Essays on
Banking Sector Development and Economic Growth in Developing Economies

by

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Summary

This thesis examines the impact of banking sector development in economic growth in developing countries. Chapter 1 examines the linkage between financial development and economic growth in an economy with an informal and a formal sector. We find that growth in such economies is mainly stimulated by human capital and higher allocations in the formal sector. Higher revenue through consumption taxation in the formal sector that results in more redistribution creates a multiplier effect on growth. For developing countries there is therefore a need to design policies that encourage accumulation of human capital and a shift of the additional human capital to the formal sector.

Chapter 2 empirically examines how banking development affects growth in regional output, agriculture and industry in India. Using state level data for India for 1999-2008, we examine if and to what extent the recent banking reforms have affected regional growth. Results show that there is strong evidence of banking development-led growth effects in India. Deposits of commercial banks positively affect growth in industry but do not significantly affect growth in agriculture. Rural banks' credits stimulate agricultural growth. Given the large share of agriculture in Indian GDP, this clearly implies that expansion of regional rural banks can positively affect economic growth in India.

Chapter 3 extends chapter 2 by examining how and to what extent development in infrastructure and rural well being can assist in explaining the banking development-led growth in state level output, agriculture and industry in India. We find that there is clear evidence of growth effects of development in banking, infrastructure and rural well being in 26 states of India. Transport expansion generally improves growth in output and industrial output, but more allocation of production in the informal sector can hurt growth. Improvement in rural well being can stimulate growth. A major determinant of the success of rural banking development-led growth in India is therefore the development of physical infrastructure and rural well being.

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Introductory Chapter

In this thesis we examine the impact of banking sector development and economic growth in developing economies. The relation between financial development and economic growth has been long under debate. Although there is plenty of evidence that financial as well as banking development plays an important role in promoting economic growth of the industrialized countries (see Beck and Levine, 2004 for a detailed survey), evidence is rather mixed within developing or emerging countries.

Economists hold startlingly different opinions regarding the importance of the financial system for economic growth. Bagehot (1873) and Hicks (1969) argue that the financial system played a crucial role in igniting industrialization in England by facilitating the mobilization of capital for 'immense works'. Levine (1997) also supports this argument when he says that "the industrial revolution had to wait for the financial revolution." Schumpeter (1912) contends that well functioning bank spur technological innovation by identifying and funding those entrepreneurs with the best chances of successfully implementing innovative products and production processes. Goldsmith (1969), McKinnon (1973) and Shaw and McKinnon (1973) have also produced considerable evidence that financial development has a strong correlation with economic growth. Recently, endogenous growth literature has reinforced the role of financial intermediaries by showing that such intermediaries can contribute to economic growth through various aspects of productive activities (e.g. Pagano, 1993). Many models in the recent literature emphasize that well-functioning financial intermediaries and markets ameliorate information and transactions costs and thereby foster efficient resource allocation and hence faster long-run growth (e.g. Bencivenga and Smith 1991; Bencivenga, Smith and Starr 1995; King and Levine 1993a).

By contrast, several well-known economists are sceptical of the view that finance plays any major role in economic development. Robinson (1952) argues that "where enterprise leads finance follows." According to this view, economic development creates demands for particular types of financial arrangement and the financial system responds automatically to these demands. Moreover, some economists just do not endorse the view that the finance-growth relationship is important. Lucas (1988), for instance, asserts that economists 'badly over-stress' the role of financial factors in economic growth, while development economists frequently express their scepticism about the role of the financial system by ignoring it (Chandavarkar, 1992). For instance, in a collection of essays by the 'pioneers of development economics,' there is no argument in favour of the finance growth nexus.

Despite the claim in Chandavarkar (1992), Lewis (1956), one of the pioneers of development economics, in his 'The Theory of Economic Growth' postulates a two-way relationship between financial development and economic growth--financial markets develop as a consequence of economic growth which in turn feeds back as a stimulant to real growth. This view is also supported by Patrick (1966). Likewise, a number of endogenous growth models (e.g. Greenwood and Jovanovic 1990; Greenwood and Bruce 1997) show a two-way relationship between financial development and economic growth.

Theory also provides conflicting predictions about whether stock markets and banks are substitutes, complements, or whether one is more conducive to growth than the other. For instance, Boyd and Prescott (1986) models the critical role that banks play in easing information frictions and therefore in improving allocation of resources, while Stiglitz (1985) and Bhide (1993) stress that markets will not produce the same improvement in resource allocation and corporate governance as banks. Some models emphasize that markets mitigate the inefficient monopoly power exercised by banks and stress that the competitive nature of markets encourages innovative and growth--enhancing activities as opposed to the excessively conservative approach taken by banks (Allen and Gale, 2000). Finally, some parts of the theory stress that it is not banks *or* markets, it is rather banks *and* markets; these different components of the financial system ameliorate different information and transaction costs. A burgeoning empirical literature however suggests that well-functioning banks accelerate economic growth.

In the light of these different views and aspects of this issue, this thesis uses existing theory to organize an analytical framework of the finance-growth nexus and then assesses the quantitative importance of the financial system in economic growth for developing economies. We design a theoretical model which is specifically appropriate for developing economies. We consider an endogenous growth monetary economy with profit maximizing financial intermediary sector. We introduce the idea of bank based creation of financial services and market based delivery of financial services. To show the true nature of developing economies we incorporate informal market in this framework. With this model and its relevant balanced growth conditions, we explain different properties of sectoral growth and its linkage with banking development.

Chapter 1 of this thesis investigates the linkage between financial development and economic growth in an endogenously growing monetary economy with informal and formal markets. In order to capture this linkage, we consider a profit maximizing financial intermediary sector in the spirit of Gillman and Kejak (2011). This chapter extends their model by introducing an endogenous growth framework that captures the idea of bank based creation of financial services and market based delivery of financial services. The main aim of this study is to investigate how and to what extent such a framework can explain the linkage between financial service and economic growth in an economy with formal and informal markets. The chapter is therefore primarily aimed at answering an important question in the contemporary growth literature; how does banking development affect growth in developing countries?

In many developing countries rural channels of credit and financial services create ease of transactions in a cash-only market. Because such transactions do not typically leave a paper trail, the predominance of such a sector (or an informal market, in general) allows consumers to avoid indirect taxes. Primarily we find that such a setting can be useful for an aggregative study on the finance-growth nexus in developing countries. In its simplest form if one adds two channels of financial services to an otherwise standard model (e.g. Gillman & Kejak 2011), one can examine the relative effects of financial development and the growth in aggregate real variables. Standard endogenous growth models are in general not capable of capturing the transactions which are accomplished in such markets and the growth effects of financial development in such economies. Our key motivation stems from this insufficiency of the models in the literature.

Chapter 1 and its key model are also motivated from the fact that in many countries across the world, the informal sector contribute large share in their GDP and in their labour forces. That is why incorporating the informal market in a standard growth model enhances the model's capacity to capture the growth effect of financial development in this type of economies.

Using state level data for the US, Jayaratne and Strahan (1996) find a positive influence of liberalization of the banking sector on growth. The findings of Levine and Zervos (1998) reveal that measures of liquidity are strongly related to capital accumulation, productivity and economic growth, but stock market size is not strongly related to growth*. They also show that bank lending to the private sector has a strong effect on growth. King and Levine (1993) for instance also argue that financial development causes economic growth, and the predetermined components of financial development are good predictors of growth for the next 10 to 30 years to follow. Demirguc-Kunt and Maksimovic (1996) concur to the same opinion, and with cross-country evidence they show that growth is positively related to the stock market turnover and different measures of law enforcement.

Levine, Loayza and Beck (2000) in their paper evaluate whether the exogenous component of the development in the financial intermediary influences economic growth and whether cross-country differences in legal and accounting systems explain differences in the level of financial development. Using both traditional cross-section instrumental variable procedures and recent dynamic panel techniques, they find that

* In a relatively more recent paper Luintel, Arestis and Demetrades (2001) discuss the links between stock market development and long term growth, where they argue that development of stock market can stimulate economic growth only under certain specified conditions.

the exogenous components of financial intermediary development are positively associated with economic growth. Their findings also suggest that legal and accounting practices can boost financial development and accelerate economic growth. But these empirical studies didn't say much about growth and its linkage with sectoral financial development. Contributions to the theory of growth and its linkage with sectoral financial development leave some areas that can benefit from our model. Our model presents a simple framework which can be considered as a benchmark that can lead to more sophisticated as well as complicated set ups. But our simple setup presents some very useful insights into the sectoral difference in productivity in producing financial services and its impact on economic growth. We find that the two sector model in this chapter serves well in providing the insights into the issue of how predominance of the informal sector affects the allocation and growth along the balanced growth path.

Many empirical studies assess the role of financial development in economic growth (e.g. King and Levine, 1993; Odedokun, 1996; and Ram, 1999). Most of the recent studies have suggested that financial development would have a substantial positive impact on growth (King and Levine, 1993; Odedokun, 1996; and Levine 1997). But these empirical investigations are mainly based on the data from industrial countries. The main focus of this thesis is on developing countries. That is why our empirical investigation in chapter 2 and chapter 3 is on India, one of the largest developing economies in the world. We choose India to carry out our empirical investigation not only because it is one of the most emerging economies in the world, but also because it has a rich history of varying types of banking sector reforms. In recent years the government of India has been making attempts to encourage the expansion of rural banking through policy reforms.

In chapter 2, we examine the effect of banking sector development on regional economic growth, agricultural growth and industrial growth in India. Using state level data for India for a sample period of 1999-2008, we examine whether or not such reforms have affected the state level growth in output and growth in the key components of state level output. Based on an empirical analysis that involve fixed effects panel and GMM estimation, we show that there is clear evidence of growth effects of commercial and rural banking development in 26 states and union territories of India.

There are very few studies that attempt to analyze the impact of banking development on local economic growth of developing countries. Among the few studies, Cheng and Degryse (2010) consider the impact of bank and non bank financial development on local economic growth of China. Their study is a follow up of a stream of studies that deal similar issue on China, such as Hasan, Wachtel and Zhou (2006), Allen, Qian and Qian (2005), Ayyagari, Demirguc-Kunt and Maksimovic (2010), and Ping (2003).

Prior to the current study there have been some attempts to examine the link between financial development and economic growth in India, but most of these look either at the aggregate economy or at the development of corporate finance schemes. Luintel and Demetriades (1996) consider aggregate data on Indian economy and examine the role of interest rate controls on aggregate economic growth. Das and Guha (2001) study the impact of aggregate financial development on economic growth of both India and China. One of their key arguments is that for both these economies financial development can be attributable to short term sustained growth in per capita income. However for the long term growth pattern their arguments are rather inconclusive.

Prior to the current study, Acharya, Imbs and Sturgess (2011) investigate the relationship between financial development and regional economic growth in India. Their approach was based on panel co-integration and fully modified ordinary least squares estimation of *ad hoc* growth specifications. Given the consideration of banking regulations in India their approach confirms a long run relationship between commercial banking development and regional economic growth. Their methodology, however, is one of reduced form which is unable to determine whether the proxies for banking sector development have any endogenous effects. In addition, they do not use a well defined growth regression, which is why their approach is unable to identify the exact growth effect of deposits and credits of the commercial banking system. Finally, their study only considers regional growth in per capita state domestic product and not the regional growth in the different components of the state domestic product. These three are the areas where the current study adds value to this particular literature.

In recent years, the structure of employment and income generation in the Indian economy has been through some important changes. India, which was predominantly an agrarian economy, is now experiencing a boost in its service sector. The recent reforms in the banking sector say a different story, however. Although the regional rural banks (RRB) started their operation since the establishment of the banking sector in India, it was only during the most recent banking sector reforms in India where the government made attempts to encourage the expansion of RRBs. This reform is aimed at promoting rural development and development in the agricultural and allied sector. We consider this as an interesting mix of facts for a fast growing emerging economy like India, which is why we find the analysis of local economic growth effects of banking sector development in India as an important economic issue. In summary, our main motivation is investigating the two questions, which are *(a)* if the recent banking sector reform in India is aimed at promoting and expanding rural banking, what impact it is likely to have on the state level growth in per capita domestic product and its components?; *(b)* which dimension of banking sector development (demand side or supply side) has a significant marginal impact on state level growth in per capita domestic product and its components? Thus the three areas where our study contributes are very important from the policy point of view. This study is therefore motivated by the literature, the state level growth facts, and the series of banking sector reforms undertaken in India.

In chapter 3, we examine how and to what extent development in infrastructure and rural well being can assist in explaining the banking development led growth in state level output, agricultural output and industrial output in India. We use state level data for India for a sample period of 1999-2008. Based on an empirical analysis that involve fixed effects panel and GMM estimation, we show that there is clear evidence of growth effects of commercial and rural banking development, infrastructure development and development in rural well being in 26 states and union territories of India.

What primarily motivates us in examining the key research question in chapter 3 is that for a fast growing and predominantly rural economy like India, there is huge disparity in state level infrastructure growth, rural well being and banking development, and there is no study in the literature that attempts to identify their growth effects in a unified growth accounting approach[†]. Identifying the exact state level growth effects of infrastructure, rural well being and banking development would enable one to directly infer policy lessons that are directed towards boosting state level growth and encouraging convergence at the state level. Also, identifying the marginal effect of infrastructure and rural well being on the components of state level growth is in fact equivalent to identifying the channels through which state level growth in production sectors (agriculture and industry) are affected by these, which in turns provides clear policy implications.

There are very few studies in the relevant literature that attempt to analyze the impact of banking development, infrastructure and rural development on local economic growth of developing countries in a unified framework. Cheng and Degryse (2010) consider the impact of bank and non bank financial development on local economic growth of China, where they give some insight about the relationship between infrastructure and local economic growth of China[‡]. They consider infrastructure (rail and road) as conditioning set of variables for regional growth difference in Chinese provinces, but they do not emphasize on the marginal growth effect of these infrastructure. They do not really focus on how variations in these can affect growth or can explain the reasons behind the regional difference in growth of output. They also do not consider the marginal effect of infrastructure on the growth of different sectors of the economy. Among others, Cull and Xu (2000) and Cull and Xu (2005) examine how the level of bureaucracy has affected in the efficiency of agricultural credit extended towards the state owned enterprises in China.

Esfahani and Ramirez (2003) in their paper develop a structural model of infrastructure and output growth that takes account of institutional and economic factors that mediate in the infrastructure-GDP interactions. Their cross country

[†] The role of infrastructure development in influencing economic growth and development has been highlighted in important works such as Schumpeter (1911), Solow (1956) and Lucas (1988).
[‡] Their study is a follow up from a stream of studies that deal similar issue on China, such as Demurger (2001) and Ping (2003).

estimates of the model indicate that the contribution of infrastructure services to GDP is substantial and in general this level exceeds the cost of provision of those services. Their results also shed light on the factors that shape a country's response to its infrastructure needs and offer policy implications for facilitating the removal of infrastructure inadequacies.

Some empirical studies also provide clear evidence that in the vast majority of cases infrastructure does induce long run growth effects. Among those studies, one of the important one is made by Canning and Pedroni (2008), where they investigate the effect of infrastructure on long run economic growth in a panel of countries for 1950-1992. They however find that these results can be inconclusive across individual countries and across individual groups of countries. They find that while telephones, electricity generating capacity and paved roads are provided at close to the growth maximizing level on an average, these are under-supplied in some countries and over-supplied in others. Their results also help in explaining why cross section and time series studies have in the past found contradictory results regarding a causal link between infrastructure provision and long run growth. Boopen (2006) in his paper provides evidence on the importance of transport capital development in promoting economic development for African and island states. His study analyses the contribution of transport capital to growth for two different data sets, namely for a sample of Sub Saharan African countries, and for developing states. In both sample cases, the analysis concluded that transport capital has been a contributor to the economic progress of these countries.

In chapter 2 and chapter 3, our regressions show that there is clear evidence of growth effects of commercial and rural banking development in the 26 states and UTs of India that we consider over the period 1999-2008. We find that deposits of commercial banks in general have a significant positive impact on the growth of per capita SDP. Thus domestic savings in commercial banks affect local economic growth positively and significantly. We also find that domestic savings and mobilization of domestic savings through commercial banks do not significantly affect the state level growth in the agricultural component of SDP, and their positive and significant impact on per capita SDP growth mainly stems from their significant marginal effect on the growth of the industrial component of SDP. This finding is robust whether we use fixed effects panel estimation or system GMM estimation. We also find that the marginal effect of SCB credits on the growth of per capita SDP is mixed. Credits that are channelled through rural banks positively affect the growth in the agricultural component of per capita SDP and the growth in per capita industrial SDP.

From these results we find some strong policy implications. In general, per capita growth in SDP in Indian states can be improved by increasing savings (i.e. deposits) in commercial banks. But it is the mobilization of savings through the RRB expansion that can contribute to the growth in agricultural production and rural well being. For industries, development in deposits and credits through commercial banking in general contributes to growth. In addition to these, from chapter 3, we also find that expansion of road transportation and rail routes improves state level growth, and expansion of informal sector has a negative effect on growth. Improving rural well being can bring in more growth to the economy. Thus these additional results suggest that in order to get the best from rural banking development in India there is a need to emphasize the role of development in the infrastructure and rural well being.

Chapter 1

Financial Development and Endogenous Growth in an Economy with Informal Sector

Chapter summary:

This chapter examines the linkage between financial development and economic growth in an endogenously growing economy with an informal and a formal sector. We find that the key engine of growth in such economies is the accumulation of human capital and greater investment of the accumulated human capital in the formal sector. An increase in the share of labour in the formal sector results in a relatively higher positive effect on growth as compared to that in the informal sector. Any such increase in the formal sector reduces the growth in consumption demand but increases the demand for human capital. Further accumulation of human capital contributes to more growth in the economy. For the formal sector higher revenue through consumption taxation creates a multiplier effect on net aggregate economic growth, which is why the growth effect of formal sector is greater. For most developing countries there is therefore a need to design policies that contribute to accumulation of human capital and a shift of the additional human capital to the formal sector. We also show that standard policy measures can hurt growth, which is why there is a need to design policies which create incentives for agents to shift more investment in the formal sector.

1.1 Introduction.

In this chapter we investigate the linkage between financial development and economic growth in an endogenously growing monetary economy with informal and formal markets. In order to capture this linkage, we consider a profit maximizing financial intermediary sector in the spirit of Gillman and Kejak (2011). We extend their model by introducing an endogenous growth framework that captures the idea of bank based creation of financial services and market based delivery of financial services. We build a model that can capture the net growth effects of expansion in the financial sector for the informal market and in the financial sector for the formal market. The main aim of this study is to investigate how and to what extent such a framework can explain the linkage between financial service and economic growth in an economy with formal and informal markets. The chapter is therefore primarily aimed at examining an important topic in the contemporary growth literature; one way in which financial development can affect growth in developing countries.

The paper's central result is that an increase in the allocation of effective labour in the formal sector results in relatively higher positive effect on growth as compared to an increase in the allocation of effective labour in the informal sector. Along a balanced growth path any such increase in the allocation of effective labour reduces the growth in consumption demand but increases the growth in consumption price, leaving the growth in total consumption expenditure from both sectors growing at the same rate. Allocation of more effective labour in any sector is associated with a trade off of working time across sectors and a higher demand for human capital. Because of the trade off of working time in production, economic agents can accumulation more human capital which contributes to more growth in the economy. Because more production in the formal sector allows the government to redistribute more (through consumption taxation), if the government adjusts the growth in money supply so as to fix the inflation at a particular level the net growth effect of an increase in the share of effective labour in the formal sector is much higher relative to that of an increase in the share of effective labour in the informal sector[1]. This result

[1] In our setting economic agents can avoid paying consumption tax by purchasing from the informal market where transactions are generally off the books.

extends important previous works such as Gillman, Harris and Matyas (2004), who find negative net growth effects for any such increase in the share of effective labour.

Our results imply that for most developing countries more allocation of real factors in the formal sector is associated with higher economic growth. This can be accomplished by accumulation of human capital, and relative to the case of allocating more labour in the informal market the higher rate of growth is achievable through higher amounts of redistribution which results from the collection of higher tax revenue. We also show that standard fiscal and monetary policy measures can hurt growth. This is why there is a need to design policies which create incentives for agents to accumulate more human capital and shift more human capital investment in the formal sector.

According to very early studies in the literature, such as Schumpeter (1911), financial development can act as a catalyst to economic growth by reallocating resources. Cross-country evidence of this conjecture is well documented in many studies. King and Levine (1993) for instance argue that financial development causes economic growth, and the predetermined components of financial development are good predictors of growth for the next 10 to 30 years to follow. Demirguc-Kunt and Maksimovic (1996) concur to the same opinion, and with cross-country evidence they show that growth is positively related to the stock market turnover and different measures of law enforcement. Using state level data for the US, Jayaratne and Strahan (1996) also show a positive influence of liberalization of the banking sector on growth. The findings of Levine and Zervos (1998) reveal that measures of liquidity are strongly related to capital accumulation, productivity and economic growth, but stock market size is not strongly related to growth. They also show that bank lending to the private sector has a strong effect on growth.

Levine, Loayza and Beck (2000) in their paper evaluate whether the exogenous component of the development in the financial intermediary influences economic growth and whether cross-country differences in legal and accounting systems explain differences in the level of financial development. Using both traditional cross-section instrumental variable procedures and recent dynamic panel techniques, they find that the exogenous components of financial intermediary development are positively associated with economic growth. Their findings also suggest that legal and accounting practices can boost financial development and accelerate economic growth. But these empirical studies didn't say much about growth and its linkage with sectoral financial development. Contributions to the theory of growth and its linkage with sectoral financial development leave some areas that can benefit from our model. Our model presents a simple framework which can be considered as a benchmark that can lead to more sophisticated as well as complicated set ups. But this simple setup presents some very useful insights into the sectoral difference in productivity in producing financial services and its impact on growth.

Prior to this study, theoretical models that attempt to answer the sectoral production as well as distribution of financial services involved mainly micro-founded models that followed the game theoretic approach. Important contributions in this spirit include Chaudhuri & Gupta (1996), Gupta & Chaudhuri (1997), Bose (1998) and Jain (1999). In these studies the key concentration is on formal and informal sector interaction in rural credit markets. Chaudhuri and Gupta (1996) in their paper presented a theory of interest rate determination in the informal credit market. According to them the market for informal credit is created by the delay in disbursement of formal credit. They use game theoretic approach in their model and show that the informal sector interest rate and the effective formal sector interest rate are equal in equilibrium. Agricultural price and credit subsidy policies may raise the interest rate in the informal credit market. According to Bose (1998), the majority of small cultivators in the least developed countries are not regarded as credit-worthy by the formal sector financial institutions and are forced to borrow from the financial institution in the informal credit market. In a framework that is similar to that in Chaudhuri and Gupta (1996) he showed that when such borrowers differ in their likelihood of default, and the informal financial institutes are asymmetrically informed about the client-specific degree of risk, the policy of providing cheap credit through the formal sector can generate adverse "composition effects" which worsen the terms of credit and the availability of loans in the informal sector.

Jain (1999) in his paper argue that in many developing countries where enterprises are active borrowers in both formal and informal credit markets, the formal sector's superior ability in deposit mobilization is traded off against the informational advantage that lenders in the informal sector enjoy. The formal sector can screen borrowers by providing only partial financing for projects thereby forcing borrowers to resort to the informal sector for the remainder of the loan. They use their model to predict how the market structure responds to changes in the environment, and they consider the policy implications of various forms of government intervention. Dasgupta (2009) examines whether the presence of informal credit markets reduces the cost of credit rationing in terms of growth. With the help of Indian household level data they show that the informal market reduces the cost of rationing by increasing the growth rate by 0.7 percent. According to them this higher growth rate (in the presence of an informal sector) is due to the ability of the informal market to separate the high risk from the low risk due to better information[2].

While these important studies mainly concentrate on the strategic interaction between financial stakeholders in informal and formal markets, in the aggregative models of economic growth this issue has not been formally addressed. In this chapter we introduce a model economy where both formal and informal market for credit and financial services co-exist, which takes the model closer to the stylized facts of many developing countries. In many developing countries rural channels of credit and financial services create ease of transactions in a cash-only market. These are markets where goods and services are exchanged for cash. Since such transactions do not typically leave a paper trail, it is not possible to tax these. This simply means that the predominance of an informal sector or an informal market in general allows consumers to avoid VAT type taxes. So in such economies advantage of buying in the informal market (e.g. a farmers' market) is that such purchases can evade the consumption tax. At the same time advantage of buying in the formal market (e.g. *tesco* direct) is that for such purchases credit is available. In addition, having an informal market at tandem with a formal market enables buyers to consider a number of allocation decisions across markets, such as supply of factors and purchase of consumption. With this model and its relevant balanced growth conditions, we explain different properties of sectoral growth and its linkage with financial development.

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[2] Rajan and Zingales (1998) hold similar views when they discuss the impact of financial repression on economic growth.

