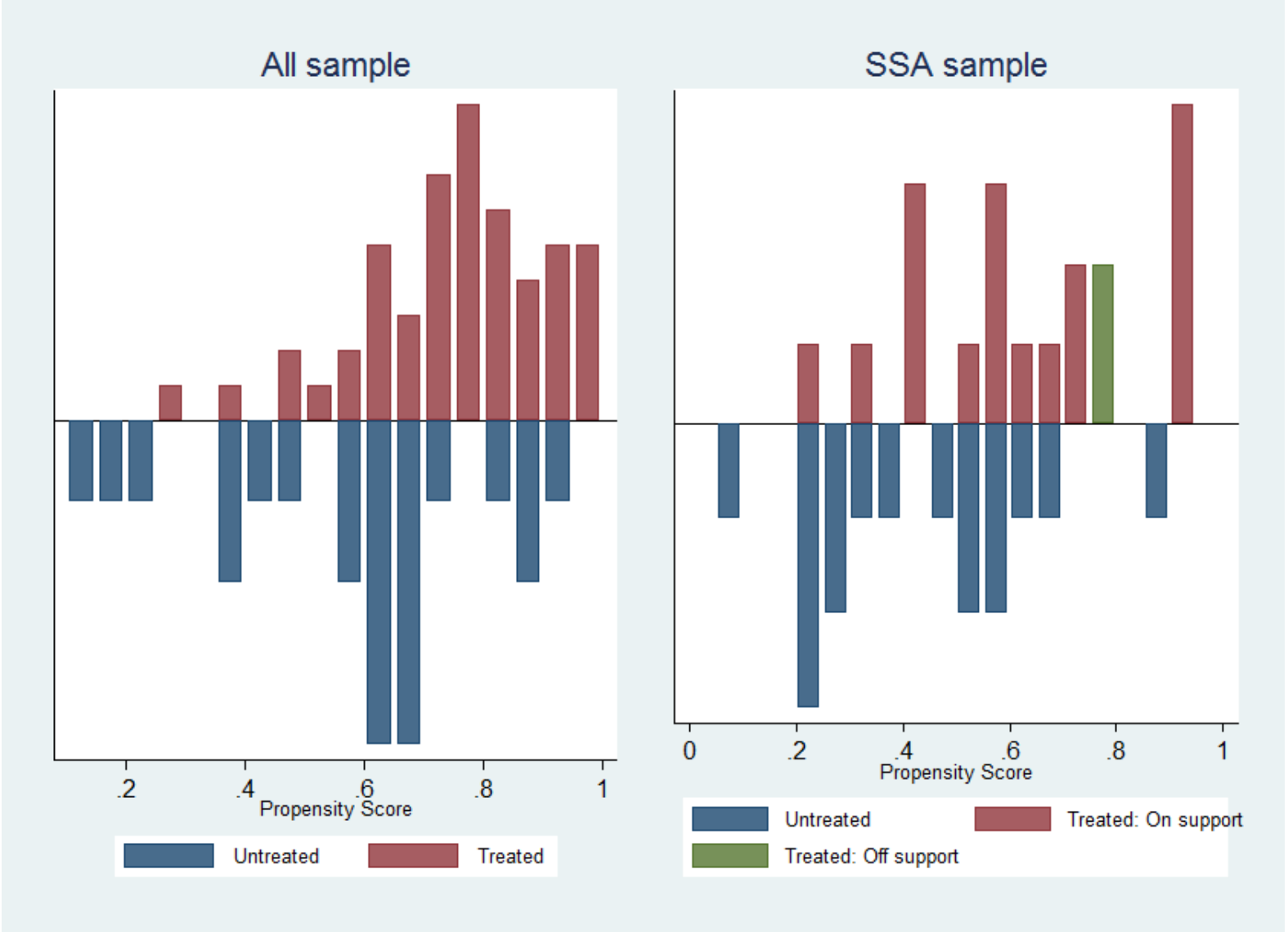


Figure 3.6: Kernel Density of the Propensity Score

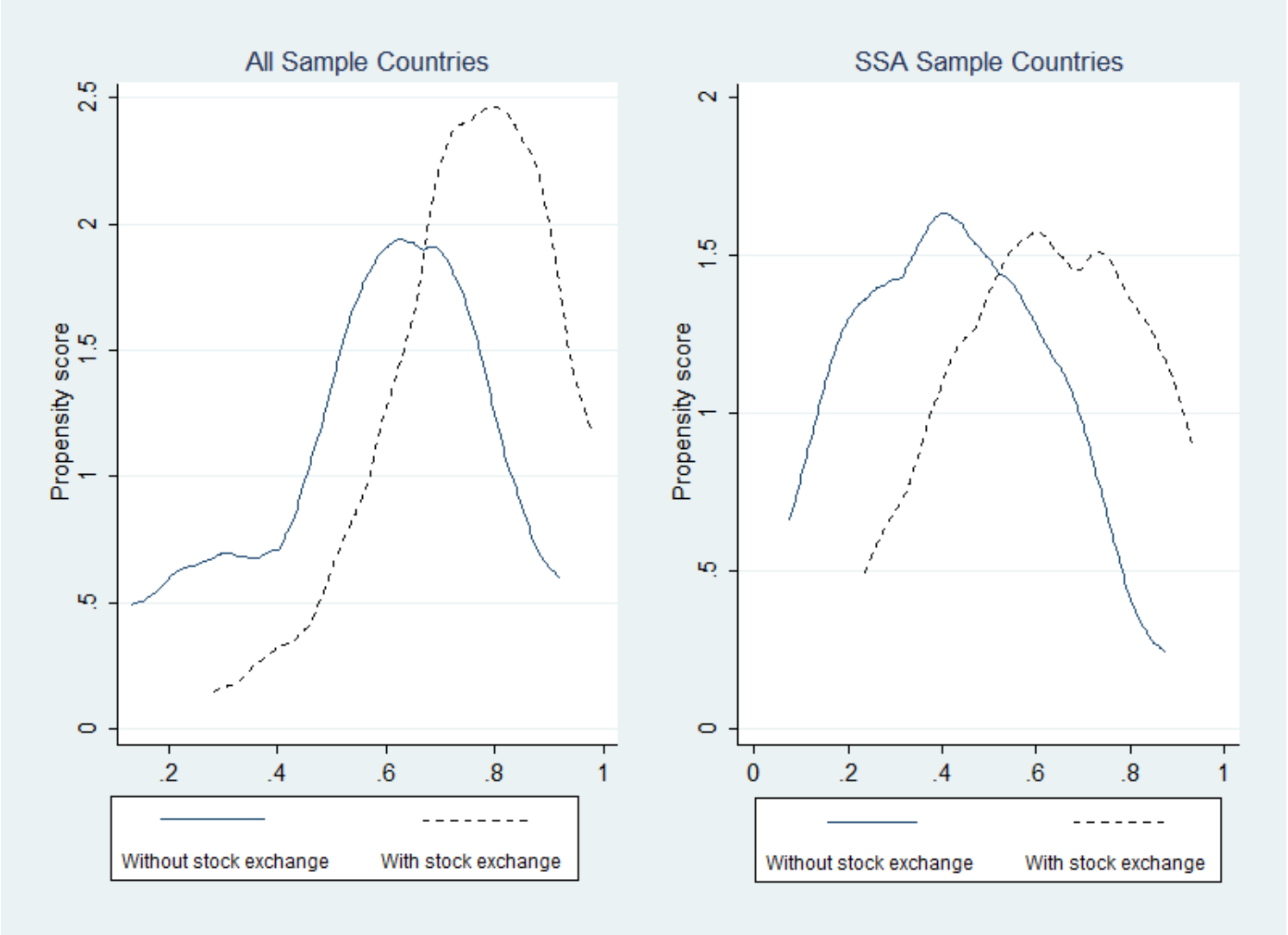
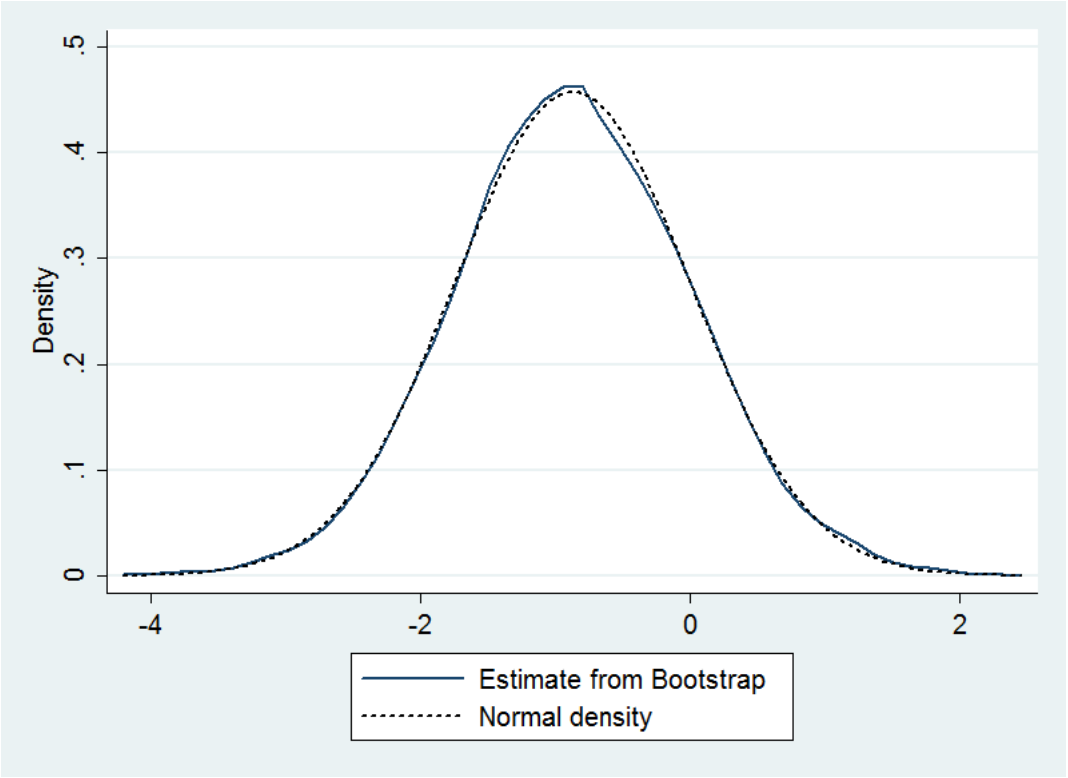


Figure 3.7: Kernel Density of Bootstrapped Estimates of the Parameter



Chapter 4

Endowment, Economic Structure and the Structure of Financial Systems

4.1 Introduction

There is a growing consensus that the financial system is central to the process of economic development. Theoretical as well as empirical studies have overwhelmingly shown that a well functioning financial system is crucial in providing for and sustaining the process of economic development.[1] By agglomerating savings and exploiting funds for investment, by collecting and producing information, thus reducing asymmetric information, and by pooling, trading and diversifying risks, a well developed financial system ensures that resources flow to growth enhancing activities. Not only does it exert a first order impact on growth, but it also plays an important role in reducing the inequality of available opportunities(Levine, 2011; Levine and Demirguc-Kunt, 2008).

A question that logically follows, therefore, is what determines financial development? Various factors have been suggested, chief among them being political sys-

[1] Levine (2005) provides a thorough review of the literature.

tem (see, among others, Rajan and Zingales (2003b); Girma and Shortland (2008)), contract enforcement and, in particular, the efficiency of the legal system (Porta et al. (1998)) and openness to international trade (see, for instance, (Do and Levchenko, 2007)). A related, and particularly contentious issue, is how to design a well-functioning financial system(Levine, 2005). This discussion is often couched in terms of whether it is a market-based or a bank-based financial system that is superior in delivering the key financial services. A vast literature has emerged around this debate. The results, however, are generally inconclusive. Some of the literature finds that financial structure does not matter for economic growth at all (see, among others,Beck and Levine (2000); Levine et al. (2001); Ndikumana (2005)), others show a bank-based system to be better placed in facilitating growth (Rioja and Valev (2011)), and yet others find that a market-based system is superior(Weinstein and Yafeh, 1998).

The validity of these debates and the insights they provide hinges on the implicit assumption that financial structure is exogenously given. It is almost customary in these debates to assume financial structures are given, and the analysis, therefore, is on which of the two is inherently superior in promoting growth and development. What if, however, the structure of the financial system itself evolves with the level of economic development? Under such circumstances, it is generally misleading to consider a given financial structure as inherently superior to the other. Lin et al. (2009) provides this line of argument. The starting point of their theory is that financial systems owe their existence to demand from the real sector of the economy. Although a financial system may not automatically respond to the demand from the real sector of the economy, they evolve to meet the financial needs and to ameliorate specific informational frictions within an economy. Financial systems have a comparative advantage in solving specific types of informational friction and/or in providing financial needs to firms of differing sizes and of differing risk distributions. Since the structure of the economy changes, it is plausible that the optimal financial structure also evolves, primarily in line with the financial needs

of the real sector of the economy.

Does the financial system evolve consistent with the dictates of the structure of the real sector? A question as to what, in general, determines the structure of the financial system is important, specifically for developing countries that often seek information on how to design their financial systems. However, there is generally limited information on this issue.[2] IIn particular, empirical studies examining the link between the structure of the economy and the financial system are few. This paper aims to fill this gap, by providing an empirical examination of the impact of economic structure on the structure of the financial system. We show that the structure of the real sector of the economy has an important first order impact on the structure of the financial system. Allen et al. (2007), to my knowledge, is the only empirical study that investigates the link between economic and financial structures. However, we use a better measure of the structure of the economy and employ an innovative method to deal with the issue of the endogeneity of the structure of the economy. We infer a country's comparative advantage and hence economic structure from its exports. Employing the Rajan and Zingales (1998) type of argument, we then compute the financial structure embedded in a country's exports and hence its comparative advantage.

This essay is related to different strands of the existing literature. First, it is related to the broader literature examining the link between financial structure and economic growth. As noted, this literature has been contentious, often with conflicting findings. The premise in the existing literature is that the financial structure is given, and determined by something exogenous to the economic system. This paper, however, poses the question as to what determines the structure of a country's financial system and provides empirical evidence that the financial system is itself driven by the structure of the economy. The paper is also related to a literature that investigates the link between financial development and international trade.

[2]The evolution of financial system has, however, attracted the theoretical examinations (see, for instance, Boyd and Smith (1998), Blackburn et al. (2005), Chakraborty and Ray (2006)).

Do and Levchenko (2007) examine the impact of trade on financial development by employing an innovative methodology. The paper demonstrates that countries that have comparative advantage in external financial dependent industries are likely to have a well developed financial system. Our paper extends this question and methodology to study the importance of comparative advantage on the structure of a country's financial system. In particular, as noted above, we show that countries that have a comparative advantage in equity dependent industries foster the development of capital markets while those with comparative advantage in bank-finance dependent industries foster a bank based financial system. Beck (2003) studies whether countries with a well-developed financial system develop comparative advantage in external finance dependent industries, and finds supporting evidence for this. In this paper, however, we ask a related but a reverse question as to whether endowment determined comparative advantage shapes the structure of the financial system.