We consider an endogenous growth monetary economy with households, firms, banks and a government. Households are identical, infinitely lived and they maximize their utility. Households own firms and banks; firms and banks own nothing except the technologies. Households supply factors of production to the firms and the banks, gets paid for their work or investment. They use their earnings to buy consumption and investment goods in perfectly competitive markets. There are two markets for the single final good: a formal market, where the good is sold for cash and credit, and an informal market where the good is sold for cash only. For the banks, two technologies exist for two types of markets. Although the bank technology in the informal market is not as efficient as bank technology in the formal market, together the banking technologies play an important role in determining growth in the financial system vis a vis the aggregate economy.

This particular chapter, thus, depicts the relationship between financial development and endogenous growth in an economy with informal and informal markets. In the remainder of the chapter, section *1.2* discusses the motivation of this study, section *1.3* presents the model and section *1.4* presents the discussion on the competitive equilibrium and balanced growth path of this model, including some analytical results of this model which are drawn from the equilibrium properties and properties of the balanced growth path. Section *1.5* presents an illustrative calibration of the BGP and some numerical examples. Section *1.6* concludes.

1.2 Motivation.

In many developing countries rural channels of credit and financial services create ease of transactions in a cash-only market. Since such transactions do not typically leave a paper trail, the predominance of such a sector (or an informal market, in general) allows consumers to avoid indirect taxes. Primarily we find that such a setting can be useful for an aggregative study on the finance-growth nexus in developing countries. In its simplest form if one adds two channels of financial services to an otherwise standard model (e.g. Gillman & Kejak (2011)), one can examine the relative effects of financial development and the growth in aggregate real variables. Standard endogenous growth models are in general not capable of capturing the transactions which are accomplished in such markets and the growth effects of financial development in such economies. Our key motivation stems from this insufficiency of the models in the literature.

This chapter and its key model are also motivated from the fact that in many countries across the world, the informal sector contribute large share in their GDP and in their labour forces. In table 1 we present some relevant evidence where it is clear that a large proportion of GDP and labour force are contributed by the informal sector in many developing countries. That is why incorporating the informal market in a standard growth model enhances its capacity to capture the growth effect of financial development in this type of economies. These leading indicators are collected from International Labour Organization (ILO) and the United Nations.

Table 1: Average Size of the Informal Economy in Terms of Value-Added and the Labour Force Over Two Periods (2004/2005).

Countries	**Average size of the Informal Economy Value-Added in % of Official GDP**	**Average size of the Informal Economy Labour Force in % of Official Labour Force**
Developing Countries	*(Number of Countries)*	*(Number of Countries)*
Africa	**42** *(23)*	**48.2** *(23)*
Central and South America	**41** *(18)*	**45.1** *(18)*
Asia	**29** *(26)*	**33.4** *(26)*
Transition Countries	**35** *(23)*	-
Western OECD Countries-Europe	**18** *(16)*	**16.4** *(7)*
North American and Pacific OECD Countries	**13.4** *(4)*	-

Source: ILO and United Nations Statistics

In an economy where the same commodity can be purchased from two different markets, one needs to distinguish features of these markets so that one can model clear incentives of using the two markets. One way to model such incentives is to introduce the idea of variable marginal utility for the same commodity purchased from the two markets. While this methodology is simple, it leaves much to be desired when one is interested to examine the balanced growth properties of the equilibrium. A simple parameter in the utility function is insufficient to capture the growth effects of sectoral allocation of resources and financial services that facilitate to channel these resources. Our motivation is thus based on the approach as in Gillman and Kejak (2011) which shows the correspondence between the developments in financial services to sectoral allocation of resources. In our model we capture such a correspondence not only between one sector's financial development with the remainder of the economy, but also across sectors. Put differently, we identify the need to model financial services with certain characteristics that enable one to assign such services to a particular sector of the economy.

Ideally, financial services produced and utilized in an informal sector are different from that produced and utilized in a formal sector. Such services have two different demands, which allow one to choose different levels of the two services. In an economy with formal and informal markets, the financial services that can be used in one sector also imposes a different marginal cost of producing as well as using such a service as compared to the service that can be used in the other sector. Intuitively, in an informal market the utility cost of producing a financial service can be modelled as much higher than the utility cost of producing a financial service in a formal market. This may be because producing and selling rural credit or any cash service often requires more working time which decreases utility. On the other hand, producing and selling financial services for the formal sector may require higher level of human as well as physical capital but may not require high level of working time. The difference in the intensity of factor allocation across these two sectors can be modelled by variations in the relevant parameters. We build on this idea. We model two financial services, one particular for the informal sector and the other particular for the formal sector. In a model with only human capital (and no physical capital) we model the informal sector financial service production as more working time intensive and the formal sector financial service production as more human capital intensive.

1.3 The Model.

We consider an endogenous growth monetary economy with households, firms, banks and a government. Time is discrete and runs forever. There is a continua of measure one of identical, infinitely lived utility maximizing households, and each household is endowed with one unit of time, $h_0 > 0$ units of human capital in the initial period, $M_0 > 0$ amount of cash money in the initial period, and the property rights of the firms and the banks. Firms and banks own nothing except the technologies. Households supply factors of production to the firms and the banks, gets paid for their work or investment, and use the proceeds to purchase consumption and investment goods in perfectly competitive markets.

There are two markets for the final good, an informal market where the good is sold for cash, and a formal market, where the good is sold for cash and credit. Although these are essentially the same commodity, we model them as two different goods only because in equilibrium they may have different unit prices. For the financial intermediary (or more simply the banks) two technologies exist for two types of markets. Sellers in the formal market combine financial services and the final good, and sell to households in exchange of credit or in cash. Sellers in the informal market combine financial services and the final good, and sell to households in exchange of cash. Consumption good purchased from the informal market for cash are not subject to consumption taxation, but consumption good purchased from the formal sector for cash or credit is subject to consumption taxation. In short, consumption goods purchased from the formal market are on the books, while those purchased from the informal sector are off the books.

The advantage of buying in the informal market is that such purchases can evade the consumption tax, while the advantage of buying in the formal market is that for such purchases credit is available. All incomes from working are subject to income taxation. The government supplies money makes lump sum transfers to households and collects revenue through income and consumption taxation.

1.3.1 The Households:

The representative household's discounted utility stream depends on the consumption purchased from the informal market, c_{st} the consumption purchased from the formal market, c_{ft} and leisure, x_t in a constant elasticity fashion:

$$u(c_{st}, c_{ft}, x_t) = \sum_{t=0}^{\infty} \beta^t (\ln c_{st} + \ln c_{ft} + \alpha \ln x_t); \beta \in (0,1), \alpha > 0 \qquad (1)$$

The representative household uses either nominal money, M_t or lump sum transfer of cash, denoted by V_t, given by government, in order to purchase consumption from the informal market at the informal market price $P_{ct}^{\ s}$, or purchase consumption from the formal market at the formal market price $P_{ct}^{\ f}$. The households face the cash-in advance (CIA) constraint:

$$M_t + V_t \geq P_{ct}^{\ s} c_{st} + P_{ct}^{\ f} c_{ft} \qquad (2)$$

We assume that all expenditures are sourced from the deposits, denoted in real units by d_{st} for the informal sector and d_{ft} for the formal sector. The per unit dividend is in essence the payment of a nominal interest rate on deposited funds. We denote the per unit nominal dividend by R_{st} and R_{ft} for the informal and the formal sector, respectively. Total nominal dividends are then $P_t R_{st} d_{st}$ and $P_t R_{ft} d_{ft}$ for the informal and the formal sector, respectively. Since all expenditures are sourced from deposits the households face the exchange constraints:

$$P_t d_{st} = P_{ct}^{\ s} c_{st} \qquad (3a)$$

$$P_t d_{ft} = P_{ct}^{\ f} c_{ft} \qquad (3b)$$

Normalizing by P_t, we can rewrite the CIA constraint and the exchange constraints as:

$$\frac{M_t + V_t}{P_t} \geq p_{ct}{}^{s} c_{st} + p_{ct}{}^{f} c_{ft} \tag{4a}$$

$$d_{st} = p_{ct}{}^{s} c_{st} \tag{4b}$$

$$d_{ft} = p_{ct}{}^{f} c_{ft} \tag{4c}$$

The households accumulate human capital through a constant return to scale production function, and this accumulation is assumed to be an internal process. The households use effective labour and stock of human capital in this production process, and with $A_H > 0$, and denoting the fractions of working time allocated to the production of human capital by n_{Ht}, the law of motion for human capital is:

$$h_{t+1} = A_H \left(n_{Ht} h_t\right) + \left(1 - \delta_H\right) h_t \tag{5}$$

The other fractions of labour allocated to work include the one for the final good production, n_{yt}, banking production in the informal sector, n_{st}, and banking production in the formal sector, n_{ft}.The fractions of working time add up to the total productively utilized time, or $(1 - x_t)$, i.e. the time allocation constraint is:

$$1 - x_t = n_{yt} + n_{Ht} + n_{ft} + n_{st} \tag{6}$$

The government has two tax instruments. The proportionate tax rates are denoted by τ_t^{c} and τ_t^{n} for consumption and labour income, respectively. The household's budget constraint for all time t is:

$$\begin{aligned} & P_{ct}{}^{s} c_{st} + \left(1 + \tau_t^{c}\right) P_{ct}{}^{f} c_{ft} + M_{t+1} \\ & \leq V_t + M_t + P_t R_{st} d_{st} + P_t R_{ft} d_{ft} + P_t h_t w_t \left(1 - \tau_t^{n}\right)\left(n_{st} + n_{ft} + n_{yt}\right) \end{aligned} \tag{7}$$

In this framework optimal behaviour of the representative household is characterized by the solution to the representative household's utility maximization problem. The households take prices as given. They choose allocations $\{c_{st}, c_{ft}, h_{t+1}, M_{t+1}, x_t, n_{yt}, n_{ft}, n_{st}, n_{Ht}, d_{st}, d_{ft}\}_{t=0}^{\infty}$ in order to maximize discounted utility defined by (1) subject to constraints (2), (3a), (3b), (5), (6) and (7). The household's normalized budget constraint ((7) divided by P_t), using (6), (4b) and (4c) to substitute out, $(n_{yt} + n_{st} + n_{ft}), d_{st}, d_{ft}$, is:

$$p_{ct}{}^{s} c_{st} + (1+\tau_t{}^{c}) p_{ct}{}^{f} c_{ft} + \frac{M_{t+1}}{P_t}$$
$$\leq (1-\tau_t{}^{n}) w_t (1 - x_t - n_{Ht}) h_t + \frac{M_t + V_t}{P_t} + R_{st} p_{ct}{}^{s} c_{st} + R_{ft} p_{ct}{}^{f} c_{ft} \qquad (8)$$

1.3.2 Firms:

There is one final good in this model economy, and we will denote its level by y_t. There is a continua of measure one of identical profit maximizing firms in this sector, who hire effective labour and use these labour in the production of the final good. The production technology for the final goods production is:

$$y_t = A_y (n_{yt} h_t) \qquad (9)$$

where, $n_{yt} h_t$ is the fraction of effective labour allocated to production in this sector, and $A_y \in (0, \infty)$. The representative firm in this sector hires these effective labour, pays wage equal to w_t per unit of effective labour, and sells this final good in two markets (the informal market and the formal market) at a competitive price P_t. The representative firm's profit maximization problem is:

$$\max_{\{n_{yt} h_t\}} \Pi_{yt} = P_t y_t - P_t w_t n_{yt} h_t \qquad (10)$$

subject to (9). Competitive profit maximization in this sector is associated with the first order condition:

$$w_t = A_y \tag{11}$$

which simply states that in this economy the equilibrium wage is inelastic of working time or effective labour.

1.3.3 Bank Technologies:

For the informal market there is a self-produced exchange function by *walking to the sector*. The production for financial services is CRS in effective labour and deposited funds. Exchange cost in this sector is just carrying the cash. With $A_s \in (0,\infty), \gamma_s \in (0,1)$ the production function is given by:

$$q_{st} = A_s (n_{st} h_t)^{\gamma_s} d_{st}^{\,1-\gamma_s} \tag{12}$$

Here, A_s doesn't change over time, $d_{st} = M_{st} = cash$ and q_{st} denotes the financial services available in the informal market. The residual return per unit of deposit, R_{st}, results after profit maximization. The informal sector bank chooses the levels of the two inputs (effective labour and deposits) and competitively maximizes profits. Profits here is the revenue $P_{st} q_{st}$ minus costs $P_t w_t h_t n_{st}$ and the dividend pay out $P_t R_{st} d_{st}$. The profit maximization problem is:

$$\max_{\{n_{st}h_t, d_{st}\}} \Pi_t^{qs} = P_{st} q_{st} - P_t n_{st} h_t w_t - P_t R_{st} d_{st} \tag{13}$$

subject to the production function (12). The first order conditions associated with this problem include:

$$w_t = p_{st}\gamma_s A_s (n_{st}h_t)^{\gamma_s - 1} d_{st}^{\ 1-\gamma_s} \quad (14a)$$
$$R_{st} = p_{st}(1-\gamma_s)A_s(n_{st}h_t)^{\gamma_s} d_{st}^{\ -\gamma_s} \quad (14b)$$

In the formal market we have bank-produced exchange function. The production for financial services is CRS in effective labour and deposited funds with $A_f \in (0,\infty), \gamma_f \in (0,1)$. The production function is given by:

$$q_{ft} = A_f (n_{ft}h_t)^{\gamma_f} d_{ft}^{\ 1-\gamma_f} \quad (15)$$

Here, $d_{ft} = M_{ft} = cash$ and q_{ft} denotes the financial services available in the formal market. The residual return per unit of deposit, R_{ft}, results after profit maximization. The competitive profit maximization problem then can be written as maximization of profit choosing the two inputs (effective labour and deposit) subject to the production function (15). The profit maximization problem is:

$$\max_{\{n_{ft}h_t, d_{ft}\}} \Pi_t^{qf} = P_{ft}q_{ft} - P_t n_{ft}h_t w_t - P_t R_{ft} d_{ft} \quad (16)$$

subject to the production function (15). With normalized variables, and with $p_{ft} = \frac{P_{ft}}{P_t}$ the first order conditions associated with this problem are:

$$w_t = p_{ft}\gamma_f A_f (n_{ft}h_t)^{\gamma_f - 1} d_{ft}^{\ 1-\gamma_f} \quad (17a)$$
$$R_{ft} = p_{ft}(1-\gamma_f)A_f(n_{ft}h_t)^{\gamma_f} d_{ft}^{\ -\gamma_f} \quad (17b)$$

Here we do not impose any restriction on the relative sizes of γ_s and γ_f, but as we will show later in the chapter, their relative size assist big time in explaining financial development led economic growth in the economy. In general, it is intuitive to assume that $\gamma_s > \gamma_f$, implying that the production of financial services in the informal sector is more labour intensive than the production of financial services in the formal sector.

1.3.4 The Informal Market:

The informal market sellers combine each unit of the good with one unit of financial service q_{st} and sell to households at price P_{ct}^{s}. The profit maximization problem for the representative seller in the informal market is:

$$\max_{\{c_{st}\}} \Pi_t^{s} = P_{ct}^{s} c_{st} - P_{st} q_{st} - P_t c_{st} \tag{18a}$$

$$s.t.\ q_{st} = c_{st} \tag{18b}$$

The first order condition associated with this problem is:

$$P_{ct}^{s} = P_{st} + P_t \tag{19}$$

We define $p_{ct}^{s} \equiv \frac{P_{ct}^{s}}{P_t}$ and $p_{st} \equiv \frac{P_{st}}{P_t}$, and rewrite the first order condition as:

$$p_{ct}^{s} = p_{st} + 1 \tag{20}$$

1.3.5 The Formal Market:

The Formal market sellers combine each unit of the good with $\psi > 0$ units of financial service and sell to households at unit price P_{ct}^{f}. The profit maximization problem for the representative informal market seller is:

$$\max_{\{c_{ft}\}} \Pi_t^{f} = P_{ct}^{f} c_{ft} - P_{ft} q_{ft} - P_t c_{ft} \tag{21a}$$

$$s.t.\ q_{ft} = \psi c_{ft} \tag{21b}$$

The first order condition associated with this problem is:

$$P_{ct}^{f} = \psi P_{ft} + P_t \tag{22}$$

and with $p_{ct}{}^f \equiv \frac{P_{ct}{}^f}{P_t}$ and $p_{ft} \equiv \frac{P_{ft}}{P_t}$, the first order condition can be rewritten as:

$$p_{ct}{}^f = \psi p_{ft} + 1 \tag{23}$$

This is where our model can explain the relative difference between purchasing from the informal market and purchasing from the formal market. Here, the consumer price of the same commodity from the two markets has two different prices, $p_{ct}{}^s$ and $p_{ct}{}^f$. We model a difference between the unit cost of financial services attached to these two goods. This is why the difference between the equilibrium consumer prices of the two goods is simply equal to the difference between p_{st} and p_{ft}, i.e. the equilibrium prices for financial services in the two sectors adjusted by the marginal cost of financial services in the two markets.

1.3.6 The Government:

The government makes a lump sum transfer of cash, denoted by V_t, to households. It has two tax instruments. The proportionate tax rates are denoted by $\tau_t{}^c$ and $\tau_t{}^n$ for consumption and labour income, respectively. The government's budget constraint is:

$$V_t + M_t = P_t w_t \left(n_{yt} + n_{st} + n_{ft}\right) h_t \tau_t{}^n + M_{t+1} + P_{ct}{}^f \tau_t{}^c c_{ft} \tag{24}$$

With $M_{t+1} = (1+\sigma)M_t$, where σ is the constant growth rate of money supply, we rewrite the budget constraint as:

$$V_t = P_{ct}{}^f \tau_t{}^c c_{ft} + P_t w_t \left(n_{yt} + n_{st} + n_{ft}\right) h_t \tau_t{}^n + \sigma M_t \tag{25}$$

and dividing by P_t, (25) becomes

$$\frac{V_t}{P_t} = p_{ct}{}^f \tau_t{}^c c_{ft} + w_t\left(n_{yt} + n_{st} + n_{ft}\right)h_t \tau_t{}^n + \sigma m_t \tag{26}$$

where $m_t \equiv \dfrac{M_t}{P_t}$ is the real money supply.

1.3.7 Utility maximization:

Taking the prices and taxes as given, the representative household chooses allocations $\{c_{st}, c_{ft}, h_{t+1}, M_{t+1}, x_t, n_{Ht}\}_{t=0}^{\infty}$ in order to maximize discounted utility defined by (1) subject to constraints (5), (4a) and (8). Let λ_{1t}, λ_{2t} and λ_{3t} denote the current value multipliers associated with the budget constraint, (8), the cash-in-advance constraint (4a), and the human capital accumulation constraint, (5). Conditions for optimal behaviour include the three constraints (5), (4a) and (8), and:

$$c_{st} : \frac{1}{c_{st}} = \lambda_{1t} p_{ct}{}^s \left(1 - R_{st}\right) + \lambda_{2t} p_{ct}{}^s \tag{27a}$$

$$c_{ft} : \frac{1}{c_{ft}} = \left(1 + \tau_t{}^c - R_{ft}\right)\lambda_{1t} p_{ct}{}^f + \lambda_{2t} p_{ct}{}^f \tag{27b}$$

$$x_t : \frac{\alpha}{x_t} = \lambda_{1t}\left(1 - \tau_t{}^n\right)w_t h_t \tag{27c}$$

$$M_{t+1} : \lambda_{1t} = \beta \frac{P_t}{P_{t+1}}\left(\lambda_{1t+1} + \lambda_{2t+1}\right) \tag{27d}$$

$$h_{t+1} : \lambda_{3t} = \beta\left[\lambda_{1t+1}\left(1 - \tau_{t+1}{}^n\right)w_{t+1}\left(1 - x_{t+1} - n_{Ht+1}\right) + \lambda_{3t+1}\{A_H n_{Ht+1} + \left(1 - \delta_H\right)\}\right] \tag{27e}$$

$$n_{Ht} : \frac{\lambda_{3t}}{\lambda_{1t}} = \frac{\left(1 - \tau_t{}^n\right)w_t h_t}{A_H h_t} \tag{27f}$$

From (27c) we get:

$$\lambda_{1t} = \frac{\alpha}{x_t\left(1 - \tau_t{}^n\right)w_t h_t} \tag{28}$$

We substitute (28) in (27a) in order to derive:

$$\lambda_{2t} = \frac{1}{p_{ct}{}^{s} c_{st}} - \frac{\alpha(1 - R_{st})}{x_t(1 - \tau_t{}^{n})w_t h_t} \tag{29}$$

We substitute (27c) in (27b) and derive:

$$\lambda_{2t} = \frac{1}{p_{ct}{}^{f} c_{ft}} - \frac{\alpha(1 + \tau_t{}^{c} - R_{ft})}{x_t(1 - \tau_t{}^{n})w_t h_t} \tag{30}$$

Substitute (27c) in (27f) in order to derive

$$\lambda_{3t} = \frac{\alpha}{x_t A_H h_t} \tag{31}$$

1.4 Competitive Equilibrium and Balanced Growth.

Before defining the competitive equilibrium, we summarize the market clearing conditions:

$$A_y(n_{yt} h_t) = p_{ct}{}^{s} c_{st} + p_{ct}{}^{f} c_{ft} \tag{32a}$$
$$1 - x_t = n_{yt} + n_{Ht} + n_{st} + n_{ft} \tag{32b}$$
$$A_H(n_{Ht} h_t) = h_{t+1} - (1 - \delta_H)h_t \tag{32c}$$
$$A_s(n_{st} h_t)^{\gamma_s} d_{st}{}^{1-\gamma_s} = c_{st} \tag{32d}$$
$$A_f(n_{ft} h_t)^{\gamma_f} d_{ft}{}^{1-\gamma_f} = \psi c_{ft} \tag{32e}$$

Here, (32a) is the goods market clearing condition, (32b) explains how time is allocated across leisure and work, (32c) is the market clearing condition for human capital, and (32d) and (32e) are the market clearing conditions for financial services for informal and formal market. A set of allocations in this framework that satisfies (32) is essentially a set of feasible allocations.

Definition 1 (Competitive Equilibrium) *A competitive equilibrium in this economy is a set of prices* $\{P_t, p_{ct}^{\ s}, p_{ct}^{\ f}, R_{st}, R_{ft}, p_{st}, p_{ft}, w_t\}_{t=0}^{\infty}$, *policy* $\{M_t, V_t, \tau_t^{\ c}, \tau_t^{\ n}\}_{t=0}^{\infty}$ *and allocations* $\{c_{st}, c_{ft}, h_{t+1}, M_{t+1}, x_t, n_{yt}, n_{st}, n_{ft}, n_{Ht}, d_{st}, d_{ft}, q_{st}, q_{ft}, y_t\}_{t=0}^{\infty}$, *such that*

(a) *Given the set of prices and the policy, the allocations* $\{c_{st}, c_{ft}, h_{t+1}, M_{t+1}, x_t, n_{yt}, n_{st}, n_{ft}, n_{Ht}, d_{st}, d_{ft}\}_{t=0}^{\infty}$ *solve the representative household's utility maximization problem;*

(b) *Given the set of prices, the allocations* $\{h_t, n_{yt}, y_t\}_{t=0}^{\infty}$ *solve the profit maximization problem of the representative firm in the goods production sector;*

(c) *Given the set of prices, the allocations* $\{n_{st}, n_{ft}, h_t, d_{st}, d_{ft}, q_{st}, q_{ft}\}_{t=0}^{\infty}$ *solve the profit maximization problem of the representative bank in the financial intermediary sector;*

(d) *Given the set of prices, the allocations* $\{c_{st}, c_{ft}, q_{st}, q_{ft}\}_{t=0}^{\infty}$ *solve the profit maximization problem of the representative sellers in the informal and formal market;*

(e) *Given the set of prices and the allocations, the government policy* $\{M_t, V_t, \tau_t^{\ c}, \tau_t^{\ n}\}_{t=0}^{\infty}$ *satisfies the sequence of government budget constraints;*

(f) *Allocations satisfy the market clearing conditions.*

As long as the representative household's optimum has an interior solution, given the production technologies and the utility function, a competitive equilibrium exists in this model[3]. In this model a corner solution would imply that one of the sectors close down and the entire consumption is sold through only one of the markets. Given the utility function in (1) the model is therefore useful in providing

[3] For a broader class of utility function that satisfy standard regularity conditions a competitive equilibrium may exist for corner solutions as well. Given the utility function that we use only interior solutions are interesting and useful. In effect we are only interested in interior solutions to the household's optimization problem. In general we are interested in the competitive equilibria where both sectors operate and the households purchase from both markets.

insights into the issues that we are interested in only if we consider an interior solution to the household's optimization problem. We therefore propose the conditions that are required to guarantee an interior solution to the representative household's optimum.

Proposition 1 *The representative household's optimum has an interior solution if* $\tau_t^n < 1$ *and* $R_{st} > 1$, *and* $R_{ft} > 1 + \tau_t^c$.

Proof. *From (28),* $\lambda_{1t} = \dfrac{\alpha}{x_t(1-\tau_t^n)w_t h_t}$, *and from (28-29) and (30),*

$$\lambda_{2t} = \frac{1}{p_{ct}^s c_{st}} - \frac{\alpha(1-R_{st})}{x_t(1-\tau_t^n)w_t h_t} = \frac{1}{p_{ct}^f c_{ft}} - \frac{\alpha(1+\tau_t^c - R_{ft})}{x_t(1-\tau_t^n)w_t h_t} \quad \text{and} \quad \lambda_{3t} = \frac{\alpha}{x_t A_H h_t}.$$

These are the shadow prices of the budget constraint, the CIA constraint and the human capital accumulation constraint, respectively. These are all strictly positive if $\tau_t^n < 1$ *and* $R_{st} > 1$, *and* $R_{ft} > 1 + \tau_t^c$, *which in turns ensure interior solution.* ■

The competitive equilibrium dynamics can be characterized by the market clearing conditions (32), equilibrium factor price equations (11),(14a),(14b),(17a) and (17b), equilibrium goods price equations (20), (23), the government budget constraint (26), and the consolidated system from (27a)-(27f), which after using (28)-(31), is:

$$\frac{1}{p_{ct}^f c_{ft}} - \frac{1}{p_{ct}^s c_{st}} = \frac{\alpha}{x_t(1-\tau_t^n)w_t h_t}\left(\tau_t^c + R_{st} - R_{ft}\right) \tag{33}$$

which is the *intratemporal* optimality condition that explains how the marginal rate of substitution across consumption and leisure is explained by their relative prices in equilibrium. Following proposition 1 and from (33), it is straightforward to see that for $R_{st} = 1, R_{ft} = 1 + \tau_t^c$ we have a corner solution where at the optimum the representative household's expenditure across the two markets are equal, and this model collapses to a simple one sector model. As long as proposition 1 holds, this model can bring some insights into the problem where the representative household has a clear advantage and a clear disadvantage of purchasing from a particular market.

Throughout the analysis of this model, we will continue assuming that the inequality restrictions $\tau_t^n < 1, R_{st} > 1, and\, R_{ft} > 1 + \tau_t^c$ hold, i.e. the solution to the representative household's optimum is an interior solution. This is also tantamount to assuming that within the government's policies, we do not allow any subsidy. Following Proposition 1 and using the association between the endogenous variables and the tax instruments, this model gives some important insights of the two sector economy.

Proposition 2 *At the optimum, if all other variables remain unchanged, higher nominal return to deposits in the informal sector bank and higher consumption tax rate are associated with higher consumption expenditure in the informal market.*

Proof. *From (33), the difference between the consumption expenditure in the informal market and the consumption expenditure in the formal market is simply equal to* $\frac{(\tau_t^c + R_{st} - R_{ft})\alpha}{x_t(1-\tau_t^n)w_t h_t}(p_{ct}^f c_{ft} p_{ct}^s c_{st})$. *Here* R_{st} *is the nominal return to deposits in the informal sector bank, and given an interior solution to the representative household's optimum the term* $(\tau_t^c + R_{st} - R_{ft}) > 0$ *as long as* $R_{st} > R_{ft}$. *In addition, this term is increasing in the spread in the nominal return (i.e.* $R_{st} - R_{ft}$*) and in the policy instrument* τ_t^c. ■

Proposition 2 is an intuitively very important *equilibrium property* which brings some insights into the stylized allocation problem in mixed structured financial markets. In this model economy, since equilibrium wage is constant the only channel through which allocation decisions are affected is the nominal return to deposits. If the nominal return to deposits in the informal sector bank is relatively higher, the representative household puts more deposit in this sector's bank which in turns results in higher production of the financial service in the informal sector bank. Because the total quantity of financial service produced in this sector is simply equal to the total quantity of consumption purchased from this sector's market, a relatively higher nominal return to deposits in this sector ultimately result in more purchase from this sector's market. In addition, if the government increases the consumption tax rate, the representative household evades this additional tax burden by purchasing higher amounts of consumption from the informal sector market. In effect, as we will discuss in proposition 3 to follow, the representative household's equilibrium reaction to any tax increase is to shift consumption to the informal market in order to avoid the excess burden of the tax.

Proposition 3 *At the optimum, if all other variables remain unchanged, higher nominal return to deposits in the informal sector bank and higher labour income tax rate are associated with higher consumption expenditure in the informal market.*

Proof. *Once again from (33), the difference between the consumption expenditure in the informal market and the consumption expenditure in the formal market is simply equal to* $\frac{(\tau_t^{\,c} + R_{st} - R_{ft})\alpha}{x_t(1-\tau_t^{\,n})w_t h_t}(p_{ct}^{\,f} c_{ft} p_{ct}^{\,s} c_{st})$. *Given an interior solution to the representative household's optimum the term* $(\tau_t^{\,c} + R_{st} - R_{ft}) > 0$ *as long as* $R_{st} > R_{ft}$. *This term is increasing in the spread in the nominal return (i.e.* $R_{st} - R_{ft}$*). In addition, the term* $\frac{(\tau_t^{\,c} + R_{st} - R_{ft})\alpha}{x_t(1-\tau_t^{\,n})w_t h_t}$ *in increasing in the policy instrument* $\tau_t^{\,n}$. ■

We have already discussed the intuition behind the correspondence between the spread of nominal returns and the spread of consumption expenditure. The intuition behind the remainder of proposition 3 is as follows. With wages and consumption tax fixed (and strictly positive), a higher income tax rate incurs the additional burden of paying higher income tax. Since equilibrium wage is inelastic to labour supply, the only way to avoid paying too much in taxes is to evade part of the consumption tax burden, which can be done by shifting consumption to the informal sector market (i.e. use cash). Thus in this economy, any tax increase leads to evasion of consumption tax which the households accomplish by shifting consumption from the formal market to the informal market.

Substituting (27c) and (30) in (27d) gives us the Euler equation that explains the intertemporal allocation of human capital in terms of current consumption and other current levels of allocations and prices,

$$\frac{x_{t+1}\left(1-\tau_{t+1}{}^{n}\right)w_{t+1}h_{t+1}}{x_{t}\left(1-\tau_{t}{}^{n}\right)w_{t}h_{t}}=\beta\frac{P_{t}}{P_{t+1}}\left[R_{st+1}+\frac{1}{p_{ct+1}{}^{s}c_{st+1}}\left(\frac{x_{t+1}\left(1-\tau_{t+1}{}^{n}\right)w_{t+1}h_{t+1}}{\alpha}\right)\right] \tag{34}$$

Notice here that same substitution in (27e) also yields an Euler equation.

$$\frac{x_{t+1}\left(1-\tau^{n}{}_{t+1}\right)w_{t+1}h_{t+1}}{x_{t}\left(1-\tau_{t}{}^{n}\right)w_{t}h_{t}}=\beta\frac{P_{t}}{P_{t+1}}\left[R_{ft+1}-\tau^{c}{}_{t+1}+\frac{1}{p^{f}{}_{ct+1}c_{ft+1}}\left(\frac{x_{t+1}\left(1-\tau^{n}{}_{t+1}\right)w_{t+1}h_{t+1}}{\alpha}\right)\right] \tag{35}$$

Combining (27e) and (27f), after substituting out the multipliers, we derive the equilibrium condition:

$$\frac{x_{t+1}h_{t+1}}{x_{t}h_{t}}=\beta[A_{H}(1-x_{t+1})+1-\delta_{H}] \tag{36}$$

Thus the optimum *intertemporal* allocation of human capital is determined by the subjective discount rate, the rate of human capital depreciation, the human capital productivity parameter, and the optimum intertemporal allocation of leisure time.

1.4.1 Balanced Growth Path:

We consider a balanced growth path (BGP). Given the multi sector approach in our setting and the cash-credit purchase of goods, the definition of the balanced growth path deserves attention, where one would have to take care in characterizing the growth of the real variables. In proposition 4 to follow we summarize the properties of the balanced growth path for this model.

Proposition 4 *A Balanced Growth Path (BGP) in this economy is a path along which for a particular set of government policy* $\{\widetilde{M}_t,\widetilde{V}_t,\widetilde{\tau}_t^{\,c},\widetilde{\tau}_t^{\,n}\}_{t=0}^{\infty}$ *the endogenous variables* $n_{yt},n_{Ht},n_{st},n_{ft},x_t,w_t$ *remain stationary and the remaining endogenous variables grow at constant rates.*

Proof. *Verify (32a), which states that along the BGP y_t, h_t and aggregate consumption expenditure $\frac{p_{ct+1}{}^{s} c_{st+1} + p_{ct+1}{}^{f} c_{ft+1}}{p_{ct}{}^{s} c_{st} + p_{ct}{}^{f} c_{ft}}$ grow at the same rate, and therefore*

$$\frac{y_{t+1}}{y_t} = \frac{h_{t+1}}{h_t} = \frac{p_{ct+1}{}^{s} c_{st+1} + p_{ct+1}{}^{f} c_{ft+1}}{p_{ct}{}^{s} c_{st} + p_{ct}{}^{f} c_{ft}} \equiv 1 + g \qquad (37)$$

Notice that $\frac{M_{t+1}}{M_t} = 1 + \sigma$, and $m_t = \frac{M_t}{P_t}$. Along the BGP all growing real variables grow at the same rate, and therefore $\frac{m_{t+1}}{m_t} = 1 + g$, which in turns imply that $\frac{P_{t+1}}{P_t} = \frac{1+\sigma}{1+g} \equiv 1 + \pi$.

The growth in nominal deposits follow the growth in nominal money supply, because the amount of deposit at any time t to any sector bank is simply equal to the cash allocated to that sector's bank. This, together with $q_{st} = c_{st}$ and $q_{ft} = \psi c_{ft}$ imply that along the BGP

$$\frac{c_{st+1}}{c_{st}} = (1+\sigma)\left(\frac{1+g}{1+\sigma}\right)^{\gamma_s} \qquad (38a)$$

$$\frac{c_{ft+1}}{c_{ft}} = (1+\sigma)\left(\frac{1+g}{1+\sigma}\right)^{\gamma_f} \qquad (38b)$$

$$\frac{p_{ct+1}{}^{s}}{p_{ct}{}^{s}} = \left(\frac{1+\sigma}{1+g}\right)^{\gamma_s} \qquad (38c)$$

$$\frac{p_{ct+1}{}^{f}}{p_{ct}{}^{f}} = \left(\frac{1+\sigma}{1+g}\right)^{\gamma_f} \qquad (38d)$$

Along the BGP, the real output and aggregate expenditure grows at constant rate g, but expenditure in individual sector grow at rate σ. This implies that the ratio of growth in expenditure across two sectors is constant.

Growth in the production of financial services along the BGP in the informal sector bank and in the formal sector bank is characterized by the growth in the amount of consumption from these two markets, characterized by (38a) and (38b), respectively. Since wage is fixed in this model, (14a) and (17a) imply that the unit price of financial services in the informal sector bank and in the formal sector bank grow at constant rates, given by

$$\frac{p_{st+1}}{p_{st}} = \left(\frac{1+\sigma}{1+g}\right)^{\gamma_s - 1} \qquad (38e)$$

$$\frac{p_{ft+1}}{p_{ft}} = \left(\frac{1+\sigma}{1+g}\right)^{\gamma_f - 1} \qquad (38f)$$

Finally, (14b) and (17b) imply that,. $\frac{R_{st+1}}{R_{st}} = \frac{R_{ft+1}}{R_{ft}} = \frac{1+g}{1+\sigma}$. *Along the BGP the list of growing variables are* $\left(h_t, y_t, c_{st}, c_{ft}, q_{st}, q_{ft}, d_{st}, d_{ft}, p_{st}, p_{ft}, p_{ct}^{\ s}, p_{ct}^{\ f}\right)$, *while the remaining endogenous variables remain constant.* ■

We discuss the details of the BGP in the next section where we present a closed form solution method of the BGP. As in (38) along the BGP the growth properties of endogenous variables $\left(c_{st}, c_{ft}, q_{st}, q_{ft}, p_{st}, p_{ft}, p_{ct}^{\ s}, p_{ct}^{\ f}\right)$ depend crucially on the parameters γ_s and γ_f, which are the parameters associated with the marginal product of effective labour in producing the financial services. If $\gamma_s = \gamma_f$, the growth properties (and rates) are same for consumption and prices across sectors. This would imply that the two sectors are perfectly symmetric and the financial services produced by the two sectors are perfectly substitutable. In contrast, any difference in these two parameters would imply that the quantity of consumption purchased from these sectors, their unit price in the retail market, and the unit price of financial services from these two sectors grow at different rates. In addition, from (38) it is straightforward to verify that consumption expenditure from the two sectors grows at the same rate, and this is simply equal to the rate of growth in nominal money supply, i.e. σ.

1.4.2 Solution of the BGP:

In order to discuss the analytical properties of the BGP, we first propose a closed form solution method for the BGP. For a given set of government policy, $\{\widetilde{M}_t, \widetilde{V}_t, \widetilde{\tau}_t^{\,c}, \widetilde{\tau}_t^{\,n}\}_{t=0}^{\infty}$, the BGP is characterized by the solution to the system of equations that involve the BGP versions of representative household's optimality conditions (33), (34), (35), (36), (4), (5), (6) and (8), market clearing conditions (32), equilibrium factor price equations (11), (14) and (17), equilibrium goods price equations (20) and (23), and the government budget constraint (26), for sets of allocations and prices, $(c_{st}, c_{ft}, h_t, x, n_y, n_s, n_f, n_H, d_{st}, d_{ft}, q_{st}, q_{ft}, y_t)$ and $(p_{ct}^{\,s}, p_{ct}^{\,f}, R_s, R_f, p_{st}, p_{ft}, w_t)$, respectively.

From competitive equilibrium condition (32c) and (32b), it is straightforward to show that along the BGP[4]:

$$x = \frac{\beta(A_H + 1 - \delta_H) - (1+g)}{\beta A_H} \qquad (39a)$$

$$n_H = \frac{g + \delta_H}{A_H} \qquad (39b)$$

Notice that from (39b) it is straightforward to understand the role of human capital in growth. More allocation of working time in accumulating human capital contributes to growth. Also from (39a) more leisure is associated with lower growth in the economy. Given the utility function more leisure is associated with higher levels of welfare, but the BGP condition (39b) states that such higher levels of welfare can result in lower growth. Along the BGP, the competitive equilibrium conditions (34) and (35) become:

[4] We will use a time subscript for endogenous variables that grow along a BGP, and no time subscripts will be used for those which remain constant along the BGP.

$$\frac{(1+g)(1+\pi)}{\beta} = R_s\left[1+\frac{\gamma_s}{(1-\gamma_s)n_s}\left(\frac{x(1-\tau^n)}{\alpha}\right)\right] \tag{40a}$$

$$\frac{(1+g)(1+\pi)}{\beta} = R_f\left[1+\frac{\gamma_f}{(1-\gamma_f)n_f}\left(\frac{x(1-\tau^n)}{\alpha}\right)\right]-\tau^c \tag{40b}$$

Using the BGP versions of (11) and (14a) and (11) and (17a), we derive

$$\gamma_s p_{st} c_{st} = A_y n_s h_t \tag{41a}$$

$$\psi\gamma_f p_{ft} c_{ft} = A_y n_f h_t \tag{41b}$$

Using the BGP versions of (20) and (23) in (41), it is simple to show that

$$c_{st} = p_{ct}{}^s c_{st} - \frac{A_y n_s h_t}{\gamma_s} \tag{42a}$$

$$c_{ft} = p_{ct}{}^f c_{ft} - \frac{A_y n_f h_t}{\gamma_f} \tag{42b}$$

Furthermore, from the BGP versions of (14b) and (17b), one can show that

$$p_{ct}{}^s c_{st} = \frac{(1-\gamma_s)}{\gamma_s}\left(\frac{A_y n_s h_t}{R_s}\right) \tag{43a}$$

$$p_{ct}{}^f c_{ft} = \frac{(1-\gamma_f)}{\gamma_f}\left(\frac{A_y n_f h_t}{R_f}\right) \tag{43b}$$

Substituting (42) and (43) in (32a), we derive:

$$n_y = \frac{(1-\gamma_s)n_s}{R_s\gamma_s} + \frac{(1-\gamma_f)n_f}{R_f\gamma_f} \tag{44}$$

Substituting (40) in (44) we derive:

$$n_y = \beta\left[\frac{(1-\gamma_s)}{\gamma_s}\left(\frac{n_s + \left(\frac{\gamma_s}{1-\gamma_s}\right)\frac{x(1-\tau^n)}{\alpha}}{(1+g)(1+\pi)}\right) + \frac{(1-\gamma_f)}{\gamma_f}\left(\frac{n_f + \left(\frac{\gamma_f}{1-\gamma_f}\right)\frac{x(1-\tau^n)}{\alpha}}{(1+g)(1+\pi)+\beta\tau^c}\right)\right] \quad (45)$$

Notice that with (32b) and (39), the BGP condition (45) is simply an equation with two unknowns, n_s and n_f. We now combine the other BGP conditions in order to derive another equation with the same two unknowns. Using (43) in the BGP versions of the CIA constraint (4a) and the market clearing condition (32a), for a particular set of policy $\{\widetilde{M}_t, \widetilde{V}_t, \widetilde{\tau}_t^c, \widetilde{\tau}_t^n\}_{t=0}^{\infty}$, we derive:

$$\frac{\widetilde{M}_t + \widetilde{V}_t}{P_t} = A_y h_t [1 - x - n_H - n_s - n_f] \quad (46)$$

From the BGP version of the government budget constraint (26), and (43), we derive:

$$\frac{\widetilde{M}_t + \widetilde{V}_t}{P_t} = A_y h_t \tau^n (1 - x - n_H) + (1+\sigma)\frac{\widetilde{M}_t}{P_t} + \tau^c A_y n_f h_t \beta\left[\frac{n_f + \left(\frac{\gamma_f}{1-\gamma_f}\right)\frac{x(1-\tau^n)}{\alpha}}{(1+g)(1+\pi)+\beta\tau^c}\right] \quad (47)$$

The two equations, (46) and (47) can be solved in order to substitute out h_t, which gives one equation in two unknowns, n_s and n_f. More specifically, from (46) we solve for h_t, and use the solution in (48) in order to derive:

$$\frac{\frac{\widetilde{M}_t + \widetilde{V}_t}{P_t} - \frac{(1+\sigma)\widetilde{M}_t}{P_t}}{\tau^n(1 - x - n_H) + \tau^c n_f \beta\left[\frac{n_f + \left(\frac{\gamma_f}{1-\gamma_f}\right)\frac{x(1-\tau^n)}{\alpha}}{(1+g)(1+\pi)+\beta\tau^c}\right]} = \frac{\frac{\widetilde{M}_t + \widetilde{V}_t}{P_t}}{1 - x - n_H - n_s - n_f} \quad (48)$$

Together with (32b) and (39), (48) is simply a BGP condition with two unknowns, n_s and n_f. The BGP conditions (45) and (48) give unique solutions for the two unknowns n_s and n_f. Using these solutions in (40) gives solution to R_s and R_f, and using them in (44) gives solution to n_y. The BGP condition (46) gives unique solution to h_t. Once we derive this solution, (41) gives unique solution to $p_{ft}c_{ft}$ and $p_{st}c_{st}$, i.e. the solution for d_{ft} and d_{st}. The BGP conditions (32d) and (32e) then can be solved in order to derive the solution for c_{st} and c_{ft}, respectively (vis a vis q_{st} and q_{ft}, respectively). Solving for the remainder of the endogenous variables, i.e. $p_{st}, p_{ct}^{s}, p_{ft}, p_{ct}^{f}$ is then straightforward.

1.4.3 Analytical Properties of the BGP:

We will now discuss some important analytical properties of this model economy that can be drawn from the BGP conditions. The BGP has a unique closed form solution. Along the BGP the total expenditure on consumption from the two sectors grow at the same rate. This growth rate is equal to the growth rate in nominal money supply. Along the BGP the growth factor associated with the unit price of financial services is equal to $(1+\pi)^{\gamma_j-1}, j=s,f$, and the growth factor associated with the quantity of financial services produced is equal to $(1+\pi)^{1-\gamma_j}(1+g)$, $j=s,f$. This simply implies that along the BGP the total revenue from selling financial services in any sector does not grow.

Proposition 5 *Along the BGP, growth in the quantity of financial services is strictly decreasing in* γ_j, $j=s,f$, *while growth in the unit price of financial services is strictly increasing in* γ_j, $j=s,f$.

Proof. *Along the BGP the growth factor associated with the unit price of financial services is equal to* $\frac{(1+\pi)^{\gamma_j}}{(1+\pi)(1+g)}$, *which is strictly increasing in* $\gamma_j \in (0,1)$, $j=s,f$. *The growth factor associated with the quantity of financial services is equal to* $\frac{(1+\pi)(1+g)}{(1+\pi)^{\gamma_j}}$, *which clearly is strictly decreasing in* $\gamma_j \in (0,1)$, $j=s,f$. ■

Corollary 1 *Along the BGP, growth in the quantity of financial services is strictly increasing in inflation, while growth in the unit price of financial services is strictly decreasing in inflation.*

Proposition 5 also implies that along the BGP, growth in the quantity of consumption purchased from each sector is strictly decreasing and growth in the unit price of consumption from each sector is strictly increasing in $\gamma_j \in (0,1)$, $j = s, f$. This analytical property provides a useful explanation of the growth properties of the model. Notice first that the magnitude of the parameter $\gamma_j \in (0,1)$, $j = s, f$ in this model is closely related to the amount of time required to producing the financial service in a particular sector. This is because from (14a) and (17a), along the BGP, $\gamma_j = \frac{A_y n_j h_t}{p_{jt} q_{jt}}$, $j = s, f$. With inelastic wage which is equal to A_y, any increase in γ is tantamount to an increase in the share of effective labour in the production of financial services. This can be associated with the allocation of higher amount of working time or higher amount of human capital, or both. It is perfectly justifiable to assume that producing the financial service for the informal sector is more labour intensive (i.e. $\gamma_s > \gamma_f$). This is a representative case of a developing economy where more working time is devoted to the informal sector. More use of effective labour in the informal sector for such an economy results in a lower growth in the production of financial services in the informal sector but a higher growth in the price of this service. This would also imply that the cash price of consumption in the informal sector grows at a higher rate.

Prior to this study, Gillman et al (2004) show that in a one sector monetary economy higher allocation of working time in the financial sector can contribute to lower aggregate economic growth. For a one sector economy this result is perfectly consistent with the fact that more allocation of deposits contributes to growth but further allocation of labour does not do so, something for which Gillman et al. (2004) find strong empirical support. Given the current model, their study would suggest a negative relation between the parameter γ and aggregate economic growth. However, for a two sector model like the one we discuss in this study, this result is not very obvious. Given (40), any change in the parameter γ changes the allocation of working time in both sectors in opposite directions. This is because more working time in one sector is associated with higher allocation of working time in human capital allocation which can be accomplished only by reducing working time in the other sector. The trade off of working times across sectors changes the BGP level of leisure. The net growth effect of the trade off of working time across sectors is therefore unclear from (40), and therefore one would need to characterize it numerically.

Along the BGP higher inflation results in a lower real price of financial services because lesser amount of financial services is now available for the same price. Because wage is inelastic in labour supply, with more money in hand households will increase the amount of deposits in both sectors which results in higher production of financial services. Inflation therefore results in higher quantity of available financial services which can be purchased at a lower price.

We now turn to the BGP properties of the retail sector where the households purchase consumption. In the retail sector, the growth properties are determined by the marginal cost of financial service for the retailer, which is represented by the parameter $\psi > 0$.

Proposition 6 *Along the BGP high (low) marginal cost of financial service in the formal market induces lesser (more) allocation of working time in the informal sector.*

Proof. *The BGP condition (41) implies*

$$\frac{n_s}{n_f} = \left[\frac{\gamma_s}{\gamma_f}\left(\frac{p_{st}c_{st}}{p_{ft}c_{ft}}\right)\right]\frac{1}{\psi} \tag{49}$$

and clearly the term $\frac{n_s}{n_f}$ *is decreasing in* ψ ∎

Along the BGP, higher marginal cost of financial services in the formal retail market makes the purchase price of consumption in the formal market higher, which in turns results in a drop in the demand for consumption from the formal market. The shift in demand from the formal to the informal market implies that more financial service is now required in the informal sector. However, since wage is inelastic in labour supply and more work results in higher disutility, the households allocate more deposits to the informal sector and less amount of working time in producing higher quantities of financial service in the informal sector.

Notice that while the productivity parameters of informal and formal sector banks matter less for BGP properties, the productivity parameter in the final goods sector affects the production of financial services. From BGP conditions (14a) and (17a), it is straightforward to see that a supply shock which is characterized by an increase in the productivity parameter of the final goods sector, A_y, results in higher production of financial services in both sectors. Because these services come in a package in the retail sector, higher amount of goods requires higher amounts of financial services to be combined with in order for the retailers to deliver it to the consumers.

Finally, we explain the aggregate growth properties for changes in government policy. We summarize this in proposition 7.