To anticipate our results, we show that the structure of the economy exerts an important and significant causal effect on the evolution of the structure of the financial system. As per our estimate, the elasticity is in fact large, ranging from -0.9 to -1.9, depending on the model. The empirical findings withstand an array of robustness checks. We also provide some additional results. First we are interested to see if the impact of economic structure on financial structure in SSA differs from its effect in other regions. We do not find any significant difference between countries in SSA and those in other regions in terms of the impact of economic structure on the structure of the financial system. Secondly, we investigated if there is any structural break in its effect, in particular since 1990, but found no such pattern.

The rest of the paper is organised as follows. Section 4.2 provides a discussion of the link between economic growth and financial structure, where we discuss how the optimal structure of the financial system changes with the structure of the economy. Section 4.3 discusses the econometric methodology used and introduces the data sources. This section provides a detailed discussion of the measures of economic and

financial structure used in the essay. The section also discusses the instrumentation strategy used to deal with the potential endogeneity of economic structure. Section 4.4 provides and discusses the estimation results. The section starts with a baseline result where we provide our estimation results without addressing the issue of endogeneity of economic structure. We then present results based on instrumenting economic structure using its two year lagged values. This is followed by our main result, where we instrument economic structure using the instrumentation strategy discussed in section 4.3. We also present further results in this section. First, we examine if the impact of economic structure on the structure of financial system is different for Sub-Saharan African countries compared to other regions. Secondly, we see if there is structural break in the effect post 1990. The section concludes by discussing the results of some robustness checks. Section4.5 summarizes and concludes.

4.2 Literature Review

The role of financial systems in the process of economic development has, for a long time, attracted the interests of economists. Some consider it integral to the process of economic growth and structural transformation, while others view it as just a sideshow of the real sector of the economy. A vast literature has emerged examining the link between finance and growth. Both theoretical as well as empirical studies have now overwhelmingly shown that a well functioning financial system is crucial to stimulating and sustaining the process of economic development.[3]

A well functioning financial system does so by providing the following key functions(Levine, 1997). First, it mobilizes savings and provides funds for investment. Secondly, it collects and processes information about entrepreneurs, industries and sectors of the economy, thus facilitating the flow of resources to their best possible uses. Thirdly, the financial system monitors investors and exerts corporate gover-

[3]See gain Levine (2005).

nance, making sure that resources are put to their optimal uses. Fourth, it manages and diversifies cross-sectional, inter-temporal and liquidity risks. By so doing, it encourages investors to part with their resources and entrepreneurs and borrowers to engage in high-risk and high-return activities such as innovation. Finally, a well developed financial system facilitates payments and hence specialization and engagement in trade.

Financial systems are diverse both across time and space.[4] They range from where the financial landscape is dominated by banks (and at times by just few of them) to where it is dominated by markets. This observation, first systematically documented by Goldsmith (1969) and expanded by subsequent studies resurrected an old-age, but yet unresolved, issue: which type of financial system serves these functions best and is, therefore, well equipped in facilitating the process of economic development? The debate has evolved over the many years since then, and Levine (2002a) identifies four strands in the literature. There are those who argue that a bank-based financial system is better placed in enhancing growth and development.[5] Others argue that it is instead a market-based system(i.e., the Anglo-Saxon type of financial system where the stock market dominates) that does the job well. Yet there are those who view this bifurcation as part of a wrong-headed and misplaced debate. In particular, the financial services view underscores that it is not the structure of the financial system that matters for growth and development. Instead it is the level of overall financial development that one should pay attention to. Within this latter category, there are those who argue that it is the legal system that matters and actually also determines the financial system itself.

It is important to be clear about the arguments employed by the proponents of each of these views.[6] The proponents of a bank-based financial system argue that

[4] Beck and Demirguc-Kunt (2010) provides up-todate evidence on this issue.

[5] Greschenkron (1962) is often mentioned as the pioneers of this view. Nevertheless, Greschenkron was not comparing *a bank-based* financial system with *a market-based*. Rather, he examined the key role of universal banking in facilitating the process of industrialization in Germany, and how it was superior to the UK type of banking system.

[6] It is interesting to note, in passing, that the bank-based versus market-based approach is mainly based on the discussion of the comparative advantage of one system over the other. The

banks are well-suited to undertaking the above mentioned key financial services. Information production, as noted above, is one of the key mechanisms through which financial systems aid the process of economic development. However, information is largely a public good and hence its production is vulnerable to the free-rider problem. Consequently it is likely to be underproduced, with serious consequences for the efficient allocation of resources.

The proponents of a bank-based view, however, argue that this problem is particularly acute in a market based system since private information will quickly be disseminated through changes in stock prices (Grossman and Stiglitz, 1980). Specifically, when individuals who have (positive) private information about a company start to buy its stock, prices will rise, sending a signal to other market participants that the company is probably doing well and worth investing in. Hence, market participants can just observe the price movement and get the necessary information without incurring any explicit costs in its production. In the extreme, all market participants may decide to sit and wait for others to generate such information, resulting in no information being produced. In a bank based system, however, information obtained about, say a firm, remains more or less an exclusive property of the bank that generates it.[7] As such, a bank-based financial system is better placed to overcome this problem and hence incentivize information production.

Corporate control and governance provide another key mechanism through which financial systems facilitate economic growth. Financial systems monitor managers and investors to make sure that the capital raised is put to their best use and that managers exert the necessary effort towards ensuring the success of the project. Concentrated ownership is an important pre-requisite for effective corporate governance and control (cite reference). Proponents of a bank-based view note that banks,

financial services view, however, appears to have been driven by the empirical studies that find a lack of importance of financial structure for economic growth.

[7]Note that there is an informational spill-over issue here too to some degree. For instance, when a bank offers a loan contract to a firm, other banks can infer that the company is worth investing. They, therefore, can offer a more competitive price, thus poaching firms away from the first mover bank. This may cultivate a culture where banks are reluctant to be first movers.

as major debt holders, have an incentive to do this much more aggressively than stock market investors. This is so for a number of reasons. Diffuse shareholders are likely to find it difficult to co-ordinate the task of monitoring and ensure adequate corporate governance. In fact, in view of the public good nature of monitoring, there is a high inventive to free-ride on others. Further, shareholders have generally less interest in paying close attention to the firm as they can sell and move away from the firm at any time. That is, shareholders have a weaker attachment to their company than a bank does to its borrower. Hence, the proponents of this view note that a bank-based system has an edge over a market-based one in exercising monitoring and corporate control.

The advocates of a market based view, however, counteract these arguments. They note that individual investors may not have to exert too much effort to monitor firms/borrowers since a stock market has a powerful mechanism to do this. Through take-over threat, stock markets ensure that managers are kept on their toes to make sure the firm performs well. Hence, this will force them to undertake actions that are consistent with that of shareholders, and ensuring that resources are put to their best uses.[8] The proponents of this view go further and note that a bank based system is, in fact, ineffective in undertaking this task, since banks and managers of a firm often collude to protect the firm from take-over and restructuring, thus obstructing the flow of resources to where they should optimally be.

Finally, the proponents of the two views also disagree on which type of financial system performs a better job of trading and diversifying risk. Stock market vests the responsibility of managing risk directly on to the individual. Further, a liquid stock market provides individuals with a large pool of assets to choose from and hence a better chance of diversifying cross-sectional risks. On the contrary, in a bank based system, individuals generally have access to a limited range of assets and

[8]However, many argue that it is ineffective. Grossman and Stiglitz (1980) cites the incentive issue. Further, Singh (1999) also provides empirical evidence that take over is systematically biased against small firm. Hence, it is just the large firms that survive, not necessarily the most efficient ones.

instruments, typically demand, time and savings deposits, and hence limited ability to diversify cross-sectional risks. In fact, as a consequence of their limited ability to diversify such risks, banks generally tend to be very cautious in their investment decisions. As a result, firms are less likely to invest in high-risk high-return activities such as R&D in a bank-based financial system than in a market based one. On the other hand, Allen and Gale (1997) argue that financial intermediaries (i.e., a bank based system) are superior in regard to intertemporal risk diversifications as compared to a market based system. Indeed, they note that the presence of a market based system may prohibit the emergence of such an institution and hence intertemporal risk diversifications.

The financial service view, on the other hand, argues that the market-based versus the bank-based debate neglects an important point. That it is the functioning of the financial system that matters for economic growth, and its structure is of marginal importance. The legal theory of finance further sharpens this view by arguing that it is the efficiency of the legal system and its enforcement that matters for financial development as well as for its effectiveness in promoting economic growth. Hence, as per this view, again the market based versus bank-based debate represents a futile discussion.

These debates have generated a vast empirical literature examining which financial system performs best. Thus, providing a summary of it is worthwhile.[9] Beck and Levine (2000) employ industry as well as firm level data to examine this issue, and find that financial structure does not matter at all. Remarkably, they find that this is so regardless of a country's level of economic development. One would have expected a bank-based (market-based) financial system to enhance creation of new and the expansion of existing firms in low(high) income economies, but they find no such evidence. Similarly, Levine (2002b) employs cross-country regression analysis to determine whether financial structure matters for growth, and, if so, which struc-

[9]This literature is vast and we do not do it justice in covering only a fraction of the existing studies. In the interests of brevity, I will discuss only those most germane to the current analysis.

ture is best. The paper shows not only that financial structure does not matter for per capita income growth, but also that it does not matter for countries at different stages of economic development. That is, essentially the same financial structure can serve countries at different stages of development. Levine et al. (2001) reach similar conclusions using country, industry and firm level data. Employing data on about 100 countries over the years 1965-1997, Ndikumana (2005) shows that while financial development has a positive and significant effect on domestic investments, its structure does not have a significant effect.

Interestingly, empirical evidence in favor of the importance of financial structure also abounds in the literature. For instance, using a firm level study, Tadesse (2006) shows that financial structure matters for innovation and hence the growth of firms. In particular, he finds that a market-based financial system is better suited in enhancing innovation by firms in informationly intensive sectors. This is consistent with Allen and Gale (1999) who argue that a market based system is well-suited to financing activities where there is a diversity of opinion. Rioja and Valev (2011) employ a system Generalized Method of Moments (GMM) on a cross-country data to see if financial structure matters for capital accumulation and productivity growth. They find that, for developing countries, banking sector development has a positive and significant effect on both capital and productivity growth while stock market development do not affect either of these two variables. In developed countries, on the other hand, stock market development affects both productivity and capital growth, while banking sector development affects capital growth alone. Hence, they show that the importance of financial structure for economic growth depends on the stages of development. Interestingly, this is in sharp contrast with the findings of Ndikumana (2005). Carlin and Mayer (2003) provides firm level evidence in support of the view that the importance of financial structure depends on the level of development. Whereas a bank-based system is better suited for countries at a lower level of economic development, it is the market based system that does a better job in countries at higher stages of economic development. Recently, Cull and Xu (2011)

report similar results. Employing firm level data they find that a bank-based financial system facilitates firm growth in low income countries while a stock market is well suited to facilitating firm growth in high income countries. Interestingly, again, this is in contrast to the findings reported in Levine et al. (2001).

Weinstein and Yafeh (1998) provide a detailed study of Japanese firms which are customers of the main banks. They find that these firms are less profitable, do not grow faster and in general pay higher interest rates than firms without a main bank. They argued that not only do banks extract large rents from these firms, they also encourage prudence and are likely to reduce the flow of resources to high-risk and high return activities such as R&D and innovation. They made a forceful observation that "[i]n the absence of contestable capital markets, large banks with close ties to industry siphon profits and restrict investment, and thus may inhibit rather than encourage growth" (Ibid:p666).[10]

From the above discussion, it is fair to say that the empirical as well as the theoretical evidence on the link between financial structure and economic growth is at best inconclusive. This is perhaps not surprising in view of the way the arguments are often framed. Most of these studies investigate whether a given financial structure is inherently superior to the other. Various theoretical studies, however, show that the importance of one financial system relative to the other changes with a country's level of development. For instance, Blackburn et al. (2005) provide a theoretical model describing the evolution of the structure of financial systems. They model households that face both adverse selection, in that they do not know the project selected by the borrower, and moral hazard, in that they do not know the effort exerted. They show how the optimal contract to deal with these problems depends on the stages of a country's economic development. In particular, debt dominated finance is an optimal contract at a low level of economic development while equity dominated financing is an optimal contractual arrangement for econo-

[10] Similarly, Yafeh and Yosha (2003), using Japanese chemical firms, provides some evidence that firms with main bank reduces expenditure on research and development.

mies at a higher stage of development. Consequently, the size of the equity market increases as the economy develops. Boyd and Smith (1998) and Greenwood and Smith (1997), in a similar fashion, provide theoretical models that demonstrate how specific financial structures evolve to solve specific problems at different stages of economic development.

In addition to the theoretical studies, country experience reveals that the evolution of financial structure occurs with the level of economic development. A fruitful research question to investigate, therefore, is whether the optimal structure of the financial system changes with the stages of economic development. Lin et al. (2009) provides a synthesis of this line of argument. Unlike the existing studies on finance and growth wherein the financial system, and in particular its structure, is often assumed to be exogenously determined, this paper proposes a demand side theory of the development of financial systems. With some risk of simplification, the thesis is based on three key arguments. Firstly, and an important point of departure of the paper, is that financial systems owe their existence primarily to the demand from the real sector of the economy. Secondly, the nature of the financial needs and informational friction changes with the structure of the economy. Thirdly, different financial institutions have differing comparative advantages in providing different types of financial services and dealing with different types of financial frictions. As a result, the optimal structure of the financial system changes depending on the stages of the country's economic development.

Although Lin et al. (2009) provides an excellent synthesis of these arguments, it is worthwhile to elaborate further on each of the lines of arguments. The idea that the financial sector of the economy owes its existence to the demand from the real sector of the economy is perhaps plain enough to warrant further discussion.[11] The nature of the financial needs of an economy changes with the level of its development. The size and risk distributions of firms are among the key determinants of the nature of financial demand. Interestingly, these distributions change with the stages

[11] Boyd and Prescott (1986) provide a formalization of this theory.

of economic development(Lin et al., 2009). Countries with abundant unskilled labor and limited capital have a comparative advantage and, all else the same, likely to specialize in labor intensive industries. These types of industries are often in technologically mature sectors. That is, most of the production involves adopting and, to a lesser extent adapting, technologies that have been tried and tested in other parts of the world. Hence, there are relatively limited product and technological innovation risks (Lin et al., 2009; Acemoglu and Zilibotti, 1997). As Lin et al. (2009) notes, the main risk faced by these types of firms is entrepreneurial risk. Further, the size (in terms of capital stock) distribution of firms in these economies are in general positively skewed. Financial structure, therefore, evolves to serve the financial needs of these types of industries. In particular, the nature of the risk distribution of firms in such economies implies that debt financing and entrepreneurial screening is the main task of financial systems. Hence, the appropriate (optimal) financial structure for these types of economies is likely to be bank, and in general, debt finance dominated ones, with financial systems that best serve small sized enterprises.