Proposition 7 *Along the BGP, a higher tax rate on labour income and/or a higher tax on consumption reduces economic growth.*

Proof. *The BGP condition (40) imply that economic growth is decreasing in both* τ^n *and* τ^c*, and in particular the BGP condition (40b) imply that economic growth is decreased when the government raises both taxes.* ■

The intuition behind proposition 7 is that because higher wage tax reduces disposable income and higher consumption tax increases the purchase price of consumption from the formal market, and because wage is inelastic for labour supply, for any increase in these tax rates the households respond with lower expenditure on consumption. Because of this, the households also reduce the accumulation of human capital. Aggregate economic growth in this model is determined by the aggregate consumption expenditure and the accumulation of human capital, both of which decrease for any increase in tax rates, resulting in lower aggregate economic growth.

For developing countries where the informal sector is predominant and so is the total consumption expenditure from the informal market, the growth effect of tax increase is more severe. In such economies an increase in wage tax results in a shift of consumption to the informal sector, as we have previously discussed in proposition 3. If consumption tax is fixed, this shifting results in a lower demand for the financial services in the formal sector. More purchase from the informal sector implies that the government collects less revenue from consumption taxation. Following the BGP condition (40b), lesser production of financial service in the formal sector implies that in order to keep the net growth effect of tax reform neutral the government must increase the consumption tax rate. An increase in the consumption tax rate encourages more evasion which results in more shifting of consumption expenditure towards the informal market. The net result is a further drop in aggregate economic growth.

1.5 An Illustrative Calibration.

In this section, we calibrate the model economy in order to present some quantitative analytics. Our aim for the calibration is to validate the analytical propositions related to the BGP of the model. Put more simply, we calibrate the model in order to numerically test the analytical findings. We are interested in BGP properties of the growth effects of changes in key parameters. We first set plausible parameter values as in the calibrations of Gomme and Rupert (2007), who use data for the US from 1954 to 2001. The calibration of the model is only intended to validate and examine the different analytical properties of the model which we have discussed[5].

[5] Our calibration technique is close to the technique applied in Basu and Fernald (1997) and Cooley and Prescott (1995).

Table 1.2: Baseline parameter values for calibration.

Parameter	Description	Baseline Value
A_s	Banking productivity parameter in informal sector	0.9
A_f	Banking productivity parameter in formal sector	1.4
A_y	Productivity parameter in final goods sector	1
ψ	Proportion of financial service sold as a package in the formal sector	1.2
γ_s	Share parameter for the informal sector bank	0.4
γ_f	Share parameter for the formal sector bank	0.14
τ^c	Proportionate tax rate for consumption	0.15
τ^n	Proportionate tax rate for labour income	0.30
σ	Money supply growth rate	0.067
β	Subjective discount rate	0.9615
α	Leisure weight	8
A_H	Human capital productivity parameter	0.15
δ_H	Human capital depreciation rate	0.05
g	Economic growth rate	0.017

The depreciation rate of human capital is set equal to 0.05. Wage is normalized to 1, which implies that $A_y = 1$. The subjective discount rate is set equal to 0.9615, consistent with real interest rate of 4%. The average annual rate of growth of real GDP, g, and the money supply growth rate, σ, are fixed equal to 1.7% and 6.7% respectively. We fix $A_H = 0.15$. From BGP condition (39a) the proportion of time allocated to leisure is equal to 0.281. From BGP condition (39b) the proportion of time allocated to human capital production is equal to 0.44. The full set of baseline parameter values are presented in table 1.2.

Notice in table 1.2 that in fixing the baseline parameter values we have set lower total factor productivity in the informal sector bank (relative to the formal sector bank), and we have also set $\gamma_s > \gamma_f$. This is done with the intention to show the growth properties and the analytical properties of the model in the sample case of a developing economy. The baseline parameter values are consistent with an inflation rate of 0.049.

The key issue in this calibration is fixing a government policy of money supply and transfers in (48). Since we are only concerned with calibrating the BGP, arbitrary choice of these exogenous variables of the model can lead to biased or inconsistent results. Notice that given (32b), we need to restrict all solutions such that working time in production satisfies $n_y + n_s + n_f = 0.279$. In addition, given proposition 1 interior solution to the system of BGP conditions require additional restrictions such as $R_s > 1$ and $R_f > 1.15$. We therefore adopt an approximation approach for the endogenous variables n_s and n_f. First, we consider (40a), which for given set of parameter values is a functional relationship between n_s and R_s. We fix $R_s = 1.0001$ and compute n_s. We conduct the same in (40b) where we fix $R_f = 1.15001$ and compute n_f. We then check the BGP condition $n_y + n_s + n_f = 0.279$ for these computed values, and given that this is satisfied, we check the consistency in (44). We continue this process by increasing R_s and R_f slightly and computing n_s and n_f until we converge to values of these two for which both (32b) and (45) are satisfied. Once we derive the convergent values of n_s and n_f, we pin them down as calibrated values (along with pinned down values of R_j, $j = s, f$. We find that given the baseline parameter values the solution n_s = 0.18 and n_f = 0.05 satisfy both (32b) and (44). This results in n_y = 0.043, R_s = 1.015 and R_f = 1.162.

1.5.1 Properties of sectoral growth.

We now discuss the growth properties of the model. These properties are discussed in light of proposition 4. We focus on the growth properties for variations in the parameter $\gamma_j, j = s, f$, as in (38). In our first experiment, we examine the effect of $\gamma_j, j = s, f$ on growth of consumption along the BGP for the two sectors assuming that aggregate growth and growth in money supply are fixed. Because the results are symmetric for the two sectors, we only present the results for the informal sector. These are in figure 1, and are perfectly consistent with the analytical results in propositions 5.

Figure 1: Growth effect of sectoral consumption and prices for changes in $\gamma_j, j = s, f$ (γ in horizontal axis)

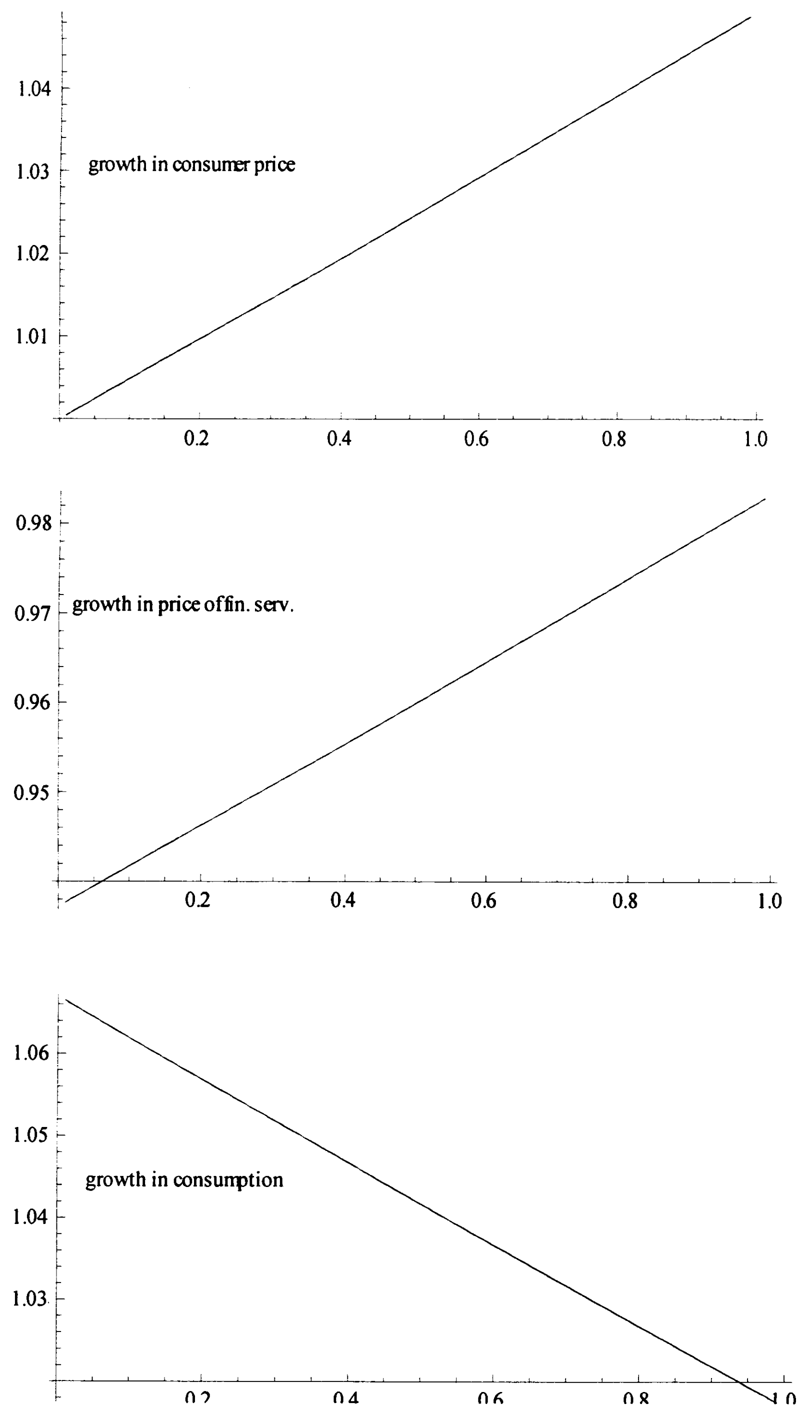
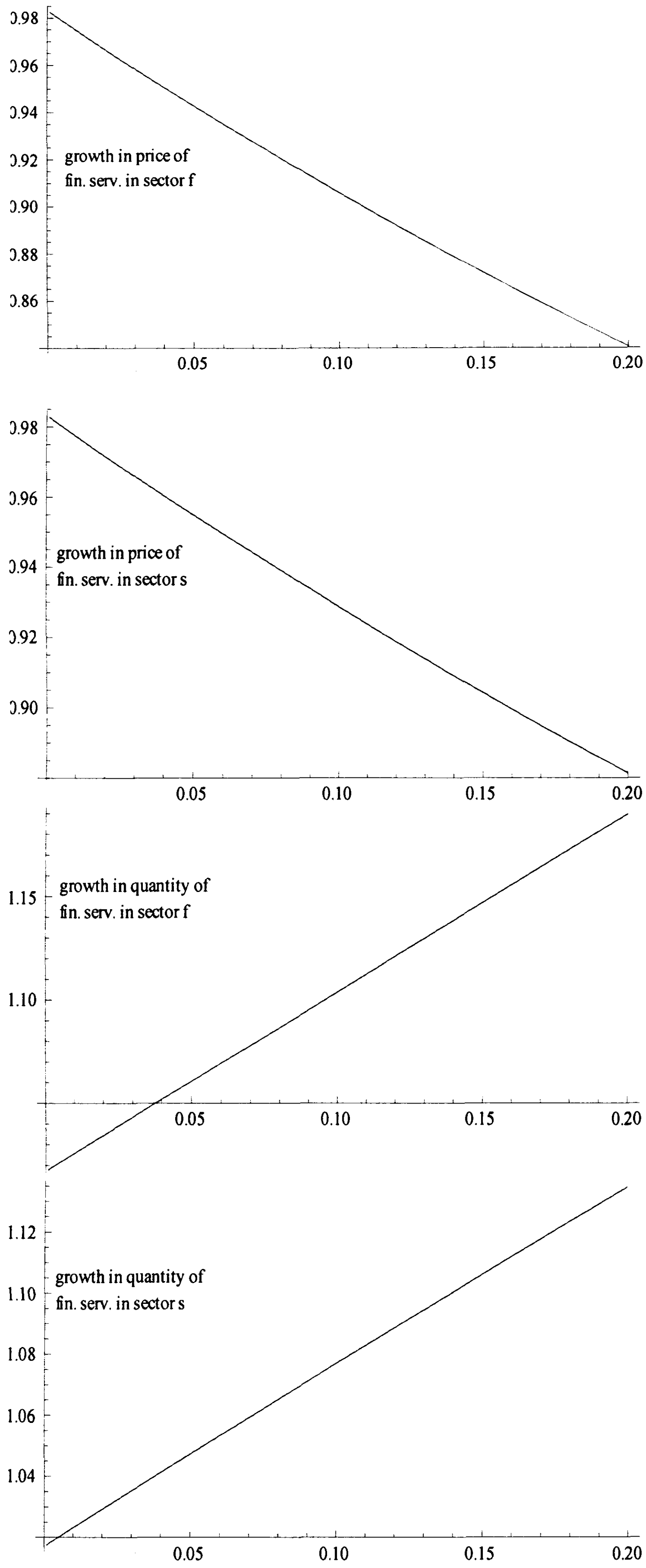


Figure 2: Growth effect of sectoral financial service supply and prices for changes in inflation (π in horizontal axis).



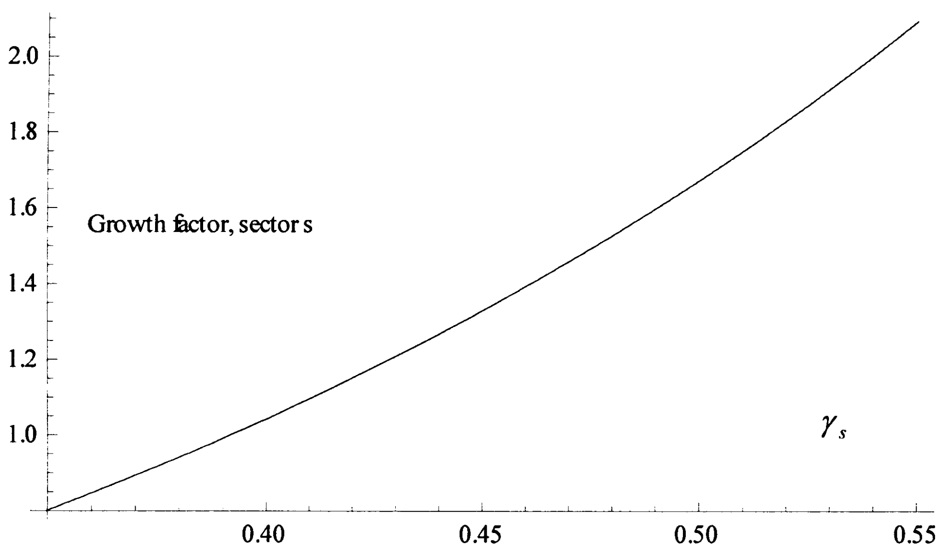
With more working time in producing the financial services and with inelastic wage, growth in consumption falls. This result is symmetric for both sectors. Lower growth in consumption demand which results from higher $\gamma_j, j = s, f$ in turns results in higher growth in consumer prices (again a symmetric result). The net effect on consumer expenditure is that it grows at the rate of growth in money supply. Higher allocation of working time in both sectors also results in a lower demand for financial services from both sectors, causing the unit price of financial services to grow. This is because more allocation of working time in producing financial services leave leisure and working time in human capital accumulation unchanged but trades off some working time in final goods production. In equilibrium this results in a lower demand for financial services required to deliver the good to the consumer.

Consider the effect of inflation on growth rates of these variables for fixed $\gamma_j, j = s, f$. These are presented in figure 2. Because now we fix the parameter, we present the growth properties for both sectors. We will assume that the increase in inflation is solely due to an increase in the money supply growth rate, and that the aggregate economic growth rate is unchanged. In figure 2, we show the growth effect of sectoral prices and supply of financial services for changes in the inflation rate (i.e. money supply growth rate). This is a numerical illustration of corollary 1. Since more inflation is associated with lower real price of financial services, and because wage is inelastic in labour supply, there is an increase in the amount of deposits to banks resulting in higher production of financial services. Excess supply of such services results in their market price to drop.

1.5.2 Properties of aggregate economic growth:

Along the BGP, the net aggregate growth effects of higher allocation of effective labour are not same across the two sectors. In order to verify this we calibrate the aggregate growth effect for a plausible range of values for the parameter γ. This calibration cannot simply be accomplished by changing the parameter $\gamma_j, j = s, f$, because any change in this parameter requires recalibration of the working time and the nominal return to deposits. The recalibrated values then need to be tested to verify the relevant BGP conditions (i.e. (32a) and (44)). Because aggregate growth is determined by the accumulation of human capital vis a vis the growth in the total consumption expenditure, recalibrating the aggregate growth for variation in key parameters of the model requires recalibration of leisure time (as in (39a)) and the working time in human capital production (as in (39b)). We first consider the calibrated values of n_s, n_f, R_s, R_f from (40) for the baseline growth rate. Given these values we vary the parameters $\gamma_j, j = s, f$ in (40) in order to calibrate the new growth rate. The new growth rate is then used to recalibrate leisure time and working time in human capital production using (39). Together with (32b) and (40), it pins down the new n_y, n_s, n_f. This process is continued until we derive convergent values of these endogenous variables. We present the result of this experiment in figure 3.

Figure 3(a): Aggregate growth effect of expansion in γ_s



More working time in the informal sector contributes to growth in the aggregate economy. Higher values of the parameter γ_s implies higher share of effective labour in production. This creates more demand for human capital, and further accumulation of human capital contributes to aggregate growth. This result is symmetric for an increase in γ_f, however the interesting thing to note is that the magnitude by which the aggregate growth improves for the formal sector is much higher than that for the informal sector. Both these experiments are accomplished for a set of solutions which are consistent with all BGP conditions. The model, as is clear by now is very sensitive to parameter values and many plausible parameter values can result in corner solutions to the BGP. We only discuss the range of values for γ for which there exists an interior solution to the BGP. We present the growth effect for $\gamma_f \in [0.1, 0.3]$ in figure 3(b).

Figure 3(b): Aggregate growth effect of expansion in γ_f.

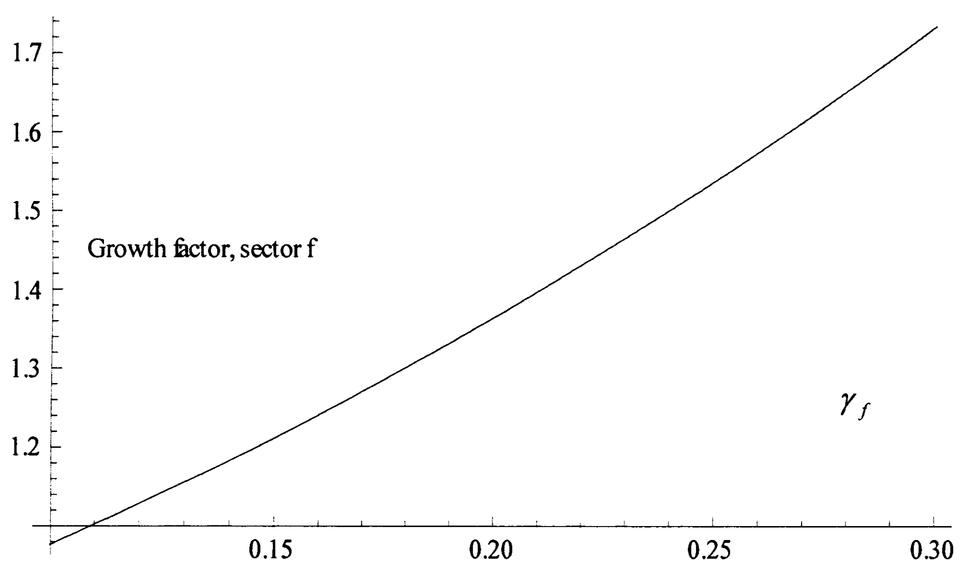


Figure 3(b) in effect illustrates one of the key findings of this study. Together with figure 3(a) it simply shows that higher values of γ for the formal sector are associated with higher margins of growth improvement as compared to that in the informal sector. The implication is clear. The effect of nominal returns to deposits for changes in working time allocated to the two sectors are presented in figure 4, which assist in understanding the aggregate growth effects. For both sectors an increase in the allocation of effective labour (reflected by an increase in the parameter γ) reduces the nominal return to deposits. This result is symmetric for both sectors. However, for the formal sector this decline in nominal return is supplemented by the taxation of consumption. Higher levels of financial service production in the formal sector bank (due to higher levels of demand for consumption from the formal market) enable the government to collect more revenue in the form of consumption taxation. This in turns enable the government to redistribute more which contributes to growth at a relatively higher level.

Figure 4(a): Effect of nominal rate of return to deposits on work in informal sector.

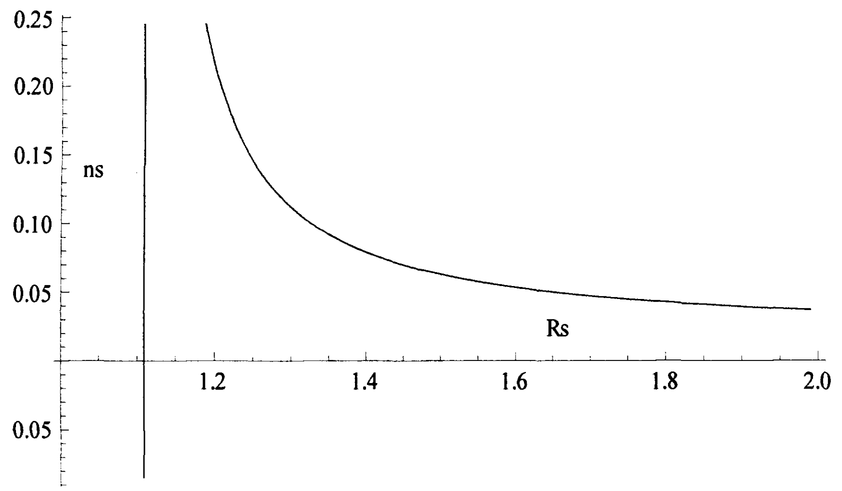
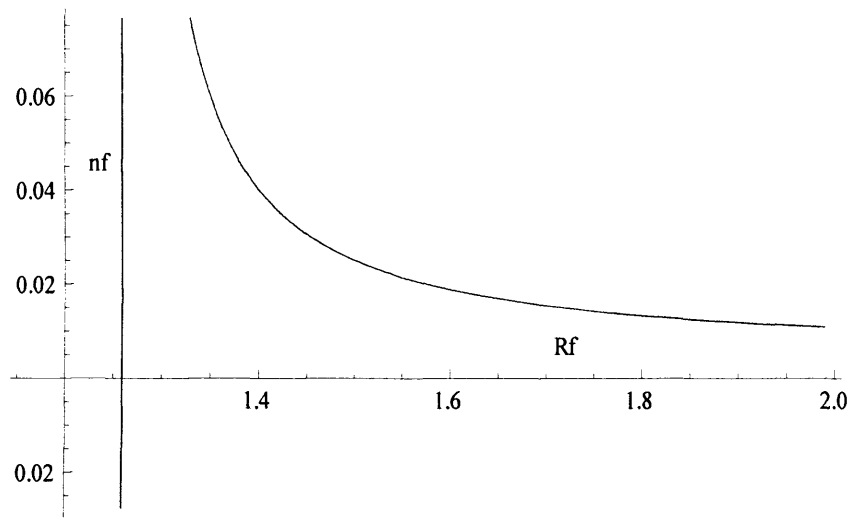
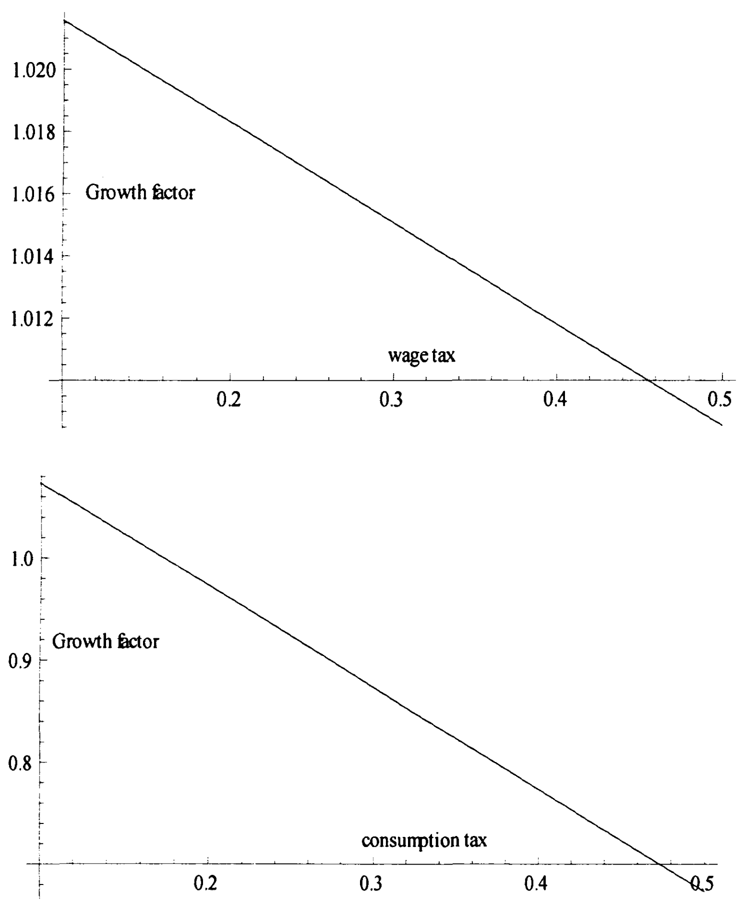


Figure 4(b): Effect of the nominal rate of return to deposits on work in formal sector



In contrast, more demand for financial services for the informal market is not associated with higher tax revenue to be collected by the government. Rather, more purchase from the informal market enables more evasion of consumption tax. The net growth effect is therefore smaller in margin. In figure 5 we present the aggregate growth effect for changes in tax rates, where we try and relate the relevant finding to the case for developing countries.