The size and risk distribution of firms change with the comparative advantage of countries. In particular, as economies develop, they become abundant in capital stock and skilled labor force. They, therefore, have comparative advantage and hence specialize in capital and skill intensive types of activities. These activities are generally in industries that are at the frontiers of their technologies. Such firms are constantly engaged in pushing frontiers of these technologies. Hence they are often in Research and Development (R&D) activities, and therefore face substantial innovation and product risks. Contrary to the size distribution of firms in labour intensive industries, these industries tend to require capital wise large firms. The size distribution of these firms, therefore, is largely negatively skewed. Hence, they need a financial system with a large degree of risk taking and with a large size of loan. Large banks and a well developed financial markets are likely to be suited to economies at this stage of development (Allen and Gale, 1999). In a nutshell, the structure of the financial system evolves with the structure of the economy.

It is important to note that a demand-side theory of financial systems evolution does not necessarily imply that the financial system automatically responds to the demand of the real sector of the economy. Financial systems may fail to evolve with the structure of the real sector for various reasons. Chief among them is the action and/or inaction of government. As is well known from the financial repression literature, governments, particularly those in developing countries, often intervene in the financial sector to direct credit to favored sectors. This have the potential to weaken the alignment of the financial structure with the structure of the real sector, except in special cases where the intervention channels credit to the sectors in which the country has a comparative advantage. [12] At the same time, inaction of government can also block financial systems from evolving in response to the dictates of the real sector of the economy. For instance, the emergence of a given financial system may require specific legal infrastructure to be in place. Such activity, however, generally falls within the realm of the task of the governments. A failure of the government to respond to fill this legal vacuum may hinder the emergence of the appropriate financial system. Nevertheless, conditioning on these obstacles, an economy's financial structure is likely to be driven by the needs of its real sector.

4.3 Empirical Strategy and Data

4.3.1 Empirical Strategy

Equation (4.1) gives the empirical model we seek to estimate.

$$FS_{ct} = \beta_1 + \beta_2 * EXPFS_{ct} + \beta_3 * Z_{ct} + \varepsilon_{ct} \tag{4.1}$$

FS_{ct}, which is discussed in more detail below, is a measure of the financial

[12] Lin et al. (2009) also note how policies aimed to remedy financial repression often have had distortive effects. In reforming the financial systems, most developing countries are often advised to look at and learn from the financial systems in developed countries, such as the US, with a market based system. This, however, is unlikely to lead to the development of financial structure that is compatible with the needs of these economies.

structure of country c in year t. We discuss the concept and measurement of the financial structure in section 4.3.1. $EXPFS_{ct}$, also discussed below, is a measure of the structure of the economy of country c in year t. The parameter of interest is β_2, which measures the impact of the structure of the real sector of the economy on the structure of the financial system. If a comparative advantage determines the financial structure, as argued by Lin et al. (2009), β_2 is different from zero. For instance, countries with comparative advantage in industries that are bank finance dependent (as compared to equity finance dependent) are more likely to develop a bank-based financial system, and *vice versa*.

Z_{ct} comprises other control variables believed to determine the financial structure, and ε_{ct} is the error term for which standard assumptions are made. We follow suggestions in the theoretical literature to guide us on which variables to include in Z. First, Blackburn et al. (2005) and Boyd and Smith (1998) provide a model showing how equity market activity increases only after certain level of economic development. We include per capita income to control for the income level and GDP to control for the size of the economy. We also include a measure of urbanization, captured by the ratio of urban population in total population. Secondly, consistent with the legal theory of finance (see, for instance, Porta et al. (1998)), we include a dummy for the origin of a country's legal system. Thirdly, we include a measure of political freedom, the Polity2 variable, as discussed in essay three of this thesis. Finally, we include other proxies for the structure of the economy, in particular the shares of industry and agriculture in total GDP.

Measures of Economic and Financial Structures

The above discussion raises a key question of how to measure the structure of the economy and of the financial system. This sub-section provides a discussion of these measures. We start with the measure of economic structure. Since our aim is to see the impact of economic structure on the evolution of the structure of the financial system, the ideal measure of economic structure should be something that captures

the size and risk distribution of enterprises in the economy. Nevertheless, such a measure is difficult to compute or obtain, and a simple sectoral composition of the GDP is most definitely not an option. We rely on the following three premises to get a proxy for this. First, the structure of a country's economy at a given point in time is determined by its comparative advantage. Following the Heckscher-Ohiln theory, countries specialize in and export goods and services in which they have a comparative advantage. Hence, all else the same, a country's comparative advantage can be inferred from its export structure. Secondly, economic sectors and activities have differing needs for different mixes of finance. For instance, as noted inAllen and Gale (1997), economic activities that engage in high risk and high return projects, one of the key attributes of innovating firms, are better served by a market-based financial system. Hence, countries with comparative advantage in such activities have stronger demand for and are better served with stock markets. Conversely, activities and sectors that engage in the production of goods and services using mature technologies are likely to be better served by the banking sector. Therefore, we capture the structure of the economy by the implied financial structure embedded within its profile of exports.

In particular, in estimating $EXPFS$ we follow the approach taken by Do and Levchenko (2007). Do and Levchenko (2007) study the impact of trade on financial development, with the specific objective to determine if countries that have comparative advantage in goods that are dependent on external finance are more likely to have a well developed financial sector. To that end, they estimate the external financial dependence of a country's export by appealing to the notion of financial dependence developed and used in Rajan and Zingales (1998). Rajan and Zingales (1998) argue that different sectors have a different technologically determined degree of dependence on external finance. Furthermore, this technologically determined level of dependence on external finance is assumed to be country invariant, in the sense that a technology that is external financial dependent in the U.S. is likely to be so in, say, South Sudan. Since U.S. has a well developed financial sector, Rajan

and Zingales (1998) argue that the external finance dependence of industries in the U.S. may represent this technologically determined optimal level of external financial dependence, in particular taking the 1980s as the optimal years. The approach, therefore, is to use the 1980s values of external financial dependence of U.S firms and apply it to the same industry in other countries.

We follow a similar approach, but estimate the financial structure of the exports instead of its external financial dependence. More specifically, the following equation gives our estimate of $EXPFS_{ct}$:

$$EXPFS_{ct} = \sum_i w_{it} * FSI_i \tag{4.2}$$

where w_{it} is the share of the industry[13] i in country c's total export for year t. FSI_i is the financial structure of industry i in the U.S. More specifically, it is the equity finance dependence of industry i (again, with industry being defined at the three digit SIC) in the U.S., measured as the fraction of capital expenditure financed through issuance of new equity. Following Rajan and Zingales (1998), we take the median value of this variable during the 1980s, and only firms that have at least four years of non-missing data are included in constructing this variable.[14]

It is important to be clear about the measure of economic structure, in particular that it is the product of a constant indicator (i.e., the average equity ratio for each industry–FSI_i) and the changing product composition of a country's export. A specific example may help to clarify this. Consider a country that exports three (at the three digit levels Standard Industrial Classification) products, viz., X, Y and Z. Corresponding to each of these products is three different levels of equity dependence given, respectively, by FSI_X, FSI_Y, and FSI_Z. Calculating the measure of a country's economic structure involves two steps. The first step is to gauge each product's dependence on equity, obtained by multiplying the share of a product in

[13]Note that industry is here defined at three digit Standard Industrial Classification (SIC).

[14]The other option to explore in the future would be to use the ratio of equity dependence of industry i in the US to the same industry's bank dependence in Germany/Japan.

a country's total export by the product's equity dependence. Hence, for product X, this is given by:

$$FSI_X * \left(\frac{X}{X+Y+Z} \right)$$ [15]

.Call this PFS_{Xt}, where X is the product (at three digit SIC) and t is year. In the second step, for each country, we take the sum of PFS_{kt} across all products, k, and that gives our measure of economic structure, $EXPFS_{ct}$.

To examine the behavior of $EXPFS_{ct}$ both across time and space, it is important to closely look at PFS_{kt}. In particular, consider a specific product, X. As noted, the equity dependence measure for this product does not change across time and space, as it is the average of X's equity dependence in the US during the 1980s. Yet, the composite indicator, PFS_{Xt}, varies across time and countries. It varies across countries because the share of X in a country's total export may differ from its share in that of another country. It varies over time because the importance of X in a country's export may change overtime. Since our final measure of economic structure, $EXPFS_{ct}$, is the sum of the index over all individual products, it too varies across space and time for these two reasons. However, $EXPFS_{ct}$ also changes because of the possible overtime change in the composition of goods a country exports. That is, for instance, country A's comparative advantage may shift and, as a result, a less equity dependent product may drop out of its export and be replaced by a new and more equity dependent product, thereby increasing the aggregate measure of its economic structure.

An important upshot of the above discussion is that the equity dependence data from the US just serve as a scaling factor, indicating the degree of implied financial structure embedded in a country's comparative advantage in each year. The variation of the measure of our economic structure is primarily because of the change in the composition of export product and the share in total exports of a particular product over time.

[15] Note that the expression in bracket corresponds to w_t, in equation (4.4), for product X.

Some of the potential drawbacks of our measure of economic structure may be evident from the above discussion. Firstly, by relying on a country's export as an indicator of its comparative advantage, the measure assumes away the fact that exports could possibly reflect policy distortion and not exclusively comparative advantage. Secondly, by concentrating on the exports of goods, our measure not only ignores the non-exporting sectors but also the increasingly important service sector exports. Finally, another key potential weakness is the use of a particular country's equity dependence over a particular decade in calculating the measure of economic structure. Although this methodology has been used in many studies examining the impact of financial development on various outcome measures, this is admittedly open to both criticism and improvements. Nevertheless, with all its limitations, we believe that this measure better captures the economic structure of a country for the specific issue at hand. In particular, it reflects better the structure of the economy than using the shares of different sectors of the economy in total GDP. The fact that it offers a better instrumentation strategy is another added advantage of this measure. One potential problem with using some measure of sectoral composition of GDP is that there is an issue of endogeneity, emanating, for instance, from a possible reverse causality running from financial structure to the sectoral composition of GDP. Hence, causal inference requires using appropriate instruments, which are often hard to come by, as discussed in Allen et al. (2007). Our measure, however, allows us to exploit an innovative instrumentation strategy, as discussed below.

The other measurement issue is our dependent variable. Financial structure is an all inclusive concept and can mean various things.[16] It may mean the mix of the different financial institutions (i.e., intermediaries and markets). It may also mean the distribution within a particular type of institution with respect to certain variables; for instance, the size or age distribution of banks. In the bulk of existing studies, financial structure is often taken to mean the relative importance of bank

[16] Lin et al. (2009) provides an interesting discussion of the concept of financial structure.

and market in a country's financial system. We follow the same concept of financial structure. Various measures have been proposed to capture this (see, (Levine, 2002b) for a discussion of these measures). We use three of the measures commonly used in the literature. First, we use a measure designed to capture the relative size of a country's banking sector to the size of its stock market. This measure is given by the ratio of bank credit to the private sector as a fraction of GDP to the market capitalization of the stock market as a fraction of GDP, where market capitalization is defined as the total value of shares listed in the stock exchange.[17] Following the literature, we call this measure the *size structure*, and it measures the extent to which a country's financial system is bank based. A higher value of this measure, therefore, indicates a more bank based financial system, and *vice versa*. Second, we use a measure constructed to capture the relative activity of a country's banking sector to its stock market. This measure is given by the ratio of bank credit to the private sector as a fraction of GDP to stock market value traded as a fraction of GDP, stock market value traded being the annual turnover of the stock market in the country. Again following the literature, we call this the *activity structure* of the financial system, and again, a higher value indicates a financial system with more active banking sector relative to the stock market. Finally, we construct a combined measure of financial structure, given by the first principal component[18] of the *size structure* and *activity structure* of the financial systems.

[17] GDP cancels out since both the numerator and denominator are as a fraction of GDP.

[18] This is essentially a weighted average of the *size structure* and *size activity* where the weights are the eigan vectors of the covariance matrix of the two variables. More formally, consider n observations on p variables $X = (x_1, x_2, ...x_p)$, with a covariance matrix of Θ. Define the first principal component of the variables as a weighted linear combinations, given by:

$$PC_1 = a_i^T X = \sum_{i=1}^{p} a_{i1} x_i$$

The weight, a, is chosen such that it maximizes the variance of $PC_1 = a^T \Theta a$, subject to $a^T a = 1$ (see Shlens (2009) for a detailed description of principal component analysis).

Endogeneity of Economic Structure and Instrumentation Strategy

As it is, $EXPFS_{ct}$ can be a good measure of a country's economic structure for the issue at hand. An important question, however, is if the coefficient of β lends itself to a causal interpretation. This may not be the case since $EXPFS_{ct}$ is potentially correlated with ε_{ct} in equation 4.1. First, there is a possibility of reverse causation from financial structure to the structure of a country's export. That is, it is possible that countries with a bank-based financial system may develop a comparative advantage in sectors that are debt finance dependent.[19] Second, $EXPFS$ is not a perfect measure of the structure of the economy. Hence there is an issue of measurement error, leading to a possible correlation between the error term and $EXPFS$. Finally, it is possible that both financial structure and the structure of the economy are driven by unobservable variables that are in some way correlated.[20] Do and Levchenko (2007) provide an innovative instrumentation strategy, by exploiting a strategy first used in Frankel and Romer (1999).We follow similar strategy here. More specifically, this involves instrumenting $EXPFS$ by a measure constructed using the values of export predicted from an estimated gravity model. The procedure therefore is as follows. First, the predicted values of export are obtained from equation 4.3. w_{it} is then constructed based on these predicted values.

We estimate the following gravity type model to obtain the predicted values of exports:

$$\begin{aligned} EXP_{xodt} \quad = \quad & lnarea_o + lnarea_d + lndist + contig + comlang_{off} + lngdp_{dt} \qquad (4.3) \\ & + lnpop_{dt} + contig * lngdp_{dt} + lndist * comlang_{off} + lndist * lngdp_{dt} \\ & + comlang_{off} * lngdp_{dt} + comlang_{off} * lnpop_{dt} + lndist * lnpop_{dt} + \varepsilon_{it} \end{aligned}$$

[19] Although not specifically about financial structure, Beck (2003) finds that countries with well developed financial system are likely to develop comparative advantage in external financial dependent sectors.