Figure 5: Aggregate growth effect of increase in tax rates.



In developing countries where the informal sector is predominant, further allocation of effective labour in that sector and its related financial services contributes to growth by relatively smaller margin. In contrast, if the country can design policies that encourage agents to shift allocations towards formalizing the financial markets it could enjoy better levels of improvement in growth. However, expansionary fiscal policy hurt growth in this model. We present a calibrated evidence of this result in figure 5, where we show that if the government increases the tax rates it results in a decline in the growth factor. The shifting of the demand for financial services would therefore have to be incentive based, and the process and the speed of this process is better left for the market to decide. Since any direct policy shock that reduces income or consumption may hurt growth, the governments of developing countries may consider designing incentive-enhancing schemes in order to expand the formal market and its capacities.

This result extends the important findings of Gillman et al. (2004). While they find that in a one sector monetary model of endogenous growth an increase in the γ equivalent would reduce the aggregate economic growth, we find that in a two sector model this experiment in general improves aggregate economic growth. In order to illustrate the intuition, we present a table of computed real variables for an increase in γ_f.

Table 1.3: Balanced growth effects on Endogenous Variables of an increase in γ_f.

Parameter	Endogenous Variables					
γ_f	n_f	n_s	n_H	R_f	R_s	g
0.14	0.05	0.18	0.44	1.162	1.015	0.017
0.15	0.07	0.15	0.46	1.16	1.017	0.055
0.16	0.08	0.13	0.48	1.158	1.019	0.089
0.17	0.09	0.12	0.52	1.156	1.017	0.122
0.18	0.09	0.11	0.54	1.155	1.016	0.188
0.19	0.1	0.1	0.56	1.152	1.01	0.213
0.20	0.11	0.08	0.57	1.151	1.002	0.239

For table 1.3 we have considered the range $\gamma_f \in [0.14, 0.20]$ for which all solutions are interior. Notice here that an increase in the parameter γ_f in this model affects aggregate economic growth through different channels, and one of which is through the trade off of working time. For an increase in γ_f, a higher share of labour in financial service output requires trading off some working time in the informal sector in order to accumulate more human capital. This accumulation contributes to higher levels of aggregate economic growth. For the formal sector, redistribution through higher consumption tax revenue creates a multiplier effect in aggregate economic growth.

Notice that with an increase in γ_f, the nominal return to deposit in the formal sector falls while that in the informal sector increases. This is because in this model wage is inelastic. Higher allocation of working time in this sector in effect results in a decline in the growth of financial service from this sector but an increase in the growth of the price of the service. Because of the retail sector the total consumption expenditure from the formal sector grows, which in turns allows the government to collect more revenue from consumption taxation. This results in more redistribution. Assuming that the government adjusts the growth in money supply so as to fix inflation at a particular level, higher redistribution contributes to higher levels of aggregate economic growth. For the informal sector the same intuition for aggregate economic growth follows apart from the fact that the multiplier effect of redistribution is absent.

1.6 Concluding Remarks.

In this chapter we discuss the linkage between financial development and economic growth in an endogenously growing monetary economy where there is an active informal sector. We built and analyzed an endogenous growth model that can capture the idea of bank based creation of financial services and market based delivery of financial services. Our key emphasis is on the growth effects of changes in allocation of effective labour in the financial sector for the informal market and the financial sector for the formal market. We find that the two sector model in this chapter serves well in providing the insights into the issue of how predominance of the informal sector affects the allocation and growth along the balanced growth path.

Chapter 2

Banking Development and Local Economic Growth in India: Evidence from State Level Data

Chapter summary:

In this chapter we examine the effect of banking sector development on regional economic growth, agricultural growth and industrial growth in India. In recent years the government of India has been making attempts to encourage the expansion of rural banking through policy reforms. Using state level data for India for a sample period of 1999-2008, we examine whether or not such reforms has affected state level growth in output and growth in the key components of state level output. Based on an empirical analysis that involve fixed effects panel and GMM estimation, we show that there is clear evidence of growth effects of commercial and rural banking development in 26 states and union territories of India. Deposits of commercial banks in general have a significant positive impact on growth, while mobilization of domestic savings through commercial banks do not significantly affect state level growth in agriculture. The positive and significant impact of domestic savings on per capita output growth mainly stems from their significant marginal effect on the growth of industry. The marginal effect of credits on state level growth is mixed. Credits that are channelled through rural banks positively affect agricultural growth. Given the relative importance of agriculture in India, this clearly implies that expansion of regional rural banks can positively affect economic growth in India.

2.1 Introduction:

It is well known that the relation between financial development and economic growth has been long under debate. Although there is plenty of evidence that financial as well as banking development plays an important role in promoting economic growth of the industrialized countries (see Beck and Levine, 2004 for a detailed survey), evidence is rather mixed within developing or emerging countries. Moreover, most studies that deal with this issue consider growth in the aggregate economy, which is why it is rather simple to explain a causal relationship (or the lack of it) between finance and growth. There have been very few studies that deal with the impact of domestic financial development on local as well as regional economic growth.

In this chapter, we examine the relation between banking development and local economic growth in a sample of 26 states and union territories (UTs) of India over the period 1999-2008 in three contexts. First, we examine the relationship between the growth in gross state domestic product (SDP) and the development of commercial and regional rural banking in these states. Second, we examine the relationship between the growth in the agricultural component of SDP and the development of commercial and regional rural banking for the same sample. Finally, we examine the relationship between the growth in the industrial component of SDP and the development of banking services to the industries for the same sample.

As discussed earlier, there are very few studies that attempt to analyze the impact of banking development on local economic growth of developing countries. Among the few studies, Cheng and Degryse (2010) consider the impact of bank and non bank financial development on local economic growth of China. Their study is a follow up of a stream of studies that deal similar issue on China, such as Hasan, Wachtel and Zhou (2006), Allen, Qian and Qian (2005), Ayyagari, Demirguc-Kunt and Maksimovic (2010), and Ping (2003).

Prior to this study there have been some attempts to examine the link between financial development and economic growth in India, but most of these look either at the aggregate economy or at the development of corporate finance schemes. Luintel and Demetriades (1996) consider aggregate data on Indian economy and examine the role of interest rate controls on aggregate economic growth. Das and Guha (2001) study the impact of aggregate financial development on economic growth of both India and China. One of their key arguments is that for both these economies financial development can be attributable to short term sustained growth in per capita income. However for the long term growth pattern their arguments are rather inconclusive.

Bhattacharya and Shivasubramanian (2003) conduct a study on the impact of money market development on aggregate economic growth of India where they use M3 over GDP as the main proxy for financial development[6]. Oura (2008) considers firm level data for India in an attempt to examine the efficiency of corporate finance schemes. This particular study is at the micro level and its key findings are very particular to one scheme of the entire financial system of India. Prior to the current study, Acharya, Imbs and Sturgess (2011) conducted a study on financial development and regional economic growth in India. Their approach was based on panel co-integration and fully modified ordinary least squares estimation of *ad hoc* growth specifications. Given the consideration of banking regulations in India their approach confirms a long run relationship between commercial banking development and regional economic growth. Their methodology, however, is one of reduced form which is unable to determine whether the proxies for banking sector development have endogenous effects, i.e. whether the lagged difference in these explains the subsequent levels in these and vice versa. In addition, they do not use a well defined growth regression, which is why their approach is unable to identify the exact growth effect of deposits and credits of the commercial banking system. Finally, their study only considers regional growth in per capita state domestic product and not the regional growth in the different components of the state domestic product. These three are the areas where the current study adds value to this particular literature.

In this study, we examine the relation between development in commercial bank deposits and credits and state level economic growth using the standard growth accounting approach, as in Barro & Salai Martin (1999). Our data is for 26 states and

[6] Their approach is very similar to that of Das and Guha (2001), but the approach in Luintel and Demetriades (1996) is relatively more comprehensive in examining the finance-growth nexus in India.

UTs of India. We use this data in order to estimate three sets of growth specifications under two different approaches. Under approach one, we examine the impact of commercial and rural banking sector development on the growth in per capita state domestic product (SDP), on per capita agricultural SDP and on per capita industrial SDP using fixed effects panel estimation technique. We conduct formal diagnostic tests to verify the significance of the fixed effects, the growth effect of deposits and the growth effect for credits for all three models. Under approach two, we extend the full analysis to a generalized method of moments (GMM) estimation in order to capture the potential endogeneity of the regressors of the growth equations.

The three areas where this study contributes are very important from policy point of view. This study is therefore motivated by the literature, the state level growth facts, and the series of banking sector reforms undertaken in India. The literature is more or less silent about how these reforms are affecting state level growth in per capita income, and there is literally no study that shows how these affect the components of per capita income in India. In recent years, the structure of employment and income generation in the Indian economy has been through some important changes. India, which was predominantly an agrarian economy, is now experiencing a boost in its service sector. This is why there is a high share of industrial output in the state level domestic product. The recent reforms in the banking sector say a different story, however. Although the regional rural banks (RRB) were started since the establishment of banking sector in India, only in the most recent banking sector reforms in India where the government is encouraging the expansion of regional rural banks (RRB). This reform is aimed at promoting rural development and development in the agricultural and allied sector. We consider this as an interesting mix of facts for a fast growing emerging economy like India, which is why we find the analysis of local economic growth effects of banking sector development in India as an important economic issue. In summary, our main motivation is investigating the two questions, which are *(a)* if the recent banking sector reform in India is aimed at promoting and expanding rural banking, what impact it is likely to have on the state level growth in per capita domestic product and its components?; *(b)* which dimension of banking sector development (demand side or supply side) has a significant marginal impact on state level growth in per capita domestic product and its components?

We find that Scheduled Commercial Bank (SCB) deposits in the states and UTs of India in general have a significant positive impact on the growth of per capita SDP, but the marginal effect of SCB credits on this growth is rather inconclusive. SCB deposits have little or no effect on the growth of per capita agricultural SDP, but SCB credits that are channelled through RRBs positively affect the growth in the agricultural component of per capita SDP. For the growth in per capita industrial SDP, we find that both SCB credits and deposits have individual significant positive effects. These findings are robust to the methodology of estimation, i.e. these hold for both the fixed effects panel estimation and the GMM estimation. For the GMM estimation (where we control for the potential endogeneity problem), we however find that these key findings hold but the resulting magnitude of the marginal effect of deposits and credits are rather small in size. Based on the standard Sargan tests, the GMM estimation of these models show consistency of the choice of instruments. For the GMM estimation, we also find that industrial credit by SCBs (priority sector lending) has a significant positive net impact on the growth of the per capita industrial SDP.

In summary, we find some strong policy implications. We find that the expansion of RRB network and more credit channelled through the RRBs can significantly boost growth in agriculture. Agricultural credits that are extended through SCBs (not RRBs) do not contribute to the growth of agricultural production, which is why it is necessary to expand the network as well as the operations of the RRBs. In general, per capita growth in SDP in Indian states can be improved by increasing savings (i.e. deposits) in commercial banks. But it is the mobilization of savings through the RRB expansion that can contribute to the growth in agricultural production and rural well being. For industries, development in deposits and credits through commercial banking in general contributes to growth.

The remainder of the chapter is organized as follows. We present a brief description of the context in section 2.2. In section 2.3 we discuss the empirical methodology and model specifications. Description of data and data sources are presented in section 2.4. In section 2.5 we discuss the results from fixed effects panel estimation, and in section 2.6 we discuss the results from GMM estimation. Section 2.7 concludes the chapter.

2.2 The Background

India, a predominantly agrarian and rural economy, is currently the eleventh largest economy in the world in terms of nominal GDP and the fourth largest in the world in terms of Purchasing Power Parity (IMF reports, 2011). It ranks second worldwide in farm output and sixteenth worldwide in terms of nominal factory output. India is currently the second fastest growing economy (after China), which registered a 8.9% growth during the most recent quarter of 2010. However, it is predicted that the ongoing global recession is likely to hit the Indian economy in the latter part of 2011.

According to the most recent report of the Federation of Indian Chambers of Commerce & Industries (FICCI), India's industrial growth dropped to 4.4% in September 2010 from 8.2% in the same month a year before. Contraction in the capital goods industry is evident as the production slumped by 4.2% in September 2010, allegedly due to non-completion of orders. The most recent (2010) share of agricultural and allied sector (fishing, logging and forestry) contribution to GDP in India was 15.7%, and these sectors employed 52.1% of the total workforce. Despite a steady decline in this share in the GDP, the agricultural and allied sector is still the largest economic sector (in terms of real production) and an important sector for the overall socio-economic development of India.

At present there are 35 regional entities in India which together are known as states and UTs. 28 of these regional entities are known as states, while the remainders, Andaman & Nicobar Islands, Chandigarh, Dadra & Nagar Haveli, Daman & Diu, Delhi, Lakshadweep and Puducherry, are known as UTs. There is huge variation in SDP per capita and the composition of SDP which makes state level study in India an interesting one. In this chapter we will discuss state level variations in output, the composition of state level growth in output and other relevant details of state level growth (i.e. local economic growth) in India in subsection 2.2.1.

The commercial banking sector in India has been through many interesting phases of reforms[7]. The Indian money market comprises of the organized sector that includes the private, public and foreign owned commercial banks and cooperative banks (together known as Scheduled Banks), and the unorganized sector that includes individual or family owned indigenous bankers or money lenders and non-banking financial companies. While the organized sector has the major share in the countrywide deposits and lending, the unorganized sector and microcredit are still allegedly preferred over traditional banks in rural and sub-urban areas, especially for non-productive purposes.

According to the reports of the Reserve Bank of India (RBI), more than half of the personal savings in India are invested in physical assets (e.g. property, gold and cattle). The public sector banks hold over 75% of total assets of the banking industry, with the private and foreign banks holding 18.2% and 6.5% respectively. Since liberalization, the government of India has undertaken many important banking reforms which mainly were aimed at encouraging mergers, reducing government intervention and thereby increasing profitability and competitiveness, opening up the banking and insurance sectors to private and foreign investors, and most importantly for this study, promoting rural banking.

In this study what stands as the key motivation to consider the two types of banks is that during the most recent banking sector reforms in India, the major emphasis was on promoting and expanding regional rural banks. In addition to this, because of the recent reforms that are expected to increase profitability and competitiveness amongst all SCBs the issue of local economic growth effects of SCB and RRB development becomes an interesting one. This chapter aims to examine the details of this effect, i.e. the effect of bank deposits on local economic growth and the effect of bank credits on local economic growth. Moreover, following chapter 1 of this thesis, the net growth effect of development in commercial banks and rural banks are likely to be different across sectors. We therefore examine sectoral growth effects of development in SCBs and RRBs within the same sample.

[7] Our main sources for the discussion on commercial banking and the related reforms in India (including those in 2.2.2 and 2.2.3 to follow) are the various reports of the Reserve Bank of India, available from the publications link of its website http://www.rbi.org.in.

2.2.1 State domestic product (SDP), its components and growth

For this study, mainly for data reasons (availability, continuity and completeness) we have chosen 25 states and 1 UT for the period 1999-2008. Because one of the main motivations of this study is to examine the impact of rural banking development on the growth in the agricultural component of SDP, relatively more urban union territories such as Chandigarh and Delhi are not included in the total sample. The states Sikkim, Mizoram and Arunachal Pradesh are excluded because of partial unavailability and discontinuity of data.

Table 2.2.1a presents the most recent estimated average growth rates of the gross SDP at constant (2000) prices for the 26 entities in this study. On an average over the period 1995-2009, the states in the south region have the highest growth, although for the current period there is low growth in SDP in Tamil Nadu. There is also a large drop in the SDP growth rates of Andhra Pradesh and Karnataka. There is significant progress in SDP growth in Uttar Pradesh (one of the largest states of India). Improvement in SDP growth is also observed in Meghalaya, Bihar and Goa. States in the northern region show consistent growth performance. The economies of most of these states (e.g. Haryana, Punjab) are primarily based on either industry or agriculture.

The summary statistics for growth in SDP, growth in the agricultural component of SDP (ASDP), growth in the industrial component of SDP (ISDP), growth in capital stock, growth in per capita SDP and growth in per capita capital stock for the 26 states and UTs for the full sample period (1999-2008) are presented in table 2.2.1b. These growth rates are computed using the SDP, ASDP, ISDP, Gross capital data (all in 2000 prices). The ASDP includes the gross state domestic product from all agricultural and allied activities, while the ISDP includes the gross state domestic product from all manufacturing and service activities[8]. The data are

[8] In India on an average approximately 9% of the total manufacturing contribution to GDP come from unregistered manufacturing activities. We use the data on total manufacturing which include both registered and unregistered manufacturing.

collected from the National Data Warehouse of the Ministry of Statistics and Programme Implementation (MOSPI) of the Government of India.

Table 2.2.1a: Real growth rates (in %) of the 26 states and union territories' gross state domestic product (2000 prices).

	State/UT (Region)	2009	Average 2003-2009	Average 1995-2009
1	Andhra Pradesh (Southern)	5.04	8.20	6.87
2	Assam (North Eastern)	6.17	5.51	3.75
3	Bihar (Eastern)	16.59	9.80	7.21
4	Jharkhand (Eastern)	5.52	7.54	5.45
5	Goa (Western)	10.12	9.60	8.12
6	Gujarat (Western)	10.08	11.19	8.48
7	Haryana (Northern)	7.92	9.28	7.78
8	Himachal Pradesh (Northern)	7.44	7.77	7.26
9	Jammu & Kashmir (Northern)	6.10	5.71	4.99
10	Karnataka (Southern)	5.08	8.10	7.13
11	Kerala (Southern)	6.98	8.73	6.92
12	Madhya Pradesh (Central)	4.92	4.51	4.63
13	Chattisgarh (Central)	6.81	9.28	6.02
14	Maharashtra (Western)	8.59	8.70	6.57
15	Manipur (North Eastern)	7.13	6.05	5.09
16	Meghalaya (North Eastern)	8.17	6.97	6.85
17	Nagaland (North Eastern)	4.98	5.92	6.45
18	Orissa (Eastern)	6.65	9.34	6.44
19	Punjab (Northern)	6.40	5.56	4.90
20	Rajasthan (Northern)	6.57	7.60	7.47
21	Tamil Nadu (Southern)	4.45	7.33	6.38
22	Tripura (North Eastern)	4.02	6.05	7.30
23	Uttar Pradesh (Central)	6.46	5.78	4.88
24	Uttarkhand (Central)	8.67	9.15	6.73
25	West Bengal (Eastern)	6.34	6.66	6.70
26	Andaman & Nicobar Island (Eastern) £	6.32	8.35	5.62

Notes: Author's own calculations from data collected from Handbook of Indian Statistics, various issues. £ Union Territory.

As can be seen in table 2.2.1b, the key source of SDP growth for our sample period has been the growth in ISDP. The ASDP has a moderate average growth of

3.4% during the sample period, but its standard deviation is large relative to those of SDP growth and ISDP growth. The 6.4% average growth in SDP of these 26 states and UTs is accompanied by a 5.8% average growth in capital stock, but the variation in the growth of capital stock across the 26 states and UTs is relatively larger than the variation in the growth of SDP.

Table 2.2.1b: Summary statistics of real growth rates of the 26 states and union territories, 1999-2008 (2000 prices).

	Growth in SDP	Growth in ASDP	Growth in ISDP	Growth in Capital Stock	Growth in per capita SDP	Growth in per capita capital
Mean	0.064	0.034	0.068	0.058	0.053	0.045
S.D.	0.049	0.126	0.044	0.228	0.452	0.053
Max	0.286	0.813	0.226	0.612	0.661	0.292
Min	-0.098	-0.335	-0.138	-0.419	-0.856	-0.135

Figure 2a presents the cross sectional mean of SDP, mean of the agricultural component of SDP, mean of the manufacturing component of SDP and mean of the service component of SDP, all in 2000 prices, for the full sample period 1999-2008 (the figures are in INR. Crore, where 1 crore = 10 millions)[9].

The trend in agricultural component of SDP and the manufacturing component of SDP is relatively flatter over the period 1999-2008, while that of SDP shows sustained increase. This is also evident in table 2.2.1a. Compared to the average growth rate of SDP for 1995-2009, the average growth rate of SDP for 2003-2009 is higher for all states in the sample except Nagaland and Madhya Pradesh. Figure 2b presents the mean of the growth rate in real per capita SDP, the growth rate in real per capita ASDP, and the mean of the growth rate in real per capita ISDP for the 26 states and UTs of India for the sample period 1999-2008, where the values are in numbers. For the full sample period, there is considerable variation in the mean growth rate of per capita ASDP, while the mean growth rate of per capita ISDP almost mimics the mean growth rate of per capita SDP. The probable reason behind this correlation (of SDP growth and ISDP growth) is that a large proportion of ISDP growth is the growth in the service component of SDP. Following the liberalization of markets in the

[9] INR is Indian Rupees.

nineties, the service sector in India has grown rapidly both in terms of output and employment.

Figure 2a: Mean of SDP and its key components for 26 states and UTs of India, 1999-2008 at 2000 prices (INR. Crore on the vertical axis, time on the horizontal axis).

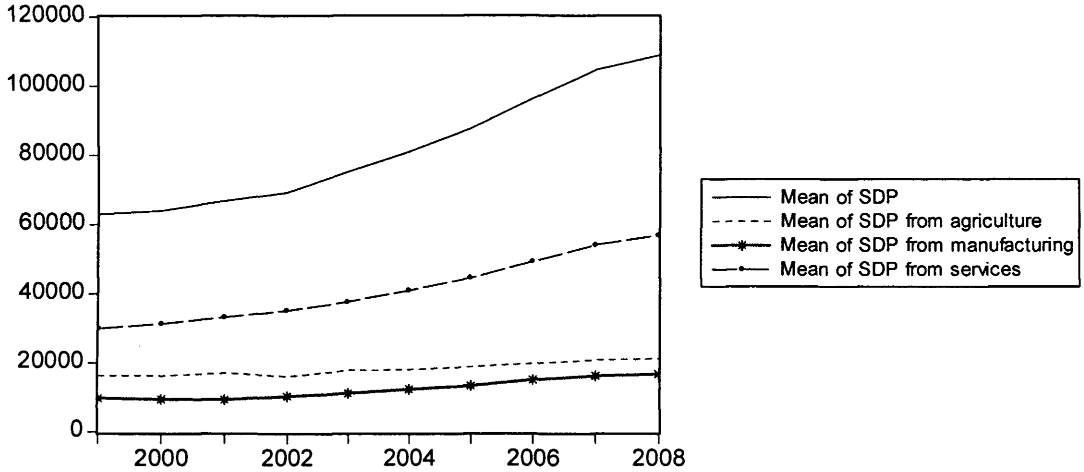


Figure 2b: Mean growth rates of per capita SDP, per capita ISDP and per capita ASDP for 26 states and UTs of India, 1999-2008 (growth rates on the vertical axis, time on the horizontal axis).