[20] Of course, in so far as these unobservables are time-invariant and country specific, fixed effect estimator of β is still consistent. The problem, however, is that some of the unobservable could possible be time variant.

where EXP_{xodt} is country o's export of commodity x, at three digit Standard Industrial Classification (SIC), to country d in year t, deflated by the exporting country's GDP; $lnarea_o$ and $lnarea_d$ are the natural log of the area of the exporting and importing countries, respectively; $lndist$ is the natural log of the distance between the major cities of the importing and exporting countries; $contig$ is a dummy taking the value of 1 if the importing and exporting countries are contiguous, and zero otherwise; $comlang_{off}$ is a dummy taking the value of 1 if the two trading countries have a common official language, and zero otherwise; $lngdp_{dt}$ is the natural log of importing country's GDP; $contig * lngdp_{dt}$ is the interaction term between the dummy of contiguity between the two countries and the GDP of the importing country; $lndist * comlang_{off}$ is the interaction term between distance between the two countries and dummy of common official language between them; $lndist * lngdp_{dt}$ is the interaction term of distance between the two countries and the GDP of the importing country; $lngdp_{dt} + comlang_{off}$ is the interaction term of dummy of common official language and the GDP of the importing country; $comlang_{off} * lnpop_{dt}$ is the interaction term of dummy of common official language and the population of the importing country; $lndist * lnpop_{dt}$ is the interaction term between the distance between the major cities of the two countries and the size of the population of the importing country; and ε_{it} is the error term. We estimate equation (4.3) at three digit Standard Industrial Classification (SIC) and use the estimated model to predicted the value of export, $\widehat{EXP}_{xeit}$.[21] We then use these predicted values to calculate the new measure of the financial structure embedded in a country's export, given as follows:

$$\widehat{EXPFS}_{ct} = \sum_i \widehat{w_{it}} * FSI_i \tag{4.4}$$

[21]One issue in the gravity type of analysis is dealing with observations with zero values, i.e., country pair-year observations for which there are no exports. Since our dependent variable is in natural logarithm, this observations are not part of the estimation of the gravity equation. However, we use the estimated equation to predict the implied trade for these countries. In short, although these observations are not part of the estimation of the gravity equation, they are part of the estimation of $\widehat{EXP}_{xeit}$. This is a conventional strategy followed in the gravity literature(Anderson and Wincoop, 2003). However, we also estimate the gravity equation replacing zero exports by one. That is, we estimate $\ln(1 + EXP_{xeit})$, and our result does not change materially.

where $\widehat{w}_{it} = \frac{\widehat{EXP}_{xeit}}{\sum_i^I \widehat{EXP}_{xeit}}$; I is the total number of commodities exported by country c in year t, and FSI is as defined earlier.

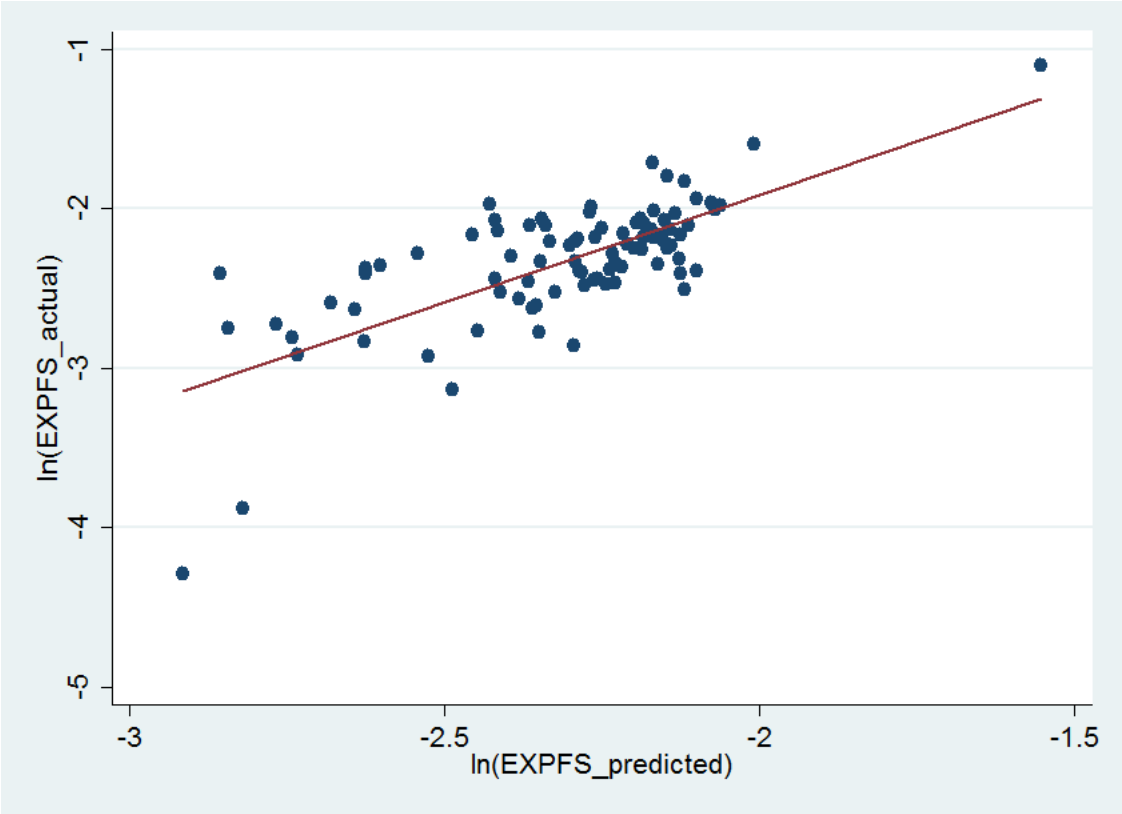
Therefore, we instrument $EXPFS_{ct}$ by $\widehat{EXPFS}_{ct}$. It is important to note that selection of variables to include in the gravity equation is guided primarily by the issue of reverse causality. More specifically, since our aim is to construct an appropriate instrument for our measure of economic structure based on the predicted values of trade, the validity of the instrument requires that variables that enter the gravity equation should not directly effect (and be affected by) the structure of the financial system. Table 4.7 reports estimate of the gravity equation for selected industries. Most of the coefficients are in line with existing studies (Anderson and Wincoop, 2001). For instance, the size of the destination country, captured by population, has a positive effect on bilateral trade; the distance between the two trading countries has a negative effect on bilateral trade; and contiguity of the two countries positively affect the bilateral trade flows.

Figure 4.1 provides a scatter plot of our measure of economic structure constructed using actual values of exports against the measure constructed using the predicted values of exports. As can be seen, the two are strongly correlated, hinting that $\widehat{EXPFS}_{ct}$ is a relevant instrument for $EXPFS_{ct}$. Figure 4.2 provides the trend in the measure of economic structure, $EXPFS_{ct}$, and its instrument, i.e.,$\widehat{EXPFS}_{ct}$, indicating that the two variables vary over time.

The instrumentation strategy follows mainly the approach used in (Do and Levchenko, 2007). However, it is important to note the main difference of our strategy. Do and Levchenko (2007) study the impact of trade on overall financial development, instrumenting trade using a measure of financial dependence predicted from gravity type equation. In our case, the objective is to examine the impact of the structure of the economy on the structure of financial system, and not on the overall financial financial development. Further, unlike them, our constructed instrument is not the overall external finance (which includes both equity and debt finance) dependence of exports, but the equity finance dependence of exports. Therefore, our instrument

is meant to capture the financial structure embedded in a country's export rather than the external finance dependence of it.

Figure 4.1: Scatter plot of Measures of financial dependence of Export based on actual and predicted trade



4.3.2 Data and Sample Selection

The data used in this chapter come from various sources. The export data comes from the National Bureau of Economic Research-UN World trade database (Feenstra et al., 2005). This database contains bilateral trade data from 1962 to 2000 for a large set of countries on commodities disaggregated at four digit Standard International Trade Classification (SITC) revision 2.[22] Per capita income, GDP and its sectoral composition, and population data come from World Bank sources. Data on distance between trading countries, area and contiguity of trading countries come

[22]Since we estimate the equation at three digit SIC code, to estimate the gravity equation, we convert the trade data to three digit SIC using concordance data provided by Feenstra on http://cid.econ.ucdavis.edu/data/sasstata/usxss.html.

from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) databse (Head et al., 2010), while data on the legal origin and a measure of political freedom come from Quality of Government Data (QoG) at the University of Gothenburg (Samanni et al., 2010). The data used to calculate the equity dependence are obtained from Datastream. Data on variables used to construct the measures of financial structure come from the dataset compiled by Thorsten Beck, Asli Demirg-Kunt and Ross Levine(Beck et al., 2010a).

The selection of countries included in the analysis is determined by data availability.[23] As such, all countries with non-missing data for all of our variables are included in the analysis. After combining the relevant dataset, we are left with a total of 86 countries, with the year ranging from 1975 to 2000. Hence, although the bilateral trade data are available from 1962 to 2000, we use data from 1975 to 2000 to estimate equation 4.3. Table 4.8 provides the list of countries in our sample. Table 4.1 reports the description of the variables used in the analysis and also contains some selected summary statistics. The countries in our sample are diverse in terms of their level of development, with per capita income ranging from \$700 to \$48,000, as well as the structure of the financial system, with *size structure* of financial system ranging from .17 (stock market dominated) to 500 (bank dominated). The diversity is particularly stark in terms of the activity of the banking sector relative to the stock market. The *activity structure* of the financial system ranges from as low as 0.2 (more active stock market relative banking system) to 67,000 (more active banking system relative to stock market).

4.4 Results and Discussion

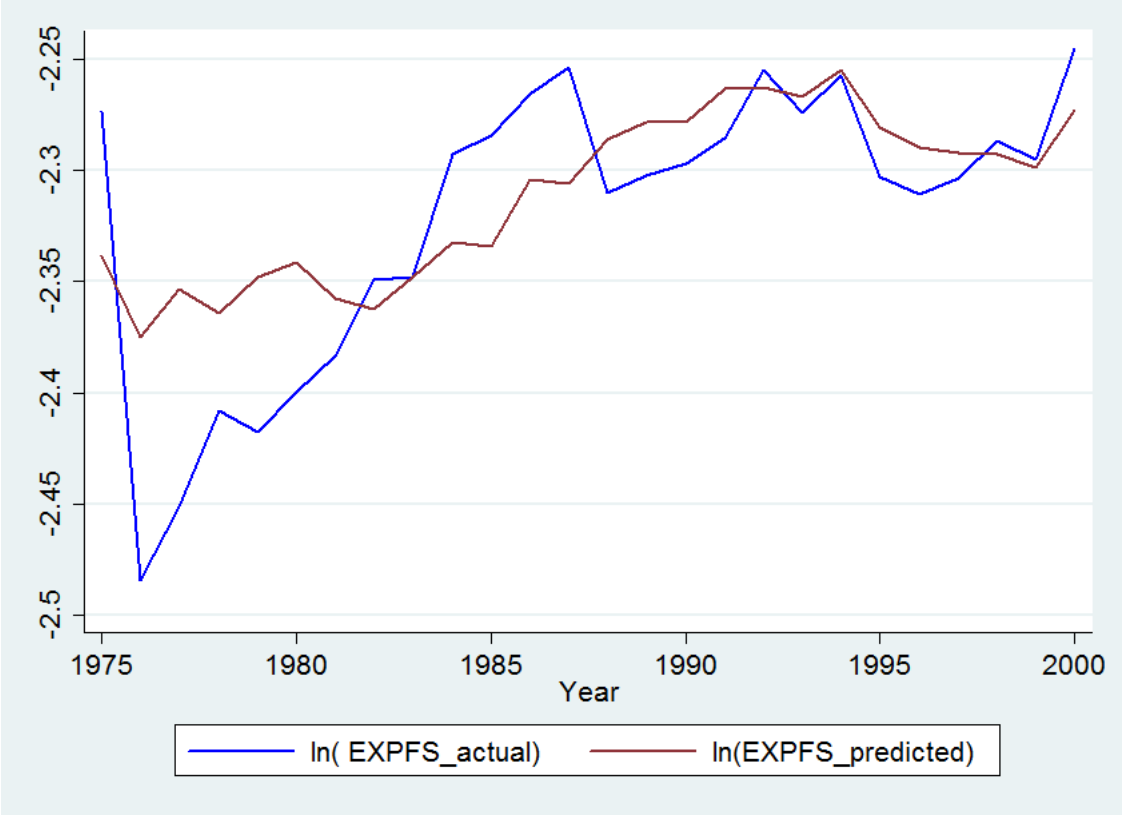
This section presents and discusses estimation results of equation 4.1. In section 4.4.1, we present the baseline results where we use estimates of $EXPFS_{ct}$ without

[23] This is with the exception of the U.S. Since we use US equity dependence as a benchmark, the country is dropped from our sample so that it does not bias our result.

Table 4.1: Variables and Summary Statistics

Variable	Description of Variables	Mean	Max	Min	Sd.	N
ln(sizestructure)	The ratio of total credit to private sector (as a percentage of GDP) as ratio of stock market capitalization.	0.82	6.20	-1.80	1.17	963
sizestructure	The ratio of total credit to private sector (as a percentage of GDP) as ratio of stock market capitalization.	7.61	492.78	.16	30.3	963
ln(sizeactivity)	The ratio of credit to private sector (as a percentage of GDP) to stock market value traded.	2.58	11.12	-1.56	1.98	1018
sizeactivity	The ratio of credit to private sector (as a percentage of GDP) to stock market value traded.	270.42	67486.60	.21	2511.24	1018
sizeall	Measure of combined financial structure, principal component of size structure and size activity.	0.00	4.35	-2.19	1.00	936
ln(EXPFS)	Measure of economic stricture based on actual value of export.	-2.30	-0.79	-4.70	0.39	1047
EXPFS	Measure of economic stricture based on actual value of export.	-2.30	-0.79	-4.70	0.39	1047
ln($\widehat{EXPFS}$)	Measure of economic structure based on the value of export predicted from estimated gravity model.	.11	.45	.01	0.04	1047
$\widehat{EXPFS}$	Measure of economic structure based on the value of export predicted from estimated gravity model.	.12	.19	.02	0.02	1047
ln(gdp)	Gross Domestic product, in constant 2000 US dollars.	24.79	29.17	20.67	1.65	1045
ln(gdpercapita)	Per capita income.	8.98	10.68	6.61	1.04	978
urbanization	Percentage of urban population.	60.14	100.00	8.50	21.82	1047
agrval_prcnt	The share of agriculture in total value added.	11.92	47.10	0.07	9.94	983
indval_prcnt	The share of industry in total value added.	31.61	60.56	13.40	7.27	983
Polity	An indicator of democracy with a scale between 0 (least democratic) and 10 (most democratic)	7.07	10.00	0.00	2.90	995
Polity2	As above, but with missing values replaced by imputed values.	7.14	10.00	0.00	2.90	1020
Common	Dummy variable taking a value of 1 if the country's legal origin is British Common law, and zero otherwise.	.44	1	0	.46	1047
Civil	Dummy variable taking a value of 1 if the country's legal origin is Civil law, and zero otherwise.	.32	1	0	.50	1047

Figure 4.2: Trend in economic structure- actual and predicted trade



addressing the endogeneity issue. Section 4.4.2 provide the main results, where we first present estimation result by instrumenting $EXPFS_{ct}$ by its two years lagged values and then discuss the results based on instrumenting the key explanatory variable for our analysis, $EXPFS_{ct}$, by $\widehat{EXPFS}_{ct}$. We end this section by providing some further results and robustness check in section 4.4.3.

4.4.1 Baseline Results

Table 4.2 provides fixed effect estimate of equation 4.1 using $EXPFS$ without dealing with its potential endogeneity. Standard errors are robust to unknown miss-specification and time and country fixed effects are controlled for in all the models. Columns (1) through (3) provide results where the dependent variable is *size structure*. Column (1) gives result of regressing *size structure* on just $EXPFS$. As can be seen, economic structure enters with a negative and statistically significant coefficient, indicating that, controlling for country and time fixed effects, countries

with comparative advantage in equity dependant activities are more likely to have a market based financial system, *all else remaining the same*. In fact, since both the regressor and regressand are in natural logarithm, the point estimates can be interpreted as the partial elasticity of financial structure with respect to the structure of real economy. The point estimate -0.7, therefore, indicates that financial structure is inelastic with respect to the structure of the economy.

Column (2) of the table gives estimates for the coefficient after controlling for per capita income, to see if economic structure still remains relevant determinant of financial structure after controlling of the level of income, in addition to the country and time fixed effects. As can be seen, the coefficient of our key variable is still negative and statistically significant at the 10% level. Per capita income also enters with a negative coefficient, although not significantly different from zero. In column (3) we control for additional variables, viz., the size of the economy, as captured by GDP[24], urbanization, sectoral compositions of GDP and a measure for democracy. Our variable of interest enters with negative coefficient, but is not now statistically significant.

Columns (4) through to (6) of the table provide estimates using *activity structure* as the dependent variable. As in the case of the *size structure* of the financial system, this measure also captures the importance (but in terms of activity) of the banking sector relative to that of the stock market. As column (4) shows, where the regression includes just $EXPFS$, our variable of interest enters with a negative and statistically significant coefficient, indicating again a strong association between the structure of the economy and that of the financial system. The result remains the same after controlling for per capita income (see column (5)). As column (6) shows, $EXPFS$ still enters with a negative and significant coefficient after controlling for a host of variables in addition to country and time fixed effects.

The result is largely similar for combined structure of the financial system as

[24]We control for GDP since the structure of a country's financial system potentially depends on the size of the economy. In particular, forming a stock exchange and the growth of equity market is viable primarily in a larger economies.

Table 4.2: Estimates of Fixed Effect Model

Fixed effects estimation result of equation (4.1). The dependent variables are the size, activity and combined structures of the financial system. Standard errors are robust to unknown misspecification.

	ln(sizestructure)	ln(sizestructure)	ln(sizestructure)	ln(sizeactivity)	ln(sizeactivity)	ln(sizeactivity)	ln(sizeall)	ln(sizeall)	ln(sizeall)
ln ($EXPFS_{ct}$)f	-0.684**	-0.671*	-0.527	-1.078*	-1.280*	-1.275**	-0.638**	-0.722**	-0.755**
	(-2.10)	(-1.78)	(-1.38)	(-1.76)	(-1.93)	(-2.27)	(-2.25)	(-2.00)	(-2.50)
ln(gdpercapita)		-0.736	-4.095***		-0.833	-6.936***		-0.561	-4.340***
		(-1.08)	(-3.35)		(-0.81)	(-3.32)		(-0.91)	(-3.70)
ln(gdp)			4.558***			7.742***			4.734***
			(4.14)			(3.66)			(4.39)
urbanization			-0.0171			-0.0469			-0.0263
			(-0.37)			(-0.76)			(-0.69)
agrval_prcnt			0.0385			-0.0109			-0.00797
			(1.01)			(-0.22)			(-0.25)
indval_prcnt			-0.00512			-0.0540*			-0.0147
			(-0.29)			(-1.90)			(-0.94)
Polity2			0.0249			0.152*			0.0640*
			(0.59)			(1.95)			(1.68)
_cons	-0.216	6.707	-74.44***	2.042	8.698	-123.3***	-0.892	4.222	-76.86***
	(-0.23)	(1.13)	(-4.28)	(1.37)	(0.97)	(-3.50)	(-1.16)	(0.78)	(-4.61)
Country Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	963	917	834	1018	954	869	936	895	815
R-Square	0.165	0.106	0.000475	0.181	0.275	0.0348	0.211	0.218	0.00460

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

column (7) to (9) of the table reveals. Again, the coefficient of our variable of interest is negative and statistically significant, indicating the importance of the structure of the real sector of the economy in shaping the structure of the financial sector. Interestingly, the coefficient still remains significant, at least at the 10% level, after controlling for additional explanatory variables.

One of the drawbacks of fixed effect estimation is that it eliminates time invariant variables. Random effect estimation is handy when one is interested in the coefficients of such variables. Nevertheless, it comes at a cost in terms of the appropriateness and the potential validity of the estimated results. First, random effect estimation assumes no correlation between unobservable country fixed effects and the covariates included in the regression. Second and importantly, it assumes that the panel units are a random draw from a large population, an assumption unlikely to be met by macroeconomic panel datasets. Nevertheless, we report the results of the random effects estimation mainly for the sake of completeness, and warning that the results be interpreted with extreme caution.[25]

Table 4.3 provides the random effect estimate of equation 4.1. Columns (1) to (3) gives estimates using the size structure of the financial system as the dependant variable. Column (1) provides the results where the regression includes only our variable of interest. As can be seen, economic structure enters with a negative and statistically significant coefficient. The coefficient of the variable remains effectively the same after controlling for per capita income, as column (2) shows. Column (3) provides estimates controlling for the legal origin dummy, and other variables. As can be seen, the result of our key variable does not change. Interestingly, the dummy for the Common/British legal origin enters with a negative and statistically significant coefficient, indicating that countries with a Common/British legal system are likely to foster larger size of stock markets relative to the banking sector.

Although the point estimate is higher than for the *size structure*, the result of

[25]As a matter of fact, as given in table 4.3, Hausman type of test indicates that the Random Effect Model is not appropriate in this case. Hence, the random effect result is just provided for the purpose of comparison.

Table 4.3: Estimate of Random effect model

Random effects estimation result of equation (4.1. Standard errors are robust to unknown misspecification.

	ln(sizestructure)	ln(sizestructure)	ln(sizestructure)	ln(sizeactivity)	ln(sizeactivity)	ln(sizeactivity)	ln(sizeall)	ln(sizeall)	ln(sizeall)
ln ($EXPFS_{ct}$)	-0.600***	-0.543***	-0.365**	-1.053***	-1.038***	-0.753***	-0.571***	-0.558***	-0.421***
	(-4.95)	(-3.90)	(-2.18)	(-4.68)	(-4.16)	(-2.88)	(-5.13)	(-4.39)	(-3.08)
ln(gdpercapita)		-0.204***	0.0362		-0.673***	-0.322		-0.256***	-0.133
		(-2.73)	(0.18)		(-5.47)	(-1.25)		(-4.35)	(-0.93)
ln(gdp)			-0.0631			-0.354***			-0.121**
			(-0.91)			(-3.65)			(-2.42)
urbanization			-0.00403			-0.00777			-0.00588
			(-0.60)			(-0.88)			(-1.23)
agrval_prcnt			0.0319			0.00312			0.00434
			(1.50)			(0.13)			(0.36)
indval_prcnt			0.00260			-0.0227			-0.00261
			(0.24)			(-1.46)			(-0.30)
Common			-0.970***			-0.339			-0.490***
			(-3.53)			(-0.94)			(-2.71)
Civil			-0.216			0.704*			0.159
			(-0.76)			(1.95)			(0.82)
Polity2			0.0562**			0.136***			0.0700***
			(2.56)			(3.91)			(3.76)
_cons	0.202	2.557***	2.125	2.461***	8.184***	14.43***	-0.534	2.119***	4.315***
	(0.46)	(3.18)	(1.14)	(3.60)	(6.22)	(5.04)	(-1.42)	(3.20)	(3.15)
Country Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	963	917	834	1018	954	869	936	895	815
R-Square	0.168	0.162	0.294	0.182	0.274	0.407	0.213	0.243	0.367
Hausman Test	52.38	57.37	116.58	53.06	46.11	111.30	53.79	55.93	143.24
P-Value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

our key variable is the same for the *activity structure* of the financial system, as reported in columns (4) to (6). In all of the three models, the coefficient of the measure of economic structure is negative and is well determined. Columns (7) to (9) provide results using *combined structure* as the dependant variable. As can be seen, the results are broadly comparable to the estimates obtained using the size and activity structures. In particular, our variable of interest is negative and significant in all of the four models.

4.4.2 Results of Instrumental Variable Estimation

The previous sub-section shows that the structure of the real economy has a statistically significant association with the structure of the financial system. Interestingly, it remains so even after controlling for a host of important variables believed to determine the structure of the financial system. However, tables 4.2 and 4.3 are based on a contemporaneous measure of economic structure. As noted in section 4.3.1, a potential problem with this estimation is the endogeneity of $EXPFS$. Therefore, the estimates of the elasticity based on $EXPFS$ may be biased. In this section, we present results that try to circumvent this problem. First, we instrument $EXPFS$ by its value lagged by two years. We then present our main result, i.e., instrumenting $EXPFS$ by $\widehat{EXPFS}_{ct}$, a variable constructed using values of exports predicted from a gravity model.

Estimation Result using Internal Instruments

One of the attractive features of using panel data, in particular one with fairly large T as in our case, is that it enables one to potentially deal with endogenous variables by using internal instruments. Revisit our estimable equation (4.1), which, with some modification can be given by:

$$FS_{ct} = \beta_1 + \beta_2 * EXPFS_{ct} + \beta_3 * Z_{ct} + \mu_i + \varepsilon_{ct}$$

All the variables are as defined in equation 4.1, except we have now included μ_i,

which is a country fixed effect. In first difference form, and focusing the discussion on our key variable, $EXPFS$, this equation is given by:

$$\Delta FS_{ct} = \beta_1 + \beta_2 * \Delta EXPFS_{ct} + \Delta\varepsilon_{ct} \tag{4.5}$$

were $\Delta y_{it} = y_{it} - y_{it-1}$, y being all the variables in the equation.

Consistent estimation of β_2 requires that $E(\Delta EXPFS_{ct}\Delta\varepsilon_{ct}) = 0$. Hence, consistent estimation requires obtaining variables that are correlated with $\Delta EXPFS_{ct}$ but not with ε_{ct}. Under the mild assumption of sequential exogeneity, [26] lagged values of $EXPFS$ present themselves as potential internal instruments. One option is to use a specific lag, say, a two years lags, of it as an instrument. Anderson and Hsiao (1982) follow a similar strategy, but in the context of panel models with a lagged dependant variable among the regressors. Table 4.4 provides the fixed effect estimate of the model, instrumenting $EXPFS$ by its value lagged two years. Columns (1) to (3) give the estimates using *size structure* as the dependant variable. From column (1), our key variable enters with a negative and statistically significant coefficient, indicating a marginally inelastic relationship between the size structure of financial system and the structure of the economy. The coefficient remains negative and significant even after controlling for additional variables including the size of the economy, urbanization, sectoral composition of GDP and a measure of democracy. The table reports roughly similar result for *size activity*, as column (4) to (6) shows. Without controlling for other variables, the measure of economic structure enters with a negative coefficient but is not significant as column (4) shows. However, as columns (5) and (6) show, our key variable becomes significant when we control for other variables. Columns (7) to (9) give the result for the *combined structure* of the financial system. As can be seen, the measure of economic structure enters with

[26] Note the difference between *sequential* and *strict* exogeneity. Strict exogeneity requires that $E(\varepsilon_{it}|EXPFS_{it}) = 0 \forall t$. This in effect means that ε at time t is not correlated with $EXPFS$ at any time t, both lagged and future time. *Sequential exogeneity*, however, requires that ε_{it} be uncorrelated with the current and past values of $EXPFS$, but can be correlated with its furture value. Hence, sequential exogeneity requires that $E(\varepsilon_{it}|EXPFS_{i1}, EXPFS_{i2}...EXPFS_{is} = 0)$ where $t = s + 1$)

a negative and statistically significant coefficient, both when it enters the equation alone as well as with additional control variables.

These results may go some distance in providing reassurance of the fact that the structure of the real sector of the economy has an important effect on the structure of the financial system. Consistency of β_{it}, in table 4.4 requires that the instrument be valid. The instruments need to be relevant, which means that the lag(s) of $EXPFS$ should be correlated with $EXPFS$. They should also be exogenous, which in this case requires that ε_{it} is not serially autocorrelated. [27] Test statistics are provided at the bottom of both tables. The results indicate that the instruments are relevant in both cases. However, the null of serial autocorrelation of ε is not rejected, except for few of the models, which means the instruments may not be exogenous and hence not valid.

Estimation results using External Instrument

We now present our main result, where $EXPFS$ is instrumented by a measure constructed using a value of export predicted from estimated equation (4.3). Table 4.4 provides the results of a two stage fixed effect estimation method.[28] Standard errors are robust to unknown mis-specification and the model is estimated with Generalized Method of Moments (GMM). Time fixed effects are also controlled for. Columns (1) to (3) give the estimation results for *the size structure* of the financial system. As column (1) shows, without controlling for other variables apart from the country and time fixed effects, our variable of interest enters with a negative and statistically significant coefficient. The elasticity estimate is roughly minus 1, indicating a unitary elastic response of the size structure of the financial system to the structure of the economy.[29] As column (2) shows, controlling for per capita income

[27] For instance, if ε is an $AR(1)$ process given by, say, $\varepsilon_{it} = \alpha\varepsilon_{it-1}$, it means that $\varepsilon_{it} = \alpha^2\varepsilon_{it-2}$. The $E(EXPFS_{it-2}\Delta\varepsilon_{it}) = 0$ holds only if there is no correlation between contemporaneous values of $EXPF$ and ε, in which case we shouldn't have gone for instrumentation in the first place.

[28] We concentrate on the discussion of the fixed effect estimate for the reason stated in footnote 25

[29] The size of the coefficient is broadly comparable to some of the estimates provided by (Allen et al., 2007).