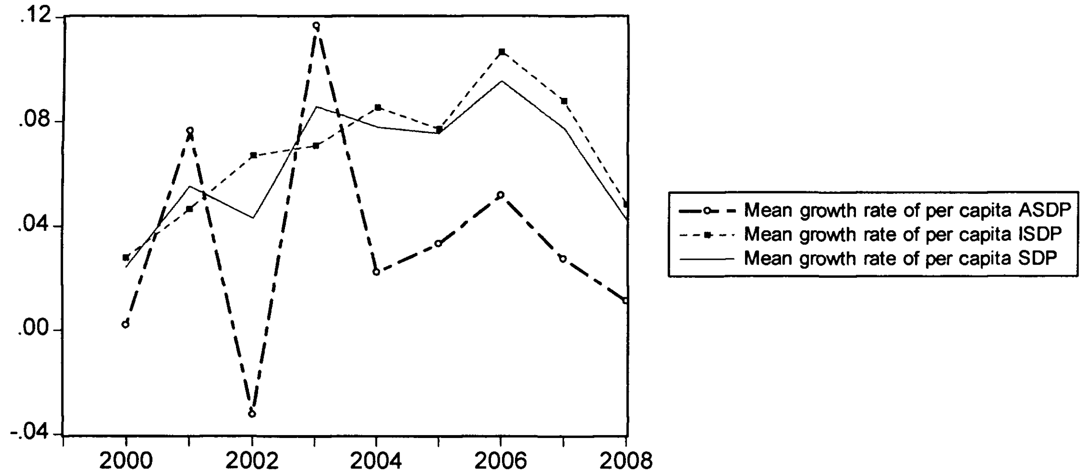
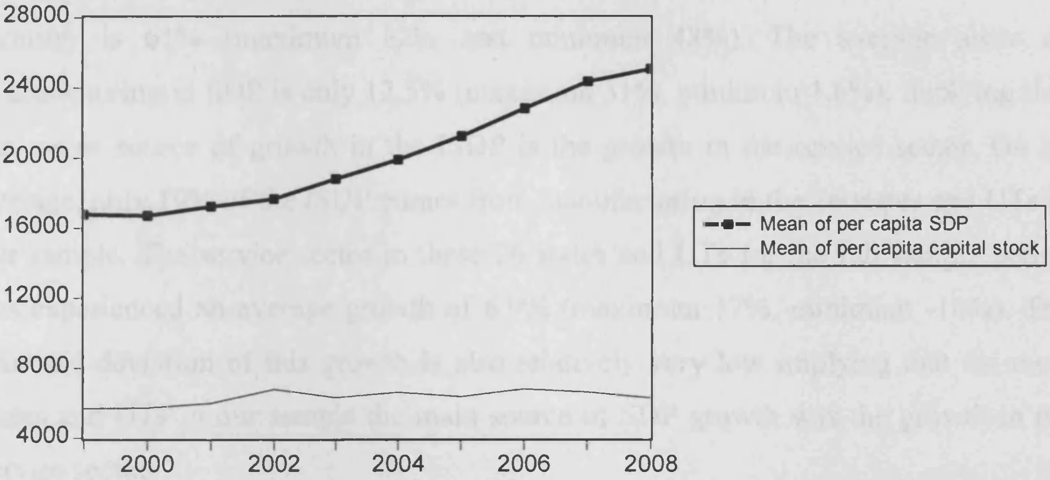


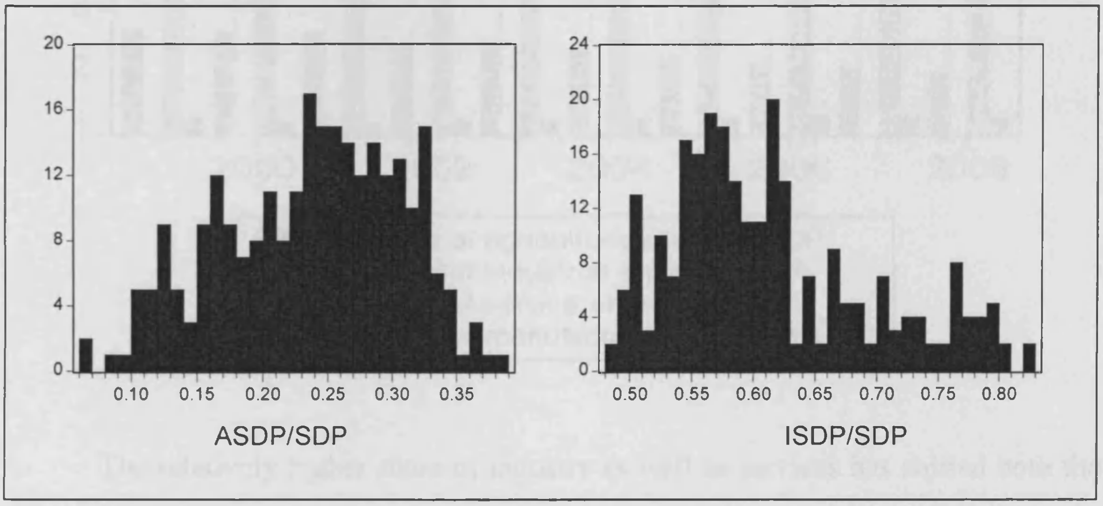
Figure 2c presents the mean of the real per capita SDP and the mean of the real per capita capital stock for the 26 states and UTs of India for the sample period 1999-2008, where the values are in INR (2000 prices). There is clear evidence that growth in per capita SDP has an increasing trend while growth in per capita capital stock remained more or less flat.

Figure 2c: Mean of per capita SDP and per capita capital stock for 26 states and UTs of India, 1999-2008 at 2000 prices (INR on the vertical axis, time on the horizontal axis).



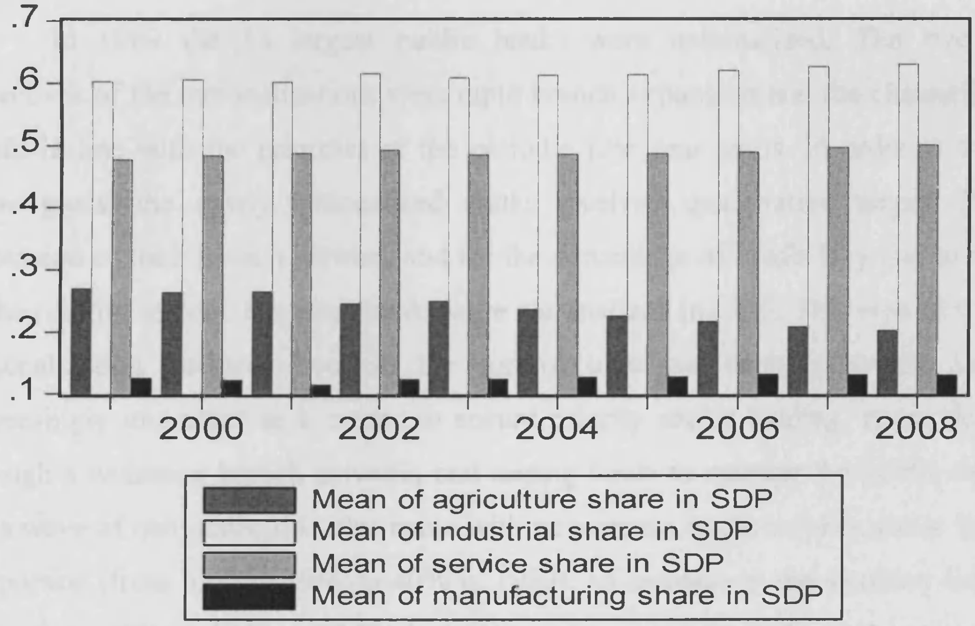
We present the histograms of the share of ASDP in SDP and the share of ISDP in SDP for the full sample in figure 2d. For majority of the states and UTs in our sample, the share of agriculture and allied in SDP is above 20%. Distribution of the ISDP starts at its minimum 48% and its density is high in the range 50%-63%.

Figure 2d: Histograms of agricultural share and industrial share in SDP for 26 states and UTs, 1999-2008 (shares on the horizontal axis).



For the full sample period the average share of agriculture and allied in SDP of all 26 states and UTs is 23% (maximum 38% and minimum 6%), while that of industry is 61% (maximum 82% and minimum 48%). The average share of manufacturing in SDP is only 12.5% (maximum 31%, minimum 1.6%), implying that the major source of growth in the ISDP is the growth in the service sector. On an average, only 19% of the ISDP comes from manufacturing in the 26 states and UTs in our sample. The service sector in these 26 states and UTs for the full sample period has experienced an average growth of 6.9% (maximum 17%, minimum -10%). The standard deviation of this growth is also relatively very low implying that for most states and UTs in our sample the main source of SDP growth was the growth in the service sector.

Figure 2e: Cross section average share of agriculture, manufacturing, services and industry, 1999-2008 (shares on the vertical axis, time on the horizontal axis).



The relatively higher share of industry as well as services has shifted both the workers and capital towards industry at the cost of a declining share of agriculture in SDP. This is presented in figure 2e. For all 26 states and UTs in our sample, there is clear evidence of a fall in the share of agriculture and a rise in the share of industry.

2.2.2 Commercial Banking in India

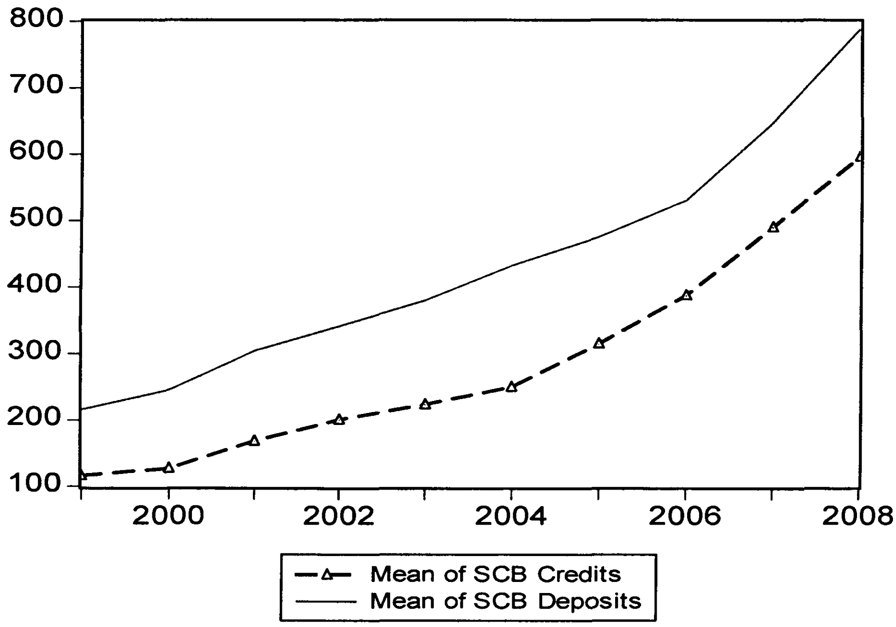
The banking system in India was primarily (in 1947) *fairly* well developed with over 600 commercial banks operating in the country. Soon after that there was a widespread perception that the banks were biased against extending credit to small-scale enterprises, agriculture and commoners. This perception led to the creation of the State Bank of India (SBI) in 1955, which was primarily aimed at ensuring better coverage of the banking needs of the larger parts of the economy and the rural constituencies. Despite the progress in the 1950s and the 1960s, it was perceived that the creation of the SBI was not far reaching enough. As a consequence, in 1967 the policy of social control over banks was announced aiming to change the management and distribution of credit by commercial banks (see Fernandez and Rodrik, 1992 for details).

In 1969 the 14 largest public banks were nationalized. The two main objectives of the nationalizations were rapid branch expansion and the channelling of credit in line with the priorities of the periodic five year plans. In order to achieve these goals, the newly nationalized banks received quantitative targets for the expansion of their branch network and for the percentage of credit they had to extend to the priority sectors. Six more banks were nationalized in 1980. This second wave of nationalization occurred because the control over the banking system became increasingly important as a means to ensure priority sector lending, reach the poor through a widening branch network, and raising funds to manage the public deficits. This wave of nationalization also came with an increase in the priority sector lending proportion (from 33% in 1969 to 40% in 1980), an increase in the statutory liquidity ratio (from 25% in 1960 to 38.5% in 1991), and an increase in the cash reserve ratio (from 2% in 1960 to 15% in 1991).

Such policies which were primarily expected to promote a more equal distribution of funds eventually led to inefficiencies in the Indian banking system, however. As a consequence, the 1991 report of the Narasimham Committee served as the basis for the subsequent banking sector reforms in India. The objective of this set of reforms was in line with the economic reforms of the 1990s that include opening the economy, giving a greater role to the markets in setting prices and allocating resources, and increasing the role of the private sector. In the following years, the banking sector reforms covered the areas of (1) liberalization including interest rate deregulation; (2) stabilization of banks; (3) partial privatization of state-owned banks; (4) changes in the institutional framework; and (5) entry deregulation for both domestic and foreign banks.

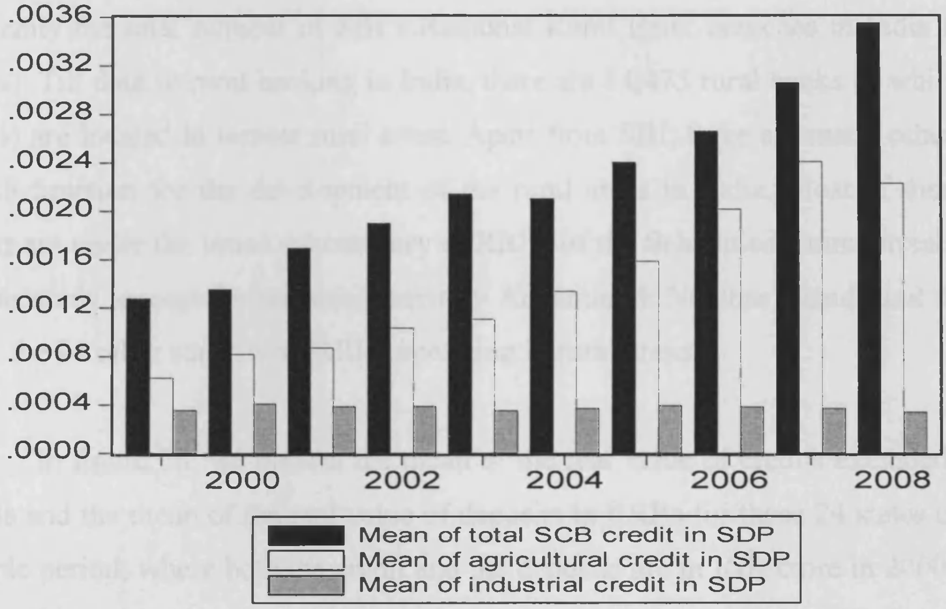
At present the commercial banking system in India is one where different categories of commercial banks are grouped under the Scheduled Commercial Banks. This group comprises of the SBI and its associates, nationalized banks, foreign banks, regional rural banks and other scheduled commercial banks.

Figure 2f: Mean values of real SCB credits and real SCB deposits for 26 states and UTs of India 1999-2008 (INR. Crore 2000 prices on the vertical axis, time on the horizontal axis).



In figure 2f we present the mean of the total value of credits and total value of deposits of all SCBs (we later denote these by SCBCRD and SCBDP respectively) for the 26 states and UTs of India for 1999-2008, where the mean values are computed at the cross sections for each year's total value of SCB credits in real terms and total value of SCB deposits in real terms (both in INR crore, 2000 prices). In figure 2g we present the mean of the ratio of SCB credits to SDP, the mean of the ratio of agricultural credit (by SCB) to SDP, and the mean of the ratio of industrial credit (by SCB) to SDP for the same sample, all evaluated in real terms (2000 prices)[10].

Figure 2g: Mean values of the share of total SCB credits, agricultural credits and industrial credits in SDP for 26 states and UTs of India, 1999-2008, evaluated at 2000 prices (shares on the vertical axis, time on the horizontal axis).



In real terms, both the deposits and credits of SCBs show an increasing trend for the full sample period. Relative to industrial credit, agricultural credits has a larger share in SDP, and during the most recent phase of banking sector reforms this share has increased (on an average for the 26 states and UTs) from 0.08% (in 2000) to 0.2% (in 2008). The average share of industrial credit in SDP has remained more or less constant during this period, but the boost in agricultural credit has contributed to larger shares of total credits in SDP.

2.2.3 Regional rural banks (RRBs) in India

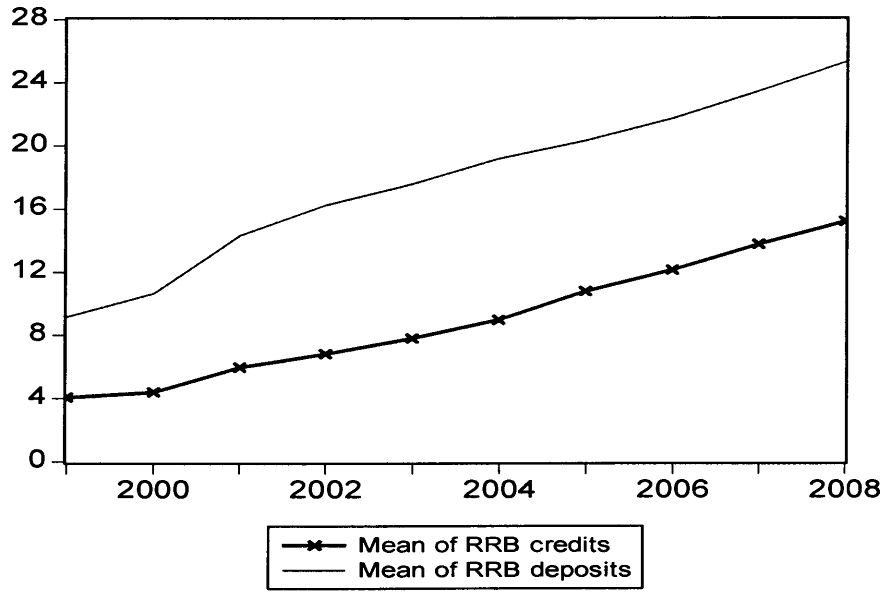
Rural banking in India started since the establishment of banking sector in India. Rural Banks in those days were mainly focussed on the agro sector. Regional rural banks in India penetrated every corner of the country and extended a helping hand in

[10] These data are from the Reserve Bank of India, and we will discuss the details of this source in section 2.4.

the growth process of the country. In 1977 the government of India passed a regulation which required both public and private banks to open at least four branches in unbanked locations for every branch they opened in banked locations. The SBI has 30 Regional Rural Banks in India known as RRBs. The rural banks of SBI is spread in 13 states extending from Kashmir to Karnataka and Himachal Pradesh to North East. Currently the total number of SBI's Regional Rural Bank branches in India is 2349 (16%). Till date in rural banking in India, there are 14,475 rural banks of which 2126 (91%) are located in remote rural areas. Apart from SBI, there are many other banks which function for the development of the rural areas in India. Most of these rural banks are under the broad subcategory of RRBs of the Scheduled Commercial Banks. In this study, except for the union territory Andaman & Nicobar Islands and the state Goa, the 24 other states have RRBs operating in rural areas.

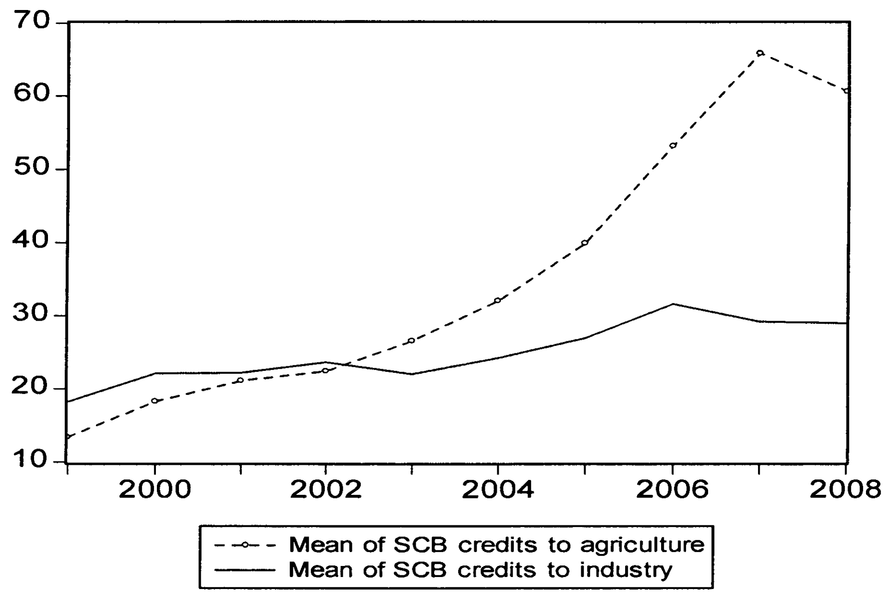
In figure 2h, we present the mean of the real value of credits extended by the RRBs and the mean of the real value of deposits in RRBs for these 24 states over the sample period, where both the credit and the deposits are in INR crore in 2000 prices. The trends are similar as in figure 2f where we present the trends in SCB deposits and SCB credits. For the full sample period, the average shares of RRB deposits and credits in total SCB deposits and credits were equal to 7.9% (standard deviation equal to 19.44) and 14.25% (standard deviation equal to 65.5), respectively.

Figure 2h: Mean values of RRB credits and RRB deposits for 24 states and UTs of India, 1999-2008, 2000 prices (INR Crore on the vertical axis, time on the horizontal axis).



In figure (2i), we present the mean of the real value of SCB credits to agriculture and the mean of the real value of SCB credits to industry for the full sample. The amounts are in INR. crore evaluated at 2000 prices. Starting from 2002-2003, there is a clear trend of extending more credit to agriculture. This is largely due to the most recent reforms in commercial banking in India. The SCB credits to agriculture includes the outstanding amounts of advances given to finance for the distribution of fertilizers and other inputs, loans to state electricity boards, other types of indirect finance and direct finances to farmers. The SCB credits to industry include advances to small scale industries, loans for setting up industrial states and advances to roads and water transport operators.

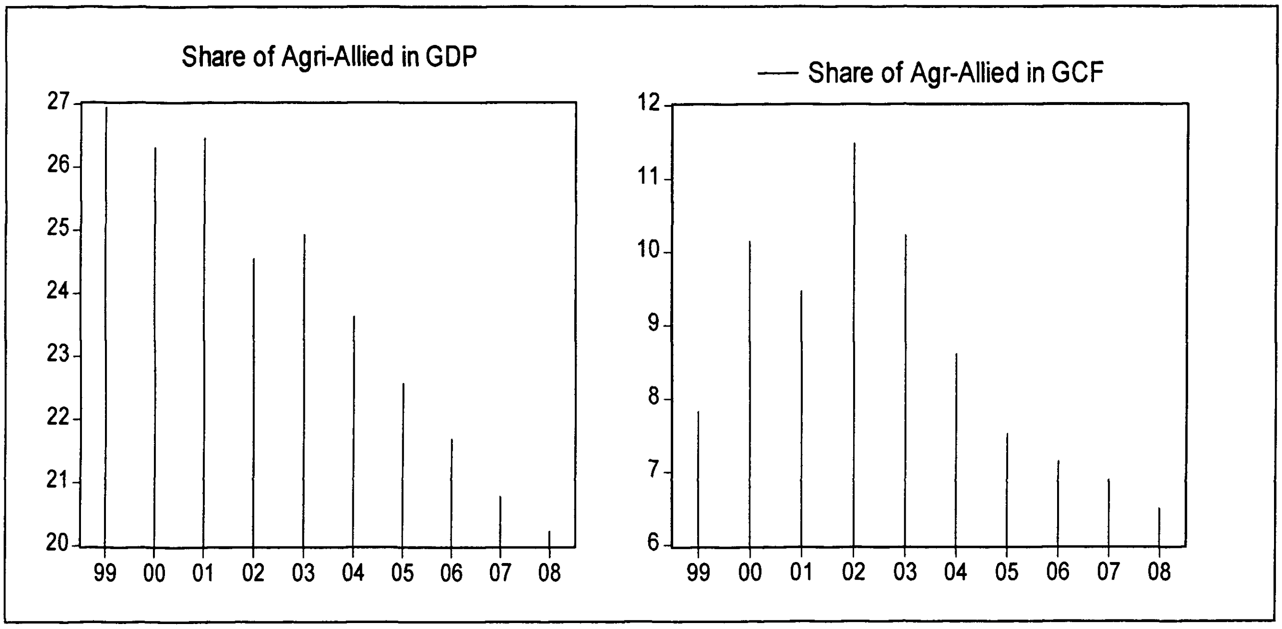
Figure 2i: Mean values of SCB credits to agriculture and SCB credits to industry for 26 states and UTs of India, 1999-2008, 2000 prices (INR Crore on the vertical axis, time on the horizontal axis).



In a study which examines the impact of rural banking on poverty in India, Burgess and Pande (2003) show that a 1% increase in the number of rural bank locations (per capita) resulted in a 0.42% decline in poverty and a 0.34% increase in total output. Growth in rural banking therefore has positive impact not only on the well being of the rural population but also for the growth in total output. In fact, according to the RBI reports many economists and policy-makers in India increasingly believe that future growth of the domestic economy will largely depend on the robust performance of the agriculture and rural sector, and that the manufacturing and service sectors cannot sustain the economy's growth if the rural sector underperforms.

In 2004, the SBI announced that it would shift its focus to rural banking in order to improve its retail portfolio. In recent times in India, the development of the telecom infrastructure in the rural areas has simplified the operations of the rural business sector. Marketing intermediaries and loan recovery agents have brought down the cost of operations. Recent studies indicate that the actual level of non-performing assets (NPAs) in the rural sector is less than elsewhere, and this coupled with the low cost of operations, less expensive labour, infrastructure, cost of living, and so on make rural India an attractive market for business. Many of these features are formally modelled in chapter 3 of this thesis.

Figure 2j: Share of agricultural and allied component of GDP in GDP and in Gross Capital Formation for India, 1999-2008, evaluated at 2000 prices (shares on the vertical axis, time on the horizontal axis).



Despite decades of effort and experimentation in banking, the organised financial sector is still not able to meet the credit gap in the rural sector. Lack of infrastructure in the rural areas and the focus in the urban sector apparently delayed the realization of the potential of rural development in eradicating poverty and increasing total output. In the eighties and the nineties, directed and subsidised lending, cumbersome procedures, delay in sanctioning loans and lack of statutory backing for recoveries were major impediments to the growth of banking in the rural sector.

It is understandable that for a predominantly ruralised economy like India, domestic economic growth largely depends on the rural sector. However, due to the near drought conditions in recent years the GDP in agriculture in India is estimated to show a meagre growth rate of 0.2% during 2009-10. In figure 2j, we present the trend in the share of agriculture and allied activities in real GDP of India, and the share of the same in real Gross Capital Formation (GCF) of India for 1999-2008. These shares are for aggregate Indian economy, where the GDP, agricultural and allied activity in GDP and the gross capital formation data are in real terms (2000 prices).