Table 4.4: Estimate of Fixed effect model using Lagged Values as Instrument

Two Stage fixed effects estimation result of equation (4.1), instrumenting $EXPFS$ by its two year lagged values, i.e., $EXPFS_{t-1}$. Coefficients are estimated by Generalized Method of Moments and standard errors are robust.

	ln(sizestructure)	ln(sizestructure)	ln(sizestructure)	ln(sizeactivity)	ln(sizeactivity)	ln(sizeactivity)	ln(sizeall)	ln(sizeall)	ln(sizeall)
ln ($EXPFS_{ct}$)	-0.961***	-0.968***	-0.723**	-0.667	-0.957*	-1.031**	-0.664***	-0.786***	-0.844***
	(-4.21)	(-3.89)	(-2.43)	(-1.49)	(-1.89)	(-1.97)	(-2.93)	(-3.10)	(-3.27)
ln(gdpercapita)		-0.724***	-4.333***		-0.811**	-8.942***		-0.547***	-4.866***
		(-3.31)	(-7.68)		(-2.11)	(-9.02)		(-2.71)	(-9.21)
ln(gdp)			4.846***			10.22***			5.412***
			(7.75)			(9.25)			(9.28)
urbanization			-0.00531			-0.0549**			-0.0248
			(-0.29)			(-1.99)			(-1.64)
agrval_prcnt			0.0320			-0.0378			-0.0194
			(0.94)			(-1.03)			(-1.01)
indval_prcnt			-0.0129			-0.0744***			-0.0273***
			(-1.21)			(-4.02)			(-2.86)
Polity2			0.0250			0.174***			0.0659***
			(0.98)			(3.93)			(2.97)
Country Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	846	814	745	843	808	740	833	803	735
Kl-PaapLM	72.53	58.99	49.86	85.53	69.94	53.01	82.15	69.94	52.94
P-val	0	0	0	0	0	0	0	0	0
K-PWald	218.3	173.4	114.0	176.5	132.5	86.52	167.8	131.4	86.01

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

does not change the result substantially. In column (3) we control for the size of the economy, the sectoral composition of GDP, urbanization and a measure of democracy. The coefficient of our key variable essentially remains the same – negative and well determined. Columns (4) to (6) give the estimation results with *activity structure* as the dependent variable. Economic structure enters with a negative and significant (albeit at 10%) coefficient. Although it ceases to be significant when we control for per capita income, as column (7) of the table shows, our variable of interest remains significant when we control for an array of other variables. Columns (7) to (9) give estimate for the *combined structure* of the financial system. Interestingly again, our key variable enters with a negative and statistically significant coefficient, clearly indicating that the structure of the economy exerts a first order effect on the structure of the financial system.

How valid is the instrument? Identification of β rests on the assumption that explanatory variables in (4.3) do not belong to equation (4.1). In fact, there is no *a priori* reason why the variables included in the gravity equation belong to equation (4.1). For instance, we do not expect area and population of the importing countries to directly affect the financial structure of their trading partner. The same holds for the size of importing country as measured by its GDP. Again, we do not see how this affects financial structure of the exporting country apart through its effect on the country's GDP, which we have already controlled for. Although it is not possible to formally test given the nature of our instrument, we are fairly confident of the exclusion restrictions.

The remaining issue, therefore, is the relevance of the instrument. We report a battery of tests to check for the relevance of the instruments. Results are given at the bottom of table 4.5. First, we provide the result of underidentification test. Since we control for unknown misspecification, the appropriate test statistic to report would be the Kleibergen-Paap F statistic. Under the null hypothesis that our instrument is weak, this statistic follows a $\chi^2(1)$. As can be seen, the size of this statistic is fairly high in all of our models, ranging from 38 to 75. And the corresponding P-values

Table 4.5: Estimate of Fixed effect model using Predicted value as instrument

Two Stage fixed effects estimation result of equation (4.1), instrumenting $EXPFS$ by $\widehat{EXPFS}$, i.e., a measure of economic structure constructed based on predicted values of export from estimated gravity model. Coefficients are estimated by Generalized Method of Moments and standard errors are robust.

	ln(sizestructure)	ln(sizestructure)	ln(sizestructure)	ln(sizeactivity)	ln(sizeactivity)	ln(sizeactivity)	ln(sizeall)	ln(sizeall)	ln(sizeall)
ln($EXPFS_{ct}$)	-1.195***	-1.282***	-0.912**	-1.178*	-1.197	-1.925**	-1.055***	-1.161***	-1.342***
	(-3.51)	(-2.89)	(-2.22)	(-1.87)	(-1.53)	(-2.33)	(-2.94)	(-2.60)	(-3.26)
ln(gdpercapita)		-0.700***	-4.130***		-0.840**	-7.067***		-0.528**	-4.505***
		(-2.87)	(-7.08)		(-2.31)	(-7.31)		(-2.44)	(-8.09)
ln(gdp)			4.542***			7.821***			4.834***
			(7.18)			(7.52)			(8.23)
urbanization			-0.0140			-0.0454*			-0.0256*
			(-0.77)			(-1.76)			(-1.68)
agrval_prcnt			0.0283			-0.0294			-0.0258
			(0.94)			(-0.78)			(-1.23)
indval_prcnt			-0.00381			-0.0527***			-0.0126
			(-0.32)			(-3.03)			(-1.32)
Polity2			0.0216			0.153***			0.0643***
			(0.85)			(3.68)			(2.84)
Country Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	961	915	832	1017	953	868	934	893	813
Kl-PaapLM	61.92	45.61	43.28	75.19	49.35	40.33	62.63	44.12	38.32
P-val	0	0	0	0	0	0	0	0	0
K-PWald	85.36	62.29	63.17	93.72	65.83	56.25	73.56	54.75	49.75

t statistics in parentheses
* $p < 0.1$, ** $p < 0.052$, *** $p < 0.01$

indicate that the null of underidentification is decisively rejected in all the models, indicating that $\widehat{EXPFS}$ is a relevant instrument for $EXPFS$.

Another key concern is the strength of the instrument. It may be the case that $\widehat{EXPFS}$ is a relevant instrument for $EXPFS$, but just marginally so. That is, it may just well be weakly relevant. One interesting observation, however, is that weak instruments can be a cure worse than the disease (Stock and Yogo, 2005). One of the problems with weak instruments is that it biases the size of tests. Based on a test statistic reported, one may think that it is safe to reject or accept a hypothesis at, say, 5% level of significance. In fact, with weak instruments, the 5% is usually not the relevant critical value; the actual critical value is often higher than the nominal value of 5%. Naturally, therefore, one would want to know how far-off the actual size of the test is from the 5%. The Stock-Yogo critical values enable one to see this. The Stock-Yogo statistic for a 10% maximal size bias is about 16.4 in our case, substantially lower than the Kilebergen-Paap statistic reported at the bottom of the table. The null hypothesis of a weak instrument is, therefore, rejected in all the cases. Overall, we are confident that our instrument is exogenous as well as relevant. β, therefore, lends itself to a causal interpretation in the current application.

4.4.3 Further results and Robustness

The previous discussion clearly shows that a country's economic structure is an important determinant of the structure of its financial system. In this section, we provide some further results and conduct some robustness checks. First, we want to see if there is a regional variation in the importance of comparative advantage in shaping the structure of the financial system. In particular we are interested in the case of Sub-Saharan Africa. The number of stock exchange in the region has increased dramatically over just two decades. By 1989 only seven countries of the region had a stock exchange. As of 2008, about 26 countries have formed their own exchanges or joined an existing common stock exchange. Most of these exchanges are formed primarily through government initiatives so much so that their operation

is often financed by the state. This led some to question the appropriateness of these policies and the relevance of encouraging the formation of such exchanges. Singh (1999), in particular, was vocal and went as far as labeling such venture as a "costly irrelevance". On the other hand, there are countries in the region where governments are vehemently opposed to the formation of stock exchanges and have gone as far as discouraging the private sector form forming one(Moss, 2003)[30]. Hence, it is fair to say that there is significant state interventions designed to shape the structure of the financial system in the region. It is, however, not clear if these interventions shaped the structure of the financial system with the needs of the economy, or led to the emergence of financial enclaves that is not consistent with the structural needs of the broader economy. It is, therefore, interesting to see if these interventions have aligned the structure of the financial system with the countries' comparative advantage or weakened the role of the country's real sector in shaping the structure of the financial system. If the interventions have led to the development of the financial structure that is not compatible with the needs of the real sector, we expect the coefficient of $EXPFS$ to be systematically lower in SSA as compared to its result for other regions.

Secondly, we check if the role of economic structure as the determinant of the structure of the financial system has declined since the 1990. Some have argued that one of the key packages of Structural Adjustment Programm (SAP), imposed on many developing countries in the late 1980s, was the reform of the financial system(Lin et al., 2009). An integral part of this reform is the formation of stock exchange even where the economic structure does not necessarily warrant one. If this indeed is the case, the importance of economic structure in shaping the financial structure must have declined since 1990s. In addition to these two further results, we

[30]Ethiopia is a case in point. Inspite of a booming equity market, manifested in the increasing number of companies, ranging from financial to large manufacturing, being formed through sales of equity issued in unorganized markets, the government often explicitly warns the private sector from any initiative to form organised stock exchanges, the argument being that the country does not have the necessary legal and physical infrastructures to do so. http://www.addisfortune.com/Vol%2010%20No%20486%20Archive/fortune_editors_note.htm

also provide some robustness check. In particular, we control for time fixed effects. We also control for some additional variables that determine financial structure and see if the results still hold.

We deal with the first issue by including an interaction term between $EXPFS$ and a dummy for Sub-Saharan Africa. Similarly, for the second issue, we include an interaction between our key variable and a dummy for post 1990 years. We do two things as a robustness check. First, to see if the results are driven by outliers, we remove the top and bottom 1% of the distribution from the measures of economic and financial structures. Secondly, instead of using Polity2 variable, we use the Polity variable.[31] Table 4.6 provides these results. Columns (1) to (3) provide the estimation result using *size structure* as the dependent variable. Removing the outliers does not appear to make a substantive change to the coefficient of our key variable. A similar result holds for *combined structure*, as column (7) shows. However, the size of the coefficient of our key variable increases for the *size activity*, as column (5) of the table shows.

Columns (3), (6) and (9) of the table give the estimates for our model by including the interaction term of our key variable with a dummy indicating post 1990 period and SSA region. As can be seen, the coefficient of the interaction term between economic structure and dummy of post 1990 is positive and is statistically significant, except for *size structure*. This again hints to the fact that comparative advantage has been somehow sidelined in the post 1990s as determinant of the financial structure. The interaction term between our key variable and the dummy of Sub-Saharan Africa is not significantly different from zero, indicating that being in Sub-Saharan Africa does not substantially weaken the importance a country's economic structure in shaping the structure of its financial system. This indicates that the interventions perhaps did not move the structure of the financial system in the region a way from what is implied by comparative advantage. As can be seen, in all these cases, our variable of interest enters with a negative and statistically significant coefficient,

[31] See table 4.1 for the difference between the two variables.

with a measure of elasticity ranging between 1.5 to 2.4 in absolute terms. As given in the bottom of the table, our instrument is still strong and valid. All in all, this reassures us that the structure of the economy is a key determinant of a country's financial structure.

4.5 Conclusions

There is a large volume of theoretical and empirical evidence showing that the financial system is integral to the process of economic development. One of the key outstanding issues is how to put in place a well-functioning financial system. Particularly contentious in this debate is how to design a financial system; should countries design their financial system along a bank-based or a market-based system? This issue has generated a large body of literature, examining the links between financial structure and growth, at firm, industry and country level. The results, however, are generally inconclusive. An implicit assumption in this literature is that financial structure is given, probably determined by factors outside the economy.

Lin et al. (2009) have recently argued that it is misleading to state that one financial system is inherently superior to another. The relative importance of a specific financial system depends on the structure of the economy. For a country at its early stage of development, often dominated by subsistence agriculture and with small firms, a market based financial system is less likely to serve the financial needs of firms in these types of economies. This, however, changes, as the country develops and its endowments and hence comparative advantages change. More specifically, as capital accumulates and the size distribution of firms increase, the financial market grows to become important. In effect, therefore, they provide a theory that shows the structure of the financial system is itself determined by the structure of the economy.

This essay sets out to provide a systematic empirical examination of this theory. We employ an innovative measure of structure of the economy. In particular, we rely on three premises to construct the measure of economic structure. First, the

structure of a country's economy at a given point in time is determined by its comparative advantage. Second, countries specialize in and export goods and services in which they have a comparative advantage. Hence, all else the same, a country's comparative advantage, and therefore economic structure, can be inferred from its export structure. Third, economic activities have differing needs for different mixes of finance. As noted in Allen and Gale (1997), for instance, economic activities that involve high risk and high return projects are better served by a market-based financial system. Consequently, countries with comparative advantage in such activities have stronger demand for and better served by stock markets. Conversely, activities and sectors that engage in the production of goods and services using mature technologies are likely to be better served by the banking sector. Therefore, we construct a financial structure that is embedded in a country's structure. Employing this measure and dealing with the endogeneity issue, we show that the structure of the real sector of the economy exerts a first order causal impact on the evolution of the structure of the financial system. The result of the essay is in line with the view that countries with a comparative advantage in labour intensive industries are likely to foster the development of a bank based financial system, while countries with a comparative advantage in skill and capital intensive industries are likely to foster the development of a market based system. The findings of this paper, therefore, caution against an active engineering of the structure of the financial system.

Although the results are largely invariant across various estimation models and robust to some additional checks, it is important to note some of the potential limitations of this essay and possible future improvements. Firstly, the analysis is limited to sample of countries that have stock exchanges. Therefore, there is a potential selection issue due to exclusion of countries without stock exchanges. The excluded are mostly low income countries, who tend to have comparative advantages in labour intensive activities. Given that these activities are mainly debt finance dependent, we conjecture that the exclusion of these countries from the analysis might weaken the impact of economic structure on the structure of the financial system. An

important future research would be to explore this by controlling for the selection issue. Secondly, the measure of economic structure used requires further enhancement. By relying on a country's export as an indicator of its comparative advantage, the measure ignores the fact that exports could also reflect policy distortion and not just comparative advantage. Since the measure is based on the export of goods, it ignores the non-exportable sectors and in particular service sector exports.

Thirdly, the use of a particular country's equity dependence over a particular decade in calculating the measure of economic structure is also an important issue. Although this methodology has been used in many studies to date that examine the impact of financial development on various measures of outcome, this is admittedly open to improvement. Equity dependence of an industry could potentially vary across countries. However, as argued by Rajan and Zingales (1998), since the U.S has the most well developed financial system, an industry's level of equity dependence in the U.S may be an optimal level for that specific industry. Hence, we believe that using the U.S as a frame of reference for equity dependence may not bias our analysis. Using an average value of equity dependence over a decade assumes that equity dependence is time invariant. It is possible, however, that an industry's equity dependence changes over time, which we could not capture for lack of data.[32] An important future enhancement, which is not attempted in this essay due to lack of data, would be to use the ratio of a given industry's equity dependence in the US to the industry's bank dependence in Germany/Japan. Finally, the existing indicators of financial development, on which our measure of the size as well as the activity structures are based, are just crude indicators. An ideal measure would capture the key functions of the financial system, such as ameliorating informational frictions, pooling and trading risk, etc. Nevertheless, to my knowledge, such a measure does not exist.

[32]This assumption in fact limits the time variability of our key explanatory variable, potentially reducing its explanatory power.

Table 4.6: Further result and some robustness

Two Stage fixed effects estimation result of equation (4.1), instrumenting $EXPFS$ by $\widehat{EXPFS}$, i.e., a measure of economic structure constructed based on predicted values of export from estimated gravity model. Estimates in this table is based on data where we remove the top and bottom 1% of the distribution from the measures of economic and financial structure. Coefficients are estimated by Generalized Method of Moments and standard errors are robust.

	ln(sizestructure)	ln(sizestructure)	ln(sizestructure)	ln(sizeactivity)	ln(sizeactivity)	ln(sizeactivity)	ln(sizeall)	ln(sizeall)	ln(sizeall)
ln($EXPFS_{ct}$)	-1.102***	-0.879**	-0.958*	-1.044*	-1.908**	-2.479**	-0.832**	-1.038**	-1.272**
	(-3.22)	(-2.16)	(-1.83)	(-1.63)	(-2.18)	(-2.34)	(-2.42)	(-2.56)	(-2.38)
ln(gdpercapita)		-3.538***	-3.845***		-5.607***	-7.160***		-3.458***	-4.095***
		(-5.97)	(-5.44)		(-5.51)	(-5.35)		(-5.86)	(-5.37)
ln(gdp)		3.619***	3.902***		6.317***	7.769***		3.651***	4.262***
		(5.73)	(5.38)		(5.99)	(5.90)		(6.12)	(5.73)
urbanization		-0.0168	-0.0237		-0.0298	-0.0583**		-0.0147	-0.0284*
		(-1.00)	(-1.31)		(-1.17)	(-2.01)		(-1.03)	(-1.69)
agrval_prcnt		-0.00791	-0.00389		-0.0624	-0.0345		-0.0321	-0.0212
		(-0.37)	(-0.20)		(-1.64)	(-1.02)		(-1.56)	(-1.15)
indval_prcnt		-0.00630	-0.00692		-0.0542***	-0.0565***		-0.00826	-0.00980
		(-0.63)	(-0.69)		(-3.15)	(-3.13)		(-0.91)	(-1.06)
Polity		0.0173	0.0273		0.134***	0.171***		0.0499**	0.0672***
		(0.71)	(1.06)		(3.36)	(3.84)		(2.34)	(2.82)
ln($EXPFS_{ct}$)*1990			0.290			1.421**			0.596*
			(0.93)			(2.49)			(1.93)
ln($EXPFS_{ct}$)*ssa			-0.265			0.959			0.0533
			(-0.43)			(0.92)			(0.10)
Country Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	926	796	796	976	825	825	898	774	774
Kl-PaapLM	58.36	39.67	35.83	68.36	31.92	33.94	57.08	32.50	31.75
P-val	0	0	0	0	0	0	0	0	0
K-PWald	83.97	65.44	56.21	80.94	41.67	43.98	66.53	44.09	41.78

t statistics in parentheses
* $p < 0.1$, ** $p < 0.052$, *** $p < 0.01$

Conclusion and Agenda for Future Research

This thesis explored financial systems and economic development using firm-level as well as aggregate country-level data. The first two essays explored the key determinants and consequences of credit constraints on micro and small-scale enterprises in Ethiopia, using a unique dataset collected on about 1000 SMEs. This first essay identifies the key determinants of access to credit for MSEs in Ethiopia, with a particular emphasis on the role of informality. We use a measure of access to credit constructed based on a series of questions that ask firms about their demand for external finance so as to elicit their access to credit. Controlling for its possible endogeneity, we show that informality has a negative and significant effect on a firm's access to credit. Apart from informality, this essay shows that firms that maintain better accounting information, that are owned by females and members of business associations are less likely to be credit constrained, while firms owned by individuals with a vocational training are more likely to be credit constrained. Although the regression models used in the essay passed various diagnostic tests and yield fairly robust results, it is important to reiterate some of the potential limitations of the essay. First, the dependant variable is defined on the basis of demand-side responses alone and reflects only the view of firms and not that of lenders. An improved measure could exploit a firm's return on capital, generated, for instance, through a randomized control trial studies. Secondly, some of the explanatory variables, such as those aimed at capturing entrepreneurial motivation, are crude proxies and can

be enhanced through using superior measures of entrepreneurial ability. Thirdly, there is a potential for measurement error in the measure of access to credit used in the essay. As noted, our key measure of access to credit is generated based on responses to series of questions. One key drawback with such approach is that the classification of the dependent variable depends, among others, on the accuracy of the answers given to each of the series of questions used to generate the variable. A recall error in one of the questions, for instance, would result in outcomes for the dependent variable to be wrongly classified. With non-linear estimation techniques such as the one used in this essay, however, the misclassification of the dependent variable produces a biased, inconsistent and inefficient estimate. Various options have been suggested to deal with such an issue. However, our efforts to model theses effects proved difficult as the likelihood function specified failed to converge. This is clearly an issue requiring further investigation, but currently lies beyond the scope of this thesis.

The second essay provides an empirical study of the effects of access to credit on firm innovation among SMEs in Ethiopia. We use a measure of innovation based on a question in the survey that asks whether a firm has 'made important improvements/changes to its product or services'. As such, we use a measure of innovation broadly defined and perhaps well suited to these types of firm. Employing various estimation techniques aimed to correct for possible endogeneity of access to credit, we show that access to credit has a significant and positive effect on a firm's innovation. In particular, we use single equation instrumental variable estimation methods and show that access to credit has a positive and statistically significant effect on firm innovation. Estimation results based on a recursive bivariate probit model and Linear Probability (LP) simultaneous equations model provide similar result, indicating that access to credit has a significant and positive effect on innovation. Although our key result is robust to various estimation methods, it is, however, important to note some of the possible limitations of the empirical work reported in this essay which future research could possibly address. First,

except for the results based on LP simultaneous equation model, and to some extent for the recursive bivariate probit model, most of our results are based on findings using single equation instrumental variable estimation techniques. This, however, entails some loss of potentially important information. Employing an appropriate system estimation method is complicated by the inherent issue of coherency for non-linear simultaneous equation models and our initial attempt to address this issue did not succeed. Exploring this further is beyond the scope of the current essay. Secondly, in view of the nature of our dependent variable and key explanatory variable, measurement errors and the issue of classification error again apply to this essay as well. There are generally limited information on the consequence for non-linear estimation and test when both the dependent and explanatory variables are misclassified. Future research, which is beyond the scope of the current essay, would be to explore theses issues and see how these may affect the key findings of this second essay. Thirdly, it is also important to note the potential weakness of the instrument set. Although the empirical evidence reported does not suggest a weak instrument set, it may be important to explore this further in the future. A potential exercise for the future would examine this in the context of randomised control trial (RTC), but this again is beyond the reach of the current essay. Finally, it may also be interesting to explore the impact of access to credit by decomposing innovation into its different component parts, which our current data does not permit. It maty well be the case that access to credit affects different types of innovation in a different manner and knowing this would provide useful policy information.

The third and fourth essays explore aspects of designing appropriate financial systems, using cross-country data. In particular, the third essay explores whether opening a stock exchange boosts per capita income growth in a set of SSA countries and how the growth impact of stock exchange formation in SSA compares to that of a set of developing countries from other regions of the world. Employing a semi-parametric Difference-in-Difference (DiD), (i.e., a DiD) on set of matched countries, we show that opening a stock exchange does not appear to have a significant impact

on economic growth in SSA. We also show that this is not an issue specific to SSA, as stock market formation also does not exert a significant effect on per capita income growth on the set of other developing countries in our sample. Although we provide some robustness check, we view the limited sample size and the estimation of standard errors in our preferred methodology as two key issues that warrant caution in the interpretation of our results. Little can be done about the limited sample size in cross-country studies. Future work can improve on this through a detailed country-level study, for instance, by comparing the patterns of financing and performances of firms in countries with and without stock exchanges. The estimated standard error computed using the DiD-cum-matching estimation technique we employed is what is currently used in the existing literature. In view of the limitations with this calculation as denoted in the essay, there are research avenues for its improvement. For instance, little is known about the theoretical implications for the standard error of using one control country multiple times. Exploring this issue is consigned to the agenda for future research. Another interesting proposal for future research in this area would be to apply the DiD-matching on an evolving basis. For instance, consider Cote d'Ivoire which opened a stock exchange in 1974. In this essay, the controls are countries that did not have a stock exchange as of 2007. An interesting case, at least when using the five years span to calculate the before-after per capita income growth, would be to use instead any country that did not open a stock exchange until 1979 as a control country. Such an approach is clearly worthy of investigation in the future when more relevant data become available.

The fourth essay explores the role of economic structure in shaping the structure of a country's financial system. We employ a measure of economic structure constructed using information on a country's comparative advantage. Employing an innovative instrumentation strategy to deal with possible endogeneity of economic structure, this essay shows that the structure of the economy exerts an important and significant causal effect on the evolution of the structure of the financial system. In particular, we show that countries dominated by equity dependent sectors

of the economy are more likely to foster larger and active stock market relative to their banking sectors. We check for the robustness of the result, and show that the results by and large hold. Although the results are largely consistent across various estimation models and robust to some additional checks, it is important to note some of the potential limitations of this essay and possible future improvements. First, by relying on a country's export as an indicator of its comparative advantage, the measure of economic structure ignores the fact that exports could also reflect the effects of policy distortion, and not only comparative advantage, and also ignores the non-exportable sectors and in particular the service export. Secondly, the use of a particular country's equity dependence over a particular decade in calculating the measure of economic structure is also an important issue. Although this methodology has been used in many studies examining the impact of financial development on various measures of outcome, this concept is admittedly open to further development. An important future improvement, which is not attempted in this essay because of lack of data, would be to use the ratio of a given industry's equity dependence in the US to the industry's bank dependence in, say, Germany or Japan. Finally, the measure of the financial structure used in the essay is just a proxy. The existing indicators of financial development, on which our measure of the size as well as the activity structures are based, are just crude indicators. An ideal measure would capture the key functions of the financial system, such as ameliorating information friction, pooling and trading risk, etc. Nevertheless, to my knowledge, such a measure does not exist but its construction clearly provides the basis for future research in this particular research area.

A couple of issues comprising part of an agenda for future research suggest themselves from the research undertaken in this thesis. The research reveals the importance of access to external finance for innovation purposes by MSEs in Ethiopia and the key role of informality in their access to credit. Examining the key determinants of informality will provide, therefore, an interesting theme for future research. Conceptually, two views suggest themselves as to why firms decide to become in-

formal, or do not want to be formal. One view, associated with DeSoto (1989), is that firms are excluded by burdensome and costly registration procedures. In other words, firms know the benefits and costs of being formal, but they are deterred by excessive entry regulations. Hence, simplifying and reducing the cost of registration may encourage more firms to become formal. The other view is that firms rationally choose to be informal. As per this view, being formal has both benefits and costs. Included in the costs are the cost to register a firm, tax payments, compliance with labour regulation, health and safety considerations, and other product standards. Among the benefits are that formality enables firms to develop contracts with large firms, do business with government, enter into contracts with banks, thereby improving their access to external finance and the associated benefits that this provides. When deciding to become formal, therefore, firms weigh the costs and benefits and register if the benefit outweighs the cost. A policy implication that logically follows from this view is that easing the cost of registration alone may not be sufficient to persuade firms to become formal. As long as there is no benefit to being formal, firms would just want to remain informal. There are few empirical studies that attempt to disentangle these competing views, though de Mel et al. (2012) provide an exception. The study undertaken by de Mel et al. (2012) conducts a field experiment on informal firms in Sri Lanka to encourage them to register. They find that reducing the direct cost of registration (through reimbursing firms their registration costs) and providing information about the potential benefits of formality does not appear to have a significant effect on the demand for formality. They show that it takes a payment of about two months profit of a median firm to encourage half of them to register. It would be interesting, therefore, to implement this type of approach in Ethiopia through, for instance, a randomized control trial on informal firms. In addition, given the findings reported in essay one,, it would also be interesting to explore if the results of essay one are robust to explicitly addressing econometrically the potential misclassification error. This did not prove feasible, as noted earlier, given problems encountered with non-convergence in the likelihood

function. However, more effort and the use of alternative econometric procedures may enhance matters in this regard.

Essay two emphasizes the importance of access to external finance on firms' innovation and hence their growth. This highlights an interesting but yet unsettled issue as to whether these firms are the bedrock for future medium and large enterprises. There is generally limited information regarding the extent to which small firms grow to become a significant source of employment generation in developing countries. This evidence is particularly lacking in the case of Ethiopia. Sutton and Kellow (2010),through an historical and descriptive study of 50 large manufacturing firms in Ethiopia, provide some support for the view that large firms tend to start start large. However, it is not clear if firms in this study are randomly sampled and hence their findings can be generalised to the current application. A systematic examination of this issue would, therefore, be an interesting avenue for future research. If SMEs grow to become important sources of employment generation, one objective of subsequent research would be to examine what, apart from factors we already know such as access to credit, determines the growth of these firms and how and what policy interventions can help in facilitating the transition of these firms from subsistence to medium-sized firms. On the other hand, if these firms do not grow beyond subsistence level, as Sutton and Kellow (2010) show, an interesting issue to examine would be what factors constrain the formation of medium-sized firms; is it lack of access to credit, lack of insurance against failure, or is it attributable to the fact that the high ability individuals are discouraged from starting their own businesses?

It is well documented that access to credit is important for firm's growth. A lot remains to be done, however, as to how to improve firm access to external finance, in particular as it relates to the role of direct government intervention. One approach is a credit guarantee scheme. Partial credit guarantee, in particular, has become a popular means of intervention to facilitate access to credit for collateral constrained firms, particularly SMEs (Honohan (2010); Beck et al. (2010b)). Despite

its popularity, this scheme is often based on tricky assumptions and information about the impact of these schemes is generally lacking. Exploring the design of an efficient credit guarantee scheme that minimizes the moral hazard issue but enhances firm access to credit would be an interesting area for future research. Particularly interesting since one of the goals of a partial credit guarantee is to encourage learning by financial intermediaries to lend to MSEs, would be to examine if credit guarantee schemes sustain lending to these firms once the credit guarantee stops. This could be a fertile area for future research employing a randomized trial type of programme evaluation.

The ultimate goal of policy aimed at expanding access to credit, however, should be to put in place policies that facilitate the development of the financial system. The results reported in essays three and four of the thesis indicate that interventions to change the structure of the financial system are not included among such policies. The essays also flag interesting future research areas. One such is a firm level historical study, for instance, comparing the patterns of financing and performances of firms in countries with and without stock exchanges. Some of the empirical methodological limitations of essay three also reveal other areas for research. In particular, these include issues relating to the estimation of the standard error using the DiD-cum-matching estimation technique. For instance, it would be interesting to explore the theoretical implications for the standard error of using one control country multiple times, and hence the efficiency gains from applying the DiD-matching on an evolving basis.