2.3 Specification of the Empirical Models

The standard econometric specification of growth models in cross-country studies regress real per capita GDP growth on a number of growth determinants (see for instance, Luintel, Khan and Theodoridis, 2008). Given the discussion in this chapter so far, my main aim is to examine the impact of banking sector development on economic growth of the states in India. For this I start with a specification of fixed effects panel model controlling for state and time fixed effects, following King and Levine (1993):

$$\gamma_{i,t} = a_0 y_{i,t-1} + a_1 \gamma_{ki,t} + a_2 bd_{i,t-1} + \theta_i + \zeta_t + \varepsilon_{i,t} \qquad (1)$$

where, $\gamma_{i,t}$ is the growth rate of real per capita gross state domestic product (*sdp*), $y_{i,t-1}$ is lagged value of the per capita gross state domestic product, $\gamma_{ki,t}$ is the growth rate of real per capita capital stock, bd is the banking development indicator of either scheduled commercial banks or regional rural banks, θ_i is a set of state dummy variables, ζ_t is a set of time dummy variables, and ε are stochastic disturbance terms which are independently and identically distributed with zero mean and constant variance equal to σ_{ε}, all for state i in period t, $i = 1,2,....,N; t = 1,2.............T$ [11].

Equation (1) is the benchmark empirical model. From the theoretical perspective, this can be considered as the estimable equation derived from a generalized Cobb-Douglas production function (with standard regularity properties) where banking development is a determinant of output growth. In equation (1), a_0 is showing the *convergence*. There are two broad concepts of convergence that appear in discussions of economic growth across countries or regions. In one view such as that of Barro (1984), Baumol (1986), Delong (1988), Barro (1991a), Barro and Sala-i-Martin (1991, 1992a, 1992b, 1999), convergence applies if a poor economy tends to grow faster than a rich one, so that the poor economy catch up with the rich one in terms of the level of per capita income or product. The second concept, such as that in Easterlin (1960), Borts and Stein (1964), Streissler (1979), Barro (1984), Baumol (1986), Dowrick and Nguyen (1989), Barro and Sala-i-Martin (1991, 1992a, 1992b) deals with the cross-sectional dispersion. According to this view convergence occurs if the measured dispersion (for instance defined by the standard deviation of the logarithm of per capita income or product across a group of countries or regions) declines over time. Convergence of the first kind tends to generate convergence of the second kind. In (1) a_0 corresponds to the first concept of convergence.

In addition to (1), we estimate other growth equations that are similar to (1) using different measures of growth in state level per capita income in order to examine the impact of banking development on agricultural growth and industrial growth in income. For this, we estimate:

$$\gamma_{agi,t} = b_0 y_{agi,t-1} + b_1 \gamma_{ki,t} + b_2 bd_{i,t-1} + \theta_{agi} + \zeta_{agi} + \varepsilon_{agi,t} \qquad (2)$$

[11] Throughout the chapter we will denote per capita variables of the state domestic product by lower case letters, and aggregate variables with upper case letters. For instance, *sdp*, *asdp* and *isdp* denote the per capita SDP, per capita SDP from agriculture and per capita SDP from industry, respectively, while *SDP*, *ASDP* and *ISDP* denote their aggregates.

where $\gamma_{agi,t}$ is the growth rate of real per capita gross state domestic product from agriculture (*asdp*), y_{ag} is the per capita gross state domestic product from agriculture in level, θ_{agi} is a set of state dummy variables, ζ_{agt} is a set of time dummy variables, and ε_{ag} are independently and identically distributed error terms with zero mean and constant variance equal to $\sigma_{\varepsilon a}$, all for state i in period t, $i = 1,2,....,N; t = 1,2.............................T$. For growth in the industrial sector, we estimate

$$\gamma_{mi,t} = c_0 y_{mi,t-1} + c_1 \gamma_{ki,t} + c_2 bd_{i,t-1} + \theta_{mi} + \zeta_{mt} + \varepsilon_{mi,t} \qquad (3)$$

where $\gamma_{mi,t}$ is the growth rate of real per capita gross state domestic product from industry (*isdp*), y_m is the per capita gross state domestic product from industry in level, θ_{mi} is a set of state dummy variables, ζ_{mt} is a set of time dummy variables, and ε_m are independently and identically distributed error terms with zero mean and constant variance equal to $\sigma_{\varepsilon m}$, all for state i in period t, $i = 1,2,....,N; t = 1,2,........................T$.

For all three models, we conduct a likelihood ratio test for the redundancy of the cross section fixed effects, the period fixed effects and jointly the cross section and the period fixed effects. The null hypothesis in this case is that these fixed effects are redundant. If the null hypothesis is true, the test statistic follows approximately a chi square distribution with degrees of freedom equal to $(N-1)$ for cross section fixed effects (N is equal to the total number of cross sections in the estimation sample), $(T-1)$ for period fixed effects (T is equal to the total number of years in the estimation sample), and $(N-1)+(T-1)$ for cross section and period fixed effects jointly. Failure to reject the null hypothesis would imply that the fixed effects (cross section, period, or cross section and period jointly, where applicable) are redundant, and that the estimation can be done using simple OLS.

A major issue in this approach to estimating growth equations such as (1), (2) and (3) is the potential endogeneity. In this chapter we directly control for endogeneity between state level finance and growth by using the system Generalized Method of Moments (GMM) estimator (proposed by Arellano and Bover, 1995). Given (1), a brief illustration of GMM is as follows:

$$\gamma_{i,t} = \beta_0 y_{i,t-1} + \beta_1 \gamma_{ki,t} + \beta_2 bd_{i,t-1} + \theta_i + \zeta_t + \varepsilon_{i,t} \tag{4.1}$$

$$y_{i,t} - y_{i,t-1} = \beta_0 (y_{i,t-1} - y_{i,t-2}) + \beta_1 (k_{i,t} - k_{i,t-1}) + \beta_2 (bd_{i,t-1} - bd_{i,t-2}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \tag{4.2}$$

A system GMM jointly estimates the regression in levels as in (4.1) and the regression in differences as in (4.2). In order to correct for endogeneity, Arellano and Bover (1995) suggest employing the lagged first differences of the explanatory variables as instruments for the equation in levels (4.1) and the lagged values of the explanatory variables in levels as instruments for the equation in differences (4.2). Under certain conditions the lagged dependent variables can be used as instruments. We follow the same approach for controlling for the endogeneity for equation (2) and equation (3).

In order to test the validity of this approach, we employ the Sargan test (of over identifying restrictions). In the Sargan test, we employ the J statistic and the instrument rank in order to derive the degrees of freedom of the Sargan test statistic, where the degrees of freedom is equal to the instrument rank minus the number of parameters in the model. Under the null hypothesis, the Sargan test statistic follows approximately chi square distribution. Failure to reject the null would imply that the over-identifying restrictions are true, i.e. the instruments are valid. In our study, we employ lagged values of the banking development indicators as instruments. Thus failure to reject the null hypothesis by the Sargan test would imply that they are valid instruments for the GMM estimation.

2.4 Variables and Data

Data are mainly collected from online sources. These sources include the *Database* of the RBI (http://www.rbi.org.in), *The National Data Warehouse of Official Statistics* (tables, metadata and reports) of the MOSPI (http://mospi.nic.in), *The Data Tables* of the Planning Commission, Government of India (PC, http://planningcommission.nic.in), *Studies and Surveys* of the FICCI (http://www.ficci.com), and the *Handbook of Statistics on Indian Economy (handbook)* which we collected from the publications site of the RBI.

2.4.1 Data on gross State Domestic Product

The state wise data for gross SDP and its components are collected from the National Data Warehouse of the MOSPI tables. For two states we could not find the full sample which is why we use the handbook to complete the SDP and its components series. The MOSPI tables report per capita nominal SDP but do not report per capita real SDP. We collect the per capita net SDP data (at 2000 prices) from the handbook (table 9).

State wise data on number of workers and various measures of capital stock are available from the tables of the national data warehouse of MOSPI. These are available under the table heading *Estimate of some important characteristics by state*, but only available for 1999-2006. For the remaining two years of our sample, we first collect state level investment data from the handbook. We then convert the investment data in real terms using the wholesale price index for manufactured products (collected from the handbook). We use the *working capital stock* for 2006 and apply the inventory approach to simulate capital stock data for 2007[12]. Similarly using the 2008 investment value and the 2007 simulated value of capital stock, we simulate capital stock for 2008. We use the full series of capital stock data and the state wise population data in order to generate a series for the capital stock per capita for each

[12] We collect information on state level depreciation from the *Estimate of some important characteristics by state* of the data warehouse of MOSPI, and pin down an average value of depreciation rate of capital stock by state.

state and UTs of our sample for the entire sample period[13]. Using the same data on the population we create the series for *asdp* and *isdp* for (2) and (3).

2.4.2 Data on commercial banking

All banking-related data are collected from the RBI database. The RBI reports these data as nominal values in INR. We use the wholesale price index for all commodities, for agricultural commodities and for the industrial commodities to convert the SCB banking data, the RRB banking data and the SCB credits to industry data into real values (2000 prices).

We use the SDP data and the banking data to create eight proxies that account for the level of financial development in the states of India. In real terms, these are different measures of the proportion of bank deposits and credits to the measures of SDP. For deposits, we create the indicators $BD1 = \frac{SCBDP}{SDP}, BD3 = \frac{RRBDP}{ASDP}$ and $BD7 = \frac{RRBDP}{ISDP}$, where SCBDP and RRBDP denote the real value of the total deposits of the SCBs and the RRBs, respectively. For credits, we create the indicators $BD2 = \frac{SCBCRD}{SDP}$ and $BD4 = \frac{RRBCRD}{ASDP}$, where SCBCRD and RRBCRD denote the real value of the total credits by the SCBs and the RRBs, respectively. We also create $BD5 = \frac{AGRCRD}{SDP}, BD6 = \frac{INDCRD}{SDP}$ and $BD8 = \frac{RRBCRD}{ISDP}$, where AGRCRD and INDCRD denote the real values of the agricultural credit by the SCBs and the industrial credit by the SCBs, respectively[14].

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[13] We derive the state wise population series by dividing the nominal SDP by the per capita nominal SDP for each state.

[14] For the banking development indicators we use upper case letters for their actual value, while in the regressions (and in section 2.3 where we define the empirical specifications) we use lower case letters to denote their logarithmic values.

2.4.3 Descriptive statistics of state level data

We present some summary statistics of the state level data in tables 2.4.3a and 2.4.3b. First in table 2.4.3a, we present the summary statistics and correlation matrix for SDP and its components. There is considerable amount of variation in the values of SDP and its components across the full sample. This justifies the use of cross section fixed effects in the panel estimation. There is a negative correlation between the ASDP and per capita SDP, but a reasonably high positive correlation between ASDP and SDP. There is very low positive correlation between per capita SDP and per capita capital stock. Service and manufacturing components of SDP have the highest positive correlation with SDP, which again justifies the predominance of these two sectors in the Indian economy.

The summary statistics and the correlation matrix of the different banking related variables are presented in table 2.4.3b. We find a correlation coefficient of 0.97 between the SCB deposits and SCB credits, and a correlation coefficient of 0.89 between the RRB deposits and RRB credits.

Table 2.4.3a: Descriptive statistics of SDP and related data for the 26 states and union territories, 1999-2008 (2000 prices).

	Real *SDP* (INR, cr)	Real *sdp* (INR)	Real Per capita capital (*pck*, INR)	Real Agr-Allied (*AGR*, INR, cr)	Real Services (*SER*, INR, cr)	Real Manuf. (*MAN*, INR, cr)
Mean	81673.19	20058.88	6316.52	18230.50	41291.13	12404.26
SD	82141.79	8935.79	4254.50	17266.66	45451.67	15422.45
Max	416247.6	60232.00	17674.01	73166.39	252155.8	79393.66
Min	936.85	5785.60	373.93	206.25	520.67	22.75
Obs.	260	260	260	260	260	260
		correlation	Matrix			
	SDP	*Sdp*	*pck*	*AGR*	*SER*	*MAN*
SDP	1	0.09	0.10	0.88	0.98	0.91
Sdp	0.09	1	0.12	-0.07	0.12	0.20
Pck	0.10	0.12	1	0.03	0.06	0.24
AGR	0.88	-0.07	0.03	1	0.82	0.69
SER	0.98	0.12	0.06	0.82	1	0.90
MAN	0.91	0.20	0.24	0.69	0.90	1

Table 2.4.3b: Descriptive statistics of banking data for the 26 states and union territories, 1999-2008 (2000 prices).

	SCBCRD (real, INR, crore)	*SCBDP* (real, INR, crore)	*RRBCRD* (real, INR, crore)	*RRBDP* (real, INR, crore)	*SCBAGR* (real, INR, crore)	*SCBIND* (real, INR, crore)
Mean	287.77	436.57	8.99	17.80	35.33	24.92
SD	631.18	676.42	11.89	23.25	48.37	35.42
Max	5869.14	6198.59	69.45	144.39	276.78	232.94
Min	0.220	2.461	0.000	0.000	0.003	0.051
Obs.	260	260	260	260	260	260
		correlation	Matrix			
	SCBCRD	*SCBDP*	*RRBCRD*	*RRBDP*	*SCBAGR*	*SCBIND*
SCBCRD	1	0.97	0.24	0.15	0.78	0.84
SCBDP	0.97	1	0.38	0.32	0.83	0.85
RRBCRD	0.24	0.38	1	0.89	0.65	0.28
RRBDP	0.15	0.32	0.89	1	0.48	0.22
SCBAGR	0.78	0.83	0.65	0.48	1	0.78
SCBIND	0.84	0.85	0.28	0.22	0.78	1

2.4.4 List of variables and key empirical hypotheses

As we have discussed earlier, we conduct the analysis on three sets of model. For model (1) and (4), we use growth rate in real per capita SDP as the dependent variable. Then for model (2) and its GMM equivalent (model 5, say), and model (3) and its GMM equivalent (model 6, say), we use growth rate in real per capita agricultural SDP and growth rate in real per capita industrial SDP as dependent variables, respectively.

Table 2.4.4a: List of variables, used in the empirical modelling.

Variable	Variable type	Mnemonics
Growth rate in real per capita SDP/real per capita agricultural SDP/real per capita industrial SDP	Dependent variables	$\gamma / \gamma_{ag} / \gamma_m$
*Real per capita SDP/real per capita agricultural SDP/real per capita industrial SDP**	Lagged regressors	$y_{t-1} / y_{agt-1} / y_{mt-1}$
Growth rate in real per capita capital stock	Regressor	γ_k
*Banking development indicator 1 (SCB deposit/SDP)**	Lagged regressor	$bd1_{t-1}$
*Banking development indicator 2 (SCB credit/SDP)**	Lagged regressor	$bd2_{t-1}$
*Banking development indicator 3 (RRB deposit/ASDP)**	Lagged regressor	$bd3_{t-1}$
*Banking development indicator 4 (RRB credit/ASDP)**	Lagged regressor	$bd4_{t-1}$
*Banking development indicator 5 (AGR credit/SDP**	Lagged regressor	$bd5_{t-1}$
*Banking development indicator 6 (IND credit/SDP)**	Lagged regressor	$bd6_{t-1}$
*Banking development indicator 7 (RRB deposit/ISDP)**	Lagged regressor	$bd7_{t-1}$
*Banking development indicator 8 (RRB credit/ISDP)**	Lagged regressor	$bd8_{t-1}$

*logarithm in regression

For all three sets of models, we use the growth in per capita capital stock as one of the regressors. We also use the (logarithm of) lagged value of per capita SDP, per capita ASDP and per capita ISDP as regressors for models (1&4), (2&5) and (3&6), respectively. In addition to these, we use the (logarithm of) lagged values of financial development proxy and their combinations as regressors. In table 2.4.4a, we summarize the list of variables used in the regressions, their role and the corresponding symbol that we use in reporting the results in section 2.5 and 2.6.

In section 2.3 we have explained the technical hypotheses that we are interested in. For the models where we employ fixed effects panel estimation, we test the statistical significance of the cross section fixed effects, the period fixed effects and the cross section and period fixed effects jointly. For the models where we employ the GMM estimation, we are interested in the Sargan test which tests the statistical significance of the instruments used in the estimation. In addition to these, we are also interested in a few important empirical hypotheses.

For all models, our key empirical interest is in the marginal effect of banking development in state level growth of per capita SDP and its components. For this we test the statistical significance of the marginal effect of (lagged) SCB deposits and credits on the growth of per capita SDP and its components for all specifications (in both the fixed effects estimation and the GMM estimation).

For each set of growth regressions, we use many combinations of (lagged values of) deposits and credits. For the specifications with only one financial development indicator, it is straightforward to test whether the marginal effect of lagged SCB deposits or credits on per capita SDP, per capita ASDP or per capita ISDP is statistically significant. To see this, consider for instance model (1)'s initial specification, 1(a), where we use $bd1_{t-1}$ as an explanatory variable. Because $bd1 = \ln\left(\frac{SCBDP}{SDP}\right)$, given (1) the marginal effect of lagged SCB deposit on per capita SDP growth is simply $\frac{\partial \gamma_{i,t}}{\partial SCBDP_{t-1}} = a_2$. We perform a simple Wald test in order to verify if this coefficient estimate is statistically significantly different from zero.

For the specifications where we use banking development indicators involving RRB deposits and credits, the marginal effects of SCB deposits and credits are simple to compute. Since all RRBs are part of SCBs, the RRB deposits and credits are fixed proportions of SCB deposits and credits, respectively. The marginal effect of SCB deposit or credit for such specifications is simply the estimated coefficient of the banking development indicator involving RRB deposit or credit. To see this, consider specification 1(c) where we use $bd3_{t-1}$ as an explanatory variable. Because

$bd3 = \ln\left(\frac{RRBDP}{ASDP}\right)$, and $RRBDP = \phi(SCBDP)$ where $\phi \in (0,1)$, the marginal effect of lagged SCB deposit on per capita SDP growth is simply $\frac{\partial \gamma_{i,t}}{\partial SCBDP_{t-1}} = a_2$.

For specifications where we use both SCB deposits (or credits) and RRB deposits (or credits), the net marginal effect of SCB deposits or credits on per capita SDP (and its components') growth has two components, one from the SCB deposits (or credits) and the other from the fixed proportion of SCB deposits (or credits) through the RRBs. To see this, consider for instance model (1)'s specification 1(e) where we use both $bd1_{t-1}$ and $bd3_{t-1}$, and assume that the associated coefficients for these two are b_2 and b_3, respectively. Given (1), the net marginal effect of lagged SCB deposits for this specification is therefore $b_2 + b_3$. We verify if this effect is significantly different from zero using the Wald test. In principle, this net marginal effect should be equal to the marginal effect of lagged SCB deposits or credits available from a specification where we use the financial development indicator that involve $bd1_{t-1}$ or $bd2_{t-1}$.

2.5 Results from fixed effects panel estimation

For model (1), we use six specification that involve financial development indicators $bd1_{t-1}, bd2_{t-1}, bd3_{t-1}$ and $bd4_{t-1}$ and their combinations. In table 2.5.1A we summarize the results from fixed effects panel estimation of these six specifications. We report the estimated coefficient and its associated p-value (based on White cross section standard errors).

All specifications are estimated using both cross section and period fixed effects. In table 2.5.1A we report the important statistics related to model selection (adjusted R^2 and Akaike Information Criterion), the F-statistic (and its associated p-value) for the overall significance of the estimated parameters, and the log of the likelihood function associated with every specifications. In the same table we also report the Chi-square test statistics (and their associated p-values) related to the joint significance of the cross section fixed effects, the period fixed effects and the cross section and period fixed effects together.

Table 2.5.1A: Summary of Fixed effects Panel estimation of model 1, dependent variable is real per capita SDP growth.

	1(a)	*1(b)*	*1(c)*	*1(d)*	*1(e)*	*1(f)*
y_{t-1}	-0.3279 [0.000]	-0.3299 [0.000]	-0.3186 [0.001]	-0.2808 [0.001]	-0.3238 [0.000]	-0.2913 [0.001]
γ_{kt}	0.0007 [0.883]	0.0007 [0.896]	0.0009 [0.855]	-0.0006 [0.901]	0.0019 [0.687]	0.0001 [0.982]
$bd1_{t-1}$	0.0274 [0.080]				0.0269 [0.068]	
$bd2_{t-1}$		0.0088 [0.271]				0.0072 [0.350]
$bd3_{t-1}$			0.0648 [0.001]		0.0633 [0.001]	
$bd4_{t-1}$				0.0482 [0.087]		0.0429 [0.131]
Observations	234	234	216	216	216	216
$\overline{R}^2$	0.309	0.294	0.312	0.293	0.332	0.295
AIC	-3.254	-3.233	-3.242	-3.215	-3.269	-3.214
ln-likelihood	417.73	415.28	385.21	382.26	389.06	383.18
Cross section Chi-square	72.58 [0.000]	68.58 [0.000]	69.37 [0.000]	59.38 [0.000]	75.53 [0.000]	61.14 [0.000]
Period Chi-square	74.538 [0.000]	84.601 [0.000]	40.564 [0.000]	26.281 [0.000]	39.073 [0.000]	26.752 [0.000]
CS-P Chi-square	116.70 [0.000]	114.25 [0.000]	103.55 [0.000]	92.82 [0.000]	106.94 [0.000]	93.94 [0.000]
F stat	3.8971 [0.000]	3.7029 [0.000]	3.8736 [0.000]	3.6258 [0.000]	4.0639 [0.000]	3.5767 [0.000]

Notes: p-values (based on White cross section standard errors) in parentheses. For specifications 1(c-f) we remove two states because there are no RRBs in these (Goa and Andaman & Nicobar Islands). Cross section and period fixed effects used in all specifications.

For all six specifications, we find that the lagged per capita SDP has significant negative marginal effect on the growth of per capita SDP. This is simply showing that there is evidence of convergence for these states and a poor state tends to grow faster than a rich one, so that the poor state catch up with the rich one in terms of the level of per capita income or product. However, for all specifications we find that the marginal effect of per capita capital stock growth on per capita SDP growth is insignificant. This finding is in line with our conjecture about the recent growth in SDP in Indian states; as we have discussed following the figure 2c in subsection 2.2.1, the rapid development of the service sector did not contribute in the growth of per capita stock of physical capital, which is why growth in this variable is not a significant component of the growth in per capita SDP. Another reason in this context we can say that, among these 26 states there are some states where capital stock really low, may be those states are influencing our this result. We find that lagged SCB deposits have significant marginal effect on per capita SDP growth. The lagged ratio of RRB credits to ASDP significantly affects growth in per capita SDP, but the lagged ratio of SCB credits to SDP fails to explain any variation in growth.

For all specifications, we find significant cross section fixed effects and period fixed effects. When considered together, these effects are statistically significant, which in turns justify our estimation technique. Based on the highest $\overline{R}^2$ and the lowest AIC, specification 1(e) (where we use the financial development indicators involving lagged SCB deposits and lagged RRB deposits together) is the best specification. We present a summary of the Wald tests that we perform for model (1) in t able 2.5.1B. In this table, we report the null hypotheses and their associated Chi-square test statistics (together with p-values).

Table 2.5.1B: Summary of Wald tests related to the results in table 2.5.1A.

Null hypothesis	*1(a)*	*1(b)*	*1(c)*	*1(d)*	*1(e)*	*1(f)*
Growth effect of SCB deposits is equal to zero	3.081 [0.079]	-	9.987 [0.001]	-	16.901 [0.000]	
Growth effect of SCB credits is equal to zero	-	1.217 [0.269]	-	2.944 [0.086]	-	3.199 [0.073]
All coef. est. are zero	12.328 [0.006]	11.658 [0.008]	16.246 [0.001]	10.508 [0.014]	19.228 [0.000]	11.135 [0.025]

Note: Chi-square test statistic [p-value] reported.

For the three specifications that involve SCB deposits and RRB deposits, we find significant marginal growth effect of SCB deposits. For specification 1(a), this effect is significant at the 10% level, while for the remaining two it is significant at the 1% level. For specification 1(e) the net marginal effect of SCB deposits is equal to 0.0902, and it is statistically significant at the 1% level. Individually, the coefficient estimates of $bd1_{t-1}$ and $bd3_{t-1}$ for 1(e) are statistically significant at the 10% and the 1% levels, respectively.

We do not reject the null hypothesis that growth effect of SCB credits is equal to zero for specification 1(b) where we use the lagged ratio of SCB credits to SDP. For specification 1(d), the net marginal growth effect of SCB credits is statistically significant at the 10% level. For specification 1(f) where we use both $bd2_{t-1}$ and $bd4_{t-1}$, the individual effects are insignificant, but the net marginal growth effect of SCB credits, which is equal to 0.0501, is statistically different from zero at the 10% level. From model (1), we therefore find that in general SCB deposits have a positive and significant net marginal effect on the growth of per capita SDP. However, the findings on the net marginal effect of SCB credits on growth are rather inconclusive.