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Appendix for Chapter-III

This appendix describes the concept and key assumptions underlying DiD. Denote the treatment by D. D takes a value of 1 if the country has a stock exchange and 0 otherwise. Denote the potential per capita real income growth by Y_t^D where t is time. t takes 0 for years before opening a stock exchange and 1 for years after post-opening stock exchange. Among the parameters of interest are estimates of the impact of opening stock exchange on countries with stock exchange. More specifically, assuming the coefficient is given by $\theta_{(x)}$, where the x denotes observable covariates, we have:

$$\theta_{(x)} = E(Y_1^1 - Y_1^0 | X = x, D = 1) \tag{4.6}$$

The fundamental problem is that Y_1^0 is not observable. Hence one has to look for a proxy. Such proxy can be obtained from the observable outcomes with two key assumptions.

- *Assumption-1* No spill-over and anticipation effects. The idea, soon be clear below, is that the pre-as well as post-treatment outcome of the control groups be unaffected by the treatment. This assumption also rules out the possibility of anticipation effect, where the pre-treatment effect of the treated group is affected by the treatment.

- *Assumption-2* Common trend. This assumption states that, absent treatment, the two groups would have followed parallel path. More formally, this assumption can be given by : $E(Y_1^0 - Y_0^0 | X = x, D = 1) = E(Y_1^0 - Y_0^0 | X = x, D = 0)$.

With these two key assumption the parameter, $\theta_{(x)}$, can be identified, as follows:

- Note that we can denote $E(Y_1^1|X = x, D = 1)$ by its observable counterpart. Hence, we have $\theta_{(x)} = E(Y_1 - Y_1^0|X = x, D = 1)$
- The only missing value is, therefore, $Y_1^0|X = x, D = 1)$.
- From the Common trend assumption and Assumption-2, we have the following: $E(Y_1^0|X = x, D = 1) = E(Y_1 - Y_0|X = x, D = 0) + E(Y_0|X = x, D = 1)$.
- Therefore, $\theta_{(x)} = E(Y_1 - Y_0|X = x, D = 1) - (E(Y_1 - Y_0|X = x, D = 0))$

Hence, $\theta_{(x)}$ is now identified since it is the function of all observable variables.

Appendix for Chapter-IV

Table 4.7: Estimation Result of the Gravity equation for Sample of commodities

A pooled OLS estimation result of gravity model for a sample of commodities. In all models, standard error is robust and clustered at country level. The dependent variable is ln(exp_gdp_{xeit}), where exp_gdp_{xeit} is country e's export of commodity x, at three digit Standard Industrial Classification (SIC), to country i in year t, deflated by country e's GDP. 'lnarea_o' and 'lnarea_d' are the natural log of the area of the exporting and importing countries, respectively; 'lndist' is the natural log of the distance between the major cities of the importing and exporting countries; 'contig' is a dummy taking the value of 1 if the importing and exporting countries are contiguous, and zero otherwise; 'comlang_off' is a dummy taking the value of 1 if the two trading countries have common official language, and zero otherwise; 'lngdp_d' is the natural log of importing country's GDP; 'border_gdp_d' is the interaction term between the dummy of contiguity between the two countries and the GDP of the importing country; 'dis_language' is the interaction term between distance between the two countries and dummy of common official language between them; 'dist_gdp_d' is the interaction term of distance between the two countries and the GDP of the importing country;'language_gdp_d' is the interaction term between dummy of common official language and the GDP of the importing country; 'lnaguage_pop_d' is the interaction term between dummy of common official language and the population of the importing country; 'dist_pop_d' is the interaction term between the distance between the major cities of the two countries and the size of the population of the importing country.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	exp_gdp	exp_gdp	exp_gdp	exp_gdp	exp_gdp	exp_gdp	exp_gdp	exp_gdp	exp_gdp	exp_gdp	exp_gdp	exp_gdp	exp_gdp	exp_gdp
lnarea_o	-0.00822*	-0.0131	-0.00916**	-0.0363*	-0.00421**	-0.000282	-0.00237***	-0.0207*	-0.00811	-0.0271*	-0.0884**	-0.0247	-0.0357**	-0.00483
	(-1.91)	(-1.59)	(-2.21)	(-1.90)	(-2.10)	(-0.09)	(-2.82)	(-1.94)	(-1.65)	(-1.90)	(-2.43)	(-0.93)	(-2.41)	(-0.91)
lnarea_d	-0.00735***	-0.0163***	0.00115	-0.0157***	-0.00262**	0.00510	-0.00279	-0.0116***	-0.00979**	-0.00900***	-0.0337*	-0.0568*	-0.00835**	0.00373
	(-2.62)	(-5.75)	(0.49)	(-3.50)	(-2.17)	(1.39)	(-1.42)	(-3.40)	(-2.10)	(-2.85)	(-1.70)	(-1.66)	(-2.01)	(0.64)
lndistance	-0.0741**	-0.0547*	-0.0518	-0.144***	0.00371	-0.0371*	0.00113	-0.0541	-0.0914**	-0.0825***	-0.0680	-0.0906	-0.0385	0.159*
	(-2.21)	(-1.73)	(-1.36)	(-2.95)	(0.25)	(-1.95)	(0.15)	(-1.02)	(-1.98)	(-2.88)	(-0.33)	(-0.36)	(-0.63)	(1.83)
contiguity	-0.0667	0.0583	0.0576	0.329***	0.0980***	-0.168**	0.0491**	0.363***	0.278	0.148*	0.522	0.670	0.229	0.303*
	(-0.87)	(0.67)	(0.48)	(3.58)	(2.99)	(-2.33)	(2.35)	(3.03)	(1.51)	(1.74)	(1.04)	(1.05)	(1.50)	(1.90)
commonlanguage_off	0.0691	0.00441	0.142	-0.104	0.123***	0.139	0.0949***	0.127	-0.194	-0.192	0.720	0.497	0.261	0.0318
	(0.72)	(0.04)	(1.24)	(-0.59)	(3.57)	(1.57)	(2.83)	(0.73)	(-0.52)	(-1.17)	(1.23)	(0.71)	(1.06)	(0.26)
lngdp_d	-0.0731**	-0.0451	-0.0404	-0.125**	0.00789	-0.0281*	0.00261	-0.0121	-0.0588	-0.0640**	-0.0427	-0.163	-0.0726	0.0889
	(-2.23)	(-1.48)	(-1.28)	(-2.39)	(0.53)	(-1.73)	(0.32)	(-0.29)	(-1.37)	(-2.25)	(-0.22)	(-0.75)	(-1.34)	(1.38)
lnpop_d	0.0933***	0.0583*	0.136***	0.124**	0.0382***	0.0346	0.00390	0.0866***	-0.00260	0.0554**	0.0585	0.598*	0.0879	0.0141
	(3.33)	(1.88)	(4.41)	(2.54)	(3.09)	(1.21)	(0.30)	(2.73)	(-0.04)	(2.19)	(0.55)	(1.91)	(1.34)	(0.24)
shareborder_gdp_d	0.00721	-0.00581	-0.00862	-0.0302***	-0.00959***	0.0161**	-0.00365**	-0.0370***	-0.0245	-0.0100	-0.0434	-0.0489	-0.0141	-0.0254*
	(0.86)	(-0.64)	(-0.72)	(-3.50)	(-2.91)	(2.32)	(-2.20)	(-3.17)	(-1.53)	(-1.48)	(-0.90)	(-0.82)	(-1.19)	(-1.87)
distance_language	-0.0163*	-0.00624	-0.0252**	0.00300	-0.00868***	-0.0248**	-0.0144***	-0.0191	-0.00145	0.0139	0.00433	0.0342	-0.0198	-0.0155
	(-1.70)	(-0.49)	(-2.06)	(0.19)	(-3.54)	(-2.00)	(-3.30)	(-1.01)	(-0.05)	(1.01)	(0.11)	(0.81)	(-1.12)	(-1.15)
distance_gdp_d	0.00987**	0.00736*	0.00747*	0.0209***	0.000842	0.00412*	-0.000206	0.00742	0.00934*	0.0101***	0.0154	0.0296	0.0124*	-0.0102
	(2.34)	(1.92)	(1.96)	(3.17)	(0.47)	(1.91)	(-0.21)	(1.42)	(1.76)	(2.87)	(0.81)	(1.28)	(1.70)	(-1.22)
language_gdp_d	0.0123*	0.0120**	0.0149	0.0159	-0.00480*	0.0148	0.00450	0.0107	0.0272	0.0138*	-0.0860	-0.0665	-0.0112	0.00602
	(1.83)	(2.13)	(1.65)	(1.51)	(-1.97)	(1.54)	(1.66)	(0.81)	(1.34)	(1.77)	(-1.64)	(-1.12)	(-0.75)	(0.48)
lnaguage_pop_d	-0.00956	-0.0111*	-0.0184**	0.00253	0.00328	-0.0207	-0.00510	-0.00852	-0.0128	-0.0101*	0.0553	-0.0155	0.00526	0.0139
	(-1.16)	(-1.80)	(-2.02)	(0.23)	(1.29)	(-1.64)	(-1.27)	(-0.74)	(-1.09)	(-1.81)	(1.16)	(-0.24)	(0.33)	(0.91)
distance_pop_d	-0.00948***	-0.00331	-0.0156***	-0.0138**	-0.00486***	-0.00417	-0.000178	-0.00878**	0.00256	-0.00527*	-0.00785	-0.0629*	-0.0113	-0.00228
	(-2.87)	(-0.86)	(-4.40)	(-2.28)	(-3.21)	(-1.18)	(-0.10)	(-2.35)	(0.32)	(-1.77)	(-0.61)	(-1.85)	(-1.40)	(-0.28)
constant	0.727**	0.644**	0.313	1.391**	-0.0886	0.211	0.0430	0.326	0.783*	0.935**	1.487	0.854	0.668	-1.285*
	(2.44)	(2.18)	(0.96)	(2.50)	(-0.63)	(1.43)	(0.72)	(0.68)	(1.84)	(2.46)	(0.80)	(0.40)	(1.46)	(-1.89)
N	42582	69154	25029	74994	27673	30621	10798	40488	24585	62400	3477	3048	4819	5384
R-Square	0.0489	0.0525	0.0982	0.121	0.0655	0.0355	0.106	0.101	0.0709	0.0860	0.0940	0.0946	0.104	0.0341

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4.8: List of countries in the sample

Country	Region	Year	
		From	To
Australia	East Asia & Pacific	1988	2000
Fiji	East Asia & Pacific	1997	1999
HongKong SA	East Asia & Pacific	1991	2000
Indonesia	East Asia & Pacific	1981	2000
Japan	East Asia & Pacific	1988	2000
South Korea	East Asia & Pacific	1975	2000
Malaysia	East Asia & Pacific	1976	2000
Mongolia	East Asia & Pacific	1995	2000
New Zealand	East Asia & Pacific	1988	2000
Philippines	East Asia & Pacific	1976	2000
Singapore	East Asia & Pacific	1988	2000
Thailand	East Asia & Pacific	1976	2000
Austria	Europe & Central Asia	1988	2000
Belgium	Europe & Central Asia	1988	2000
Bulgaria	Europe & Central Asia	1995	2000
Croatia	Europe & Central Asia	1994	2000
Cyprus	Europe & Central Asia	1991	2000
Czech Republic	Europe & Central Asia	1994	2000
Denmark	Europe & Central Asia	1988	2000
Estonia	Europe & Central Asia	1997	2000
Finland	Europe & Central Asia	1988	2000
France	Europe & Central Asia	1988	2000
Georgia	Europe & Central Asia	2000	2000
Germany	Europe & Central Asia	1989	2000
Greece	Europe & Central Asia	1975	2000
Hungary	Europe & Central Asia	1991	2000
Iceland	Europe & Central Asia	1994	2000
Ireland	Europe & Central Asia	1994	2000
Italy	Europe & Central Asia	1988	2000
Kazakhstan	Europe & Central Asia	1997	2000
Kyrgyz Repub	Europe & Central Asia	1999	2000
Latvia	Europe & Central Asia	1996	2000
Lithuania	Europe & Central Asia	1995	2000
Macedonia	Europe & Central Asia	1996	2000
Moldova	Europe & Central Asia	1996	2000
Netherlands	Europe & Central Asia	1988	2000
Norway	Europe & Central Asia	1988	2000
Poland	Europe & Central Asia	1991	2000
Portugal	Europe & Central Asia	1977	2000
Russian Fede	Europe & Central Asia	1994	2000
Slovak Repub	Europe & Central Asia	1994	2000
Slovenia	Europe & Central Asia	1995	2000
Spain	Europe & Central Asia	1988	2000
Sweden	Europe & Central Asia	1988	2000
Switzerland	Europe & Central Asia	1991	2000
Turkey	Europe & Central Asia	1983	2000
United Kingd	Europe & Central Asia	1988	2000
Argentina	Latin America & Caribbean	1988	2000
Barbados	Latin America & Caribbean	1990	2000
Bolivia	Latin America & Caribbean	1995	2000
Brazil	Latin America & Caribbean	1992	2000
Chile	Latin America & Caribbean	1976	2000
Colombia	Latin America & Caribbean	1976	2000
Costa Rica	Latin America & Caribbean	1995	1999
Ecuador	Latin America & Caribbean	1993	2000
El Salvador	Latin America & Caribbean	1996	2000
Guatemala	Latin America & Caribbean	1995	2000
Jamaica	Latin America & Caribbean	1988	2000
Mexico	Latin America & Caribbean	1975	2000
Paraguay	Latin America & Caribbean	1995	1999
Peru	Latin America & Caribbean	1989	2000
Trinidad and	Latin America & Caribbean	1988	2000
Uruguay	Latin America & Caribbean	1993	1999
Venezuela,	Latin America & Caribbean	1975	2000
Bahrain	Middle East & North Africa	1998	2000
Egypt	Middle East & North Africa	1988	2000
Iran	Middle East & North Africa	1993	2000
Israel	Middle East & North Africa	1988	2000
Jordan	Middle East & North Africa	1978	2000
Kuwait	Middle East & North Africa	1988	2000
Malta	Middle East & North Africa	1994	2000
Morocco	Middle East & North Africa	1988	2000
Saudi Arabia	Middle East & North Africa	1991	2000
Tunisia	Middle East & North Africa	1988	2000
Canada	North America	1988	2000
Bangladesh	South Asia	1994	2000
India	South Asia	1976	2000
Nepal	South Asia	1994	2000
Pakistan	South Asia	1984	2000
Sri Lanka	South Asia	1985	2000
Cote d'Ivoir	Sub-saharan Africa	1988	2000
Ghana	Sub-saharan Africa	1993	2000
Kenya	Sub-saharan Africa	1990	2000
Mauritius	Sub-saharan Africa	1990	2000
Nigeria	Sub-saharan Africa	1976	2000
South Africa	Sub-saharan Africa	1988	2000
Tanzania	Sub-saharan Africa	1998	2000
Zambia	Sub-saharan Africa	1996	2000