The results summary of fixed effects panel estimation for model (2)'s seven specifications are reported in table 2.5.2A. The presentation structure of the summary is as same as in table 2.5.1A. For this model, our dependent variable is the growth in per capita ASDP. We find significant negative marginal effect of the lagged per capita ASDP, and insignificant marginal effect of per capita capital stock growth for all seven specifications. Specification 2(f) where we use $bd1_{t-1}$ and $bd3_{t-1}$ together as explanatory variables have the highest $\overline{R}^2$ and the lowest AIC. For all specifications, we find statistically significant cross section and period fixed effects. Except for $bd4_{t-1}$ which represents the lagged ratio of RRB credits to ASDP, the other financial development indicators perform poorly as explanatory variables for this model. In specification 2(d) the coefficient estimate for $bd4_{t-1}$ is statistically significant at the 10% level, and when used jointly with $bd2_{t-1}$ in specification 2(g), its coefficient estimate is significant at the 1% level.

Table 2.5.2A: Summary of Fixed effects Panel estimation of model 2, dependent variable is real per capita ASDP growth.

	2(a)	*2(b)*	*2(c)*	*2(d)*	*2(e)*	*2(f)*	*2(g)*
y_{agt-1}	-0.7508 [0.000]	-0.7498 [0.000]	-0.8387 [0.000]	-0.8767 [0.000]	-0.7361 [0.000]	-0.8467 [0.000]	-0.8884 [0.000]
γ_{kt}	-0.0187 [0.537]	-0.0221 [0.508]	-0.0377 [0.257]	-0.0388 [0.238]	-0.0257 [0.456]	-0.0328 [0.208]	-0.0368 [0.214]
$bd1_{t-1}$	0.0567 [0.137]					0.0550 [0.123]	
$bd2_{t-1}$		0.0054 [0.854]					0.0096 [0.738]
$bd3_{t-1}$			0.0182 [0.641]			0.0235 [0.097]	
$bd4_{t-1}$				0.0633 [0.078]			0.0724 [0.000]
$bd5_{t-1}$					0.0130 [0.653]		
Observations	234	234	216	216	234	216	216
$\bar{R}^2$	0.420	0.403	0.453	0.458	0.403	0.468	0.457
AIC	-1.698	-1.669	-1.772	-1.780	-1.669	-1.797	-1.775
ln-likelihood	235.71	232.31	226.43	227.33	232.36	230.11	227.72
Cross section Chi-square	135.58 [0.000]	128.04 [0.000]	130.91 [0.000]	133.17 [0.000]	127.67 [0.000]	137.76 [0.000]	133.82 [0.000]
Period Chi-square	49.767 [0.000]	63.461 [0.000]	47.401 [0.000]	44.644 [0.000]	37.315 [0.000]	44.003 [0.000]	45.125 [0.000]
CS – P Chi-square	164.11 [0.000]	156.71 [0.000]	162.54 [0.000]	164.80 [0.000]	156.54 [0.000]	169.16 [0.000]	165.45 [0.000]
F stat	5.7006 [0.000]	5.3805 [0.000]	6.2485 [0.000]	6.3460 [0.000]	5.3850 [0.000]	6.4243 [0.000]	6.1711 [0.000]

Notes: p-values (based on White cross section standard errors) in parentheses. For specifications 2(c-d) and 2(f-g) we remove two states because there are no RRBs in these (Goa and Andaman & Nicobar Islands). Cross section and period fixed effects used in all specifications.

The summary of Wald tests associated with the estimation results in table 2.5.2A is reported in table 2.5.2B, again following the same structure as in table 2.5.1B. Here we do not find any statistically significant net marginal effect of SCB deposits on the growth of per capita ASDP. The marginal growth effects of SCB credit to agriculture (which is in specification 2(e)) and aggregate SCB credit (which is in specification 2(b)) are insignificant as well. However, when we use RRB credits in specifications 2(d) and 2(g), the net marginal growth effects of SCB credits, equal to 0.063 and 0.082, respectively, are both statistically significant at the 10% level.

Table 2.5.2B: Summary of Wald tests related to the results in table 2.5.2A.

Null hypothesis	*2(a)*	*2(b)*	*2(c)*	*2(d)*	*2(e)*	*2(f)*	*2(g)*
Growth effect of SCB deposits is equal to zero	2.221 [0.136]	-	0.215 [0.642]	-	-	1.328 [0.249]	-
Growth effect of SCB credits is equal to zero	-	0.0333 [0.854]	-	3.134 [0.076]	0.201 [0.653]	-	2.813 [0.093]
All coef. est. are zero	47.871 [0.000]	40.137 [0.000]	63.513 [0.000]	35.708 [0.000]	38.001 [0.000]	92.160 [0.000]	74.209 [0.000]

Note: Chi-square test statistic [p-value] reported.

These findings suggest that in general SCB deposits had no impact but SCB credits had a significant positive net impact on the growth of per capita ASDP for these 26 states and UTs during 1999-2008. The rather interesting finding is that SCB credits that are extended to agriculture in particular had no significant impact on the growth of per capita agricultural output. The only channel through which SCB credits has made a significant improvement in per capita agricultural output growth is the credits that were channelled through RRBs. The clear policy implication of this finding is that there is a need for expanding the network of RRBs in India.

The summary of results from fixed effects panel estimation of model (3), for which our dependent variable is growth in per capita ISDP, is reported in table 2.5.3A, and the summary of Wald tests corresponding to this estimation is in table 2.5.3B. For this model, specification 3(b) has the highest $\overline{R}^2$ and the lowest AIC. For all specifications the cross section and the period fixed effects are statistically significant.

For this model, we find that the marginal effect of SCB deposits is positive and statistically significant at the 10% level for specification 3(a), but the net effect of SCB deposits in specification 3(f) is statistically not different from zero. This is because we find significant negative marginal effect of RRB deposits as a share of ISDP.

Table 2.5.3A: Summary of Fixed effects Panel estimation of model 3, dependent variable is real per capita ISDP growth.

	3(a)	*3(b)*	*3(c)*	*3(d)*	*3(e)*	*3(f)*	*3(g)*
y_{mt-1}	-0.1823 [0.003]	-0.1885 [0.001]	-0.1784 [0.007]	-0.1522 [0.018]	-0.1786 [0.005]	-0.1871 [0.003]	-0.1833 [0.002]
γ_{kt}	0.0002 [0.099]	0.0012 [0.109]	-0.0006 [0.249]	0.0001 [0.394]	-0.0000 [0.691]	0.0010 [0.594]	0.0025 [0.660]
$bd1_{t-1}$	0.0187 [0.061]					0.0193 [0.056]	
$bd2_{t-1}$		0.0109 [0.006]					0.0113 [0.002]
$bd7_{t-1}$			-0.0244 [0.004]			-0.0255 [0.005]	
$bd8_{t-1}$				0.0127 [0.555]			0.0010 [0.692]
$bd6_{t-1}$					0.0100 [0.199]		
Observations	234	234	216	216	234	216	216
$\overline{R}^2$	0.397	0.400	0.370	0.366	0.386	0.385	0.385
AIC	-3.748	-3.754	-3.746	-3.740	-3.730	-3.767	-3.766
ln-likelihood	475.63	476.28	439.62	439.01	473.50	442.89	442.77
Cross section Chi-square	77.09 [0.000]	78.98 [0.000]	70.61 [0.000]	66.70 [0.000]	73.91 [0.000]	76.45 [0.000]	73.64 [0.000]
Period Chi-square	90.044 [0.000]	94.999 [0.000]	62.849 [0.000]	46.218 [0.000]	100.880 [0.000]	61.456 [0.000]	49.021 [0.000]
CS – P Chi-square	142.48 [0.000]	144.70 [0.000]	126.39 [0.000]	120.00 [0.000]	145.43 [0.000]	127.47 [0.000]	122.48 [0.000]
F stat	5.2706 [0.000]	5.3308 [0.000]	4.7225 [0.000]	4.6655 [0.000]	5.0775 [0.000]	4.8599 [0.000]	4.8493 [0.000]

Notes: p-values (based on White cross section standard errors) in parentheses. For specifications 3(c-d) and 3(f-g) we remove two states because there are no RRBs in these (Goa and Andaman & Nicobar Islands). Cross section and period fixed effects used in all specifications.

In specification 3(c), the marginal effect of $bd7_{t-1}$ on the growth of per capita industrial output is equal to – 0.024, and this effect is statistically significant at the 1% level. This negative marginal effect is understandable, since higher amounts of RRB deposits is unlikely to create any positive impact on industrial output at the state level. This can also be justified from specification 3(d) where the marginal effect of $bd8_{t-1}$ (i.e. the ratio of RRB credit to ISDP) on per capita growth in industrial output is insignificant. For the best specification, 3(b), the marginal effect of SCB credits on per capita ISDP growth is equal to 0.0109, and it is statistically significant at the 1% level. In specification 3(g), the coefficient estimate for $bd2_{t-1}$ is individually significant, but when considered together with $bd8_{t-1}$ the net marginal effect of SCB credit in the growth of ISDP (equal to 0.0123) is not significantly different from zero.

Table 2.5.3B: Summary of Wald tests related to the results in table 2.5.3A.

Null hypothesis	*3(a)*	*3(b)*	*3(c)*	*3(d)*	*3(e)*	*3(f)*	*3(g)*
Growth effect of SCB deposits is equal to zero	3.529 [0.060]	-	8.502 [0.003]	-	-	0.196 [0.657]	-
Growth effect of SCB credits is equal to zero	-	7.684 [0.005]	-	0.349 [0.554]	1.656 [0.198]	-	0.324 [0.199]
All coef. est. are zero	9.835 [0.020]	18.130 [0.000]	18.931 [0.000]	6.115 [0.106]	8.689 [0.033]	22.235 [0.000]	21.619 [0.000]

Note: Chi-square test statistic [p-value] reported.

Notice that the coefficient estimate of the growth in per capita capital stock for 3(a) and 3(b) are statistically significant at the 10% level. This indicates the importance of physical capital growth in explaining the growth in per capita industrial output. In general for model (3) we find that both SCB credits and deposits have individual significant effect on the growth of ISDP, but RRB operations in general do not contribute to this growth rate. We also find that SCB credits to industry in the form of priority sector lending did not significantly contribute to the growth of per capita industrial output.

2.6 Results from GMM estimation

In this section we discuss the results from system GMM estimation of models (4), (5) and (6). The system GMM estimation is a dynamic panel estimation where we set the explanatory variables as instruments, and test whether these instruments are the correct choice. We have discussed the rationale behind using this estimation technique in section 2.3. The key idea behind this estimation is the consideration of the potential endogeneity of regressors, or more simply the potential endogeneity of a set of explanatory variables. In order to correct for this potential endogeneity, we employ the lagged first differences of the explanatory variables as instruments for the specification in levels, and the lagged values of the explanatory variables as instruments for the specification in differences.

A summary of results from the GMM estimation of model (4) is presented in table 2.6.1A, and the summary of Wald tests corresponding to the results in table 2.6.1A is presented in table 2.6.1B. For all GMM estimations we use time dummies but in reporting the results we suppress the details of the estimates corresponding to these time dummies. We test the joint significance of the time dummies and the associated results are in the Wald test summary tables. In the results summary tables for all three models, we report the coefficient estimates for the explanatory variables (except time dummies) and their associated p-values, the instrument rank, and the J-statistic and its associated p-value. We set out the specifications for model (4) in the same way we did for model (1). Specifications for model (5) and model (6) correspond to the similar specifications for model (2) and model (3), respectively.

For model (4) where our dependent variable is growth in per capita SDP, we estimate six specifications. For all specifications, based on the Sargan test we fail to reject the null hypothesis that the instruments as a group are exogenous, i.e. they are valid instruments.

Table 2.6.1A: Summary of GMM estimation of model 4, dependent variable is real per capita SDP growth.

	4(a)	*4(b)*	*4(c)*	*4(d)*	*4(e)*	*4(f)*
y_{t-1}	-0.8701 [0.000]	-0.8641 [0.000]	-0.8403 [0.000]	-0.8491 [0.000]	-0.8358 [0.000]	-0.8396 [0.000]
γ_{kt}	0.0020 [0.309]	0.0020 [0.324]	0.0024 [0.250]	0.0020 [0.357]	0.0029 [0.084]	0.0026 [0.139]
$bd1_{t-1}$	0.0188 [0.000]				0.0165 [0.015]	
$bd2_{t-1}$		0.0062 [0.048]				0.0066 [0.050]
$bd3_{t-1}$			0.0404 [0.226]		0.0371 [0.028]	
$bd4_{t-1}$				-0.0026 [0.917]		-0.0059 [0.822]
Observations	182	182	168	168	168	168
Instrument Rank	38	38	38	38	39	39
J-statistic [p-value]	36.15 [0.326]	36.76 [0.309]	36.32 [0.311]	36.79 [0.307]	35.08 [0.361]	35.86 [0.346]

Table 2.6.1B: Summary of Wald tests related to the results in table 2.6.1A.

Null hypothesis	*4(a)*	*4(b)*	*4(c)*	*4(d)*	*4(e)*	*4(f)*
Growth effect of SCB deposits is equal to zero	12.259 [0.000]	-	1.475 [0.224]	-	3.216 [0.072]	-
Growth effect of SCB credits is equal to zero	-	3.945 [0.047]	-	0.010 [0.917]	-	0.0007 [0.978]
All time dummies are insignificant	87.385 [0.000]	77.654 [0.000]	63.414 [0.000]	75.712 [0.000]	69.572 [0.000]	75.155 [0.000]
All coef. est. (except time dummies) are zero	571.33 [0.000]	32.872 [0.000]	23.530 [0.000]	28.935 [0.000]	58.095 [0.000]	37.427 [0.000]

Note: Chi-square test statistic [p-value] reported.

As we found earlier in the estimation of model (1) using fixed effects panel method, the GMM estimation of model (4) also suggests that the lagged per capita SDP has significant negative effect while growth in per capita capital stock has insignificant effect of growth of per capita output. We find that in the GMM estimation of model (4), the coefficient estimates for $bd1_{t-1}$ and $bd2_{t-1}$ are positive and statistically significant at the 5% level. Given specification 4(a), this finding is consistent with the findings of specifications 1(a), i.e. the aggregate SCB deposits have a strictly positive and significant impact on growth of per capita SDP. The coefficient estimates for the financial development indicators in specifications 1(c) and 1(d), i.e. the ones that include RRB deposits and credits, are statistically insignificant. The net marginal effect of SCB deposits on growth in per capita SDP are equal to 0.0188 and 0.0536 for specifications 4(a) and 4(e), respectively, and both are statistically significant at the 10% level. We find significant (at the 5% level) net marginal effect of SCB credits (equal to 0.006) for specification 4(b) only.

The results of GMM estimation of model (4) therefore is consistent with the results we discussed earlier for model (1). The SCB deposits which are channelled through the RRBs in general fails to explain the changes in growth of per capita SDP, whereas the aggregate level of SCB deposits does very well in this. The result is similar for SCB credits. The time effects are statistically significant which justifies the choice of specification. The instruments are valid, and therefore the results in general satisfy the robustness characteristics.

Table 2.6.2A: Summary of GMM estimation of model 5, dependent variable is real per capita ASDP growth.

	5(a)	*5(b)*	*5(c)*	*5(d)*	*5(e)*	*5(f)*	*5(g)*
y_{agt-1}	-1.4061 [0.000]	-1.4108 [0.000]	-1.4370 [0.000]	-1.5281 [0.000]	-1.3762 [0.000]	-1.4380 [0.000]	-1.5393 [0.000]
γ_{kt}	-0.0078 [0.646]	-0.0115 [0.501]	-0.0195 [0.187]	-0.0185 [0.161]	-0.0186 [0.244]	-0.0147 [0.242]	-0.0156 [0.195]
$bd1_{t-1}$	0.0398 [0.086]					0.0343 [0.080]	
$bd2_{t-1}$		0.0034 [0.791]					0.0063 [0.568]
$bd3_{t-1}$			0.0136 [0.758]			0.0186 [0.094]	
$bd4_{t-1}$				0.1069 [0.007]			0.1113 [0.013]
$bd5_{t-1}$					0.0353 [0.282]		
Observations	182	182	168	168	182	168	168
Instrument Rank	38	38	38	38	38	39	39
J statistic [p-value]	37.53 [0.310]	39.04 [0.253]	33.96 [0.469]	35.30 [0.406]	37.59 [0.309]	33.04 [0.413]	34.99 [0.436]

Table 2.6.2B: Summary of Wald tests related to the results in table 2.6.2A.

Null hypothesis	*5(a)*	*5(b)*	*5(c)*	*5(d)*	*5(e)*	*5(f)*	*5(g)*
Growth effect of SCB deposits is equal to zero	2.968 [0.084]	-	0.0938 [0.759]	-	-	0.110 [0.740]	-
Growth effect of SCB credits is equal to zero	-	0.0697 [0.791]	-	7.285 [0.007]	1.162 [0.281]	-	7.031 [0.008]
All time dummies are insignificant	36.652 [0.000]	39.975 [0.000]	47.359 [0.000]	55.926 [0.000]	32.274 [0.000]	48.014 [0.000]	56.139 [0.000]
All coef. est. (except time dummies) are zero	51.318 [0.000]	42.147 [0.000]	30.426 [0.000]	33.418 [0.000]	43.513 [0.000]	36.857 [0.000]	35.810 [0.000]

Note: Chi-square test statistic [p-value] reported.

In table 2.6.2A we report the summary of the GMM estimation results for model (5) where our dependent variable is real per capita ASDP growth. As we did for fixed effects panel estimation of model (2), we use seven specifications for this model. The associated Wald test results summary is presented in table 2.6.2B. The way we construct these reports is similar to the way we constructed the reports in tables 2.6.1A and 2.6.1B, which were for model (4). Based on the Sargan test for all specification in table 2.6.2A, we fail to reject the null hypothesis concerning the validity of over identifying restrictions in these estimations. The Sargan tests therefore validate the choice of instruments for all specifications. As we found before, we find significant negative impact of lagged per capita agricultural SDP and insignificant impact of growth in per capita capital stock on the growth in per capita agricultural SDP. The coefficient estimate for aggregate SCB deposits is statistically significant at the 10% level for specifications 5(a) and 5(f), while that of aggregate SCB credits are statistically insignificant for specifications 5(b) and 5(g). The coefficient estimates for $bd3_{t-1}$ that concerns SCB deposits in RRBs is insignificant in specification 5(c), and only marginally significant in specification 5(f). The SCB credits that are channelled through RRBs however have significant impacts on the growth of per capita ASDP, as confirmed by the estimations of specifications 5(d) and 5(g). Priority sector lending to agriculture by SCBs do not have any significant impact on the growth of per capita ASDP, as can be seen in specification 5(e).

As can be summarized from table 2.6.2B, the net marginal growth effect of SCB deposits in specification 5(a) is significantly different from zero. However for the other two specifications this effect is insignificant. The net marginal growth effect of SCB credits in specifications 5(d) and 5(g), both of which involve the credits channelled through RRBs, is significantly different zero (at the 1% level). All time dummies are jointly significant for this model. These findings are very much in line with what we found earlier for model (2) using the fixed effects panel estimation technique.

The GMM estimation summary for model (6) and the Wald tests associated with this estimation are presented in table 2.6.3A and table 2.6.3B, respectively. Dependent variable for this estimation is the growth in per capita industrial SDP. Except for the growth in per capita capital stock and the marginal effect of industrial credit by SCBs, the findings are generally similar to the findings of fixed effects panel estimation of model (3). The Sargan tests for all seven specifications once again confirm the validity of the instruments and the approach. The lagged per capita ISDP has a significant negative impact on growth of per capita ISDP for all specifications.

The coefficient estimates for $bd1_{t-1}$ and $bd2_{t-1}$ are positive and statistically significant for the specifications where these are used as explanatory variables. The coefficient estimates that are related to RRB credits are statistically insignificant. For specification 6(e) we find significant (at the 5% level) positive marginal growth effect of priority sector industrial credit, where the effect is equal to 0.006. The net marginal growth effect of SCB credits in specification 6(b) and 6(g) are equal to 0.014 and 0.011, and they are statistically significant at the 5% and the 1% level, respectively. Thus except for the significant marginal effect of priority sector lending in industry, the findings are generally similar to those of model (3).

Table 2.6.3A: Summary of GMM estimation of model 6, dependent variable is real per capita ISDP growth.

	6(a)	*6(b)*	*6(c)*	*6(d)*	*6(e)*	*6(f)*	*6(g)*
y_{mt-1}	-0.6877 [0.000]	-0.6395 [0.000]	-0.6502 [0.000]	-0.6351 [0.000]	-0.6613 [0.000]	-0.6322 [0.000]	-0.5983 [0.000]
γ_{kt}	0.0050 [0.469]	0.0092 [0.236]	0.0011 [0.284]	0.0010 [0.481]	0.0036 [0.244]	0.0037 [0.242]	0.0039 [0.195]
$bd1_{t-1}$	0.0149 [0.005]					0.0013 [0.080]	
$bd2_{t-1}$		0.0139 [0.026]					0.0102 [0.068]
$bd7_{t-1}$			0.0028 [0.928]			-0.0108 [0.094]	
$bd8_{t-1}$				0.0091 [0.672]			0.0003 [0.113]
$bd6_{t-1}$					0.0061 [0.021]		
Observations	182	182	168	168	182	168	168
Instrument Rank	38	38	38	38	38	39	39
J statistic [p-value]	23.80 [0.904]	23.51 [0.911]	24.53 [0.883]	24.25 [0.888]	23.56 [0.900]	25.02 [0.816]	24.49 [0.822]

Table 2.6.3B: Summary of Wald tests related to the results in table 2.6.3A.

Null hypothesis	*6(a)*	*6(b)*	*6(c)*	*6(d)*	*6(e)*	*6(f)*	*6(g)*
Growth effect of SCB deposits is equal to zero	7.799 [0.005]	-	0.0074 [0.931]	-	-	0.177 [0.674]	-
Growth effect of SCB credits is equal to zero	-	5.034 [0.024]	-	0.178 [0.672]	5.041 [0.021]	-	7.713 [0.009]
All time dummies are insignificant	93.998 [0.000]	99.939 [0.000]	81.971 [0.000]	74.398 [0.000]	77.564 [0.000]	64.256 [0.000]	69.154 [0.000]
All coef. est. (except time dummies) are zero	56.985 [0.000]	51.247 [0.000]	25.546 [0.000]	27.952 [0.000]	26.113 [0.000]	29.896 [0.000]	35.264 [0.000]

Note: Chi-square test statistic [p-value] reported.

2.7 Conclusion

In recent years the government of India has been making attempts to encourage the expansion of rural banking in India. These attempts involve regulations towards SCBs to open more branches in rural areas, higher level of social sector expenditure directed towards rural development, formalization of rural financial markets and encouraging competitive environment in the rural credit markets etc. Whether or not such reforms will affect state level growth remains an important question; and one way of answering this question is to examine the growth effect of commercial vis a vis rural banking development in the states of India. This is exactly what is attempted in this chapter.

We use a growth accounting approach in accomplishing this task. Our regressions show that there is clear evidence of growth effects of commercial and rural banking development in the 26 states and UTs of India that we consider over the period 1999-2008. We find that deposits of commercial banks in general have a significant positive impact on the growth of per capita SDP. Thus domestic savings in commercial banks affect local economic growth positively and significantly. We also find that domestic savings and mobilization of domestic savings through commercial banks do not significantly affect the state level growth in the agricultural component of SDP, and their positive and significant impact on per capita SDP growth mainly stems from their significant marginal effect on the growth of the industrial component of SDP. This finding is robust whether we use fixed effects panel estimation or system GMM estimation. We also find that the marginal effect of SCB credits on the growth of per capita SDP is mixed. Credits that are channelled through rural banks positively affect the growth in the agricultural component of per capita SDP and the growth in per capita industrial SDP. When we consider the potential endogeneity of the explanatory variables and use these variables as instruments for the GMM estimation, we find that the resulting magnitude of the marginal effect of deposits and credits are smaller.

What we find interesting is the variation in growth effect of deposits and credits, and the channel through which development in commercial vis a vis rural banking in India affect different measures of growth. This implicitly implies that some state specific characteristics that are essential in determining the level and strength of banking development (e.g. rural well being, infrastructure) may assist in explaining the growth effects of banking development better.

Chapter 3

The Role of Infrastructure and Rural Development in Explaining the Banking-Growth Nexus in India: Evidence from State Level Data

Chapter summary:

In this chapter we examine how and to what extent development in infrastructure and rural well being can assist in explaining the banking development led growth in state level output, agricultural output and industrial output in India. We use state level data for India for a sample period of 1999-2008. Based on an empirical analysis that involve fixed effects panel and GMM estimation, we show that there is clear evidence of growth effects of commercial and rural banking development, infrastructure development and development in rural well being in 26 states and union territories of India. We find that expansion of road transportation and rail routes generally improves state level growth in output and industrial output. More allocation of production in the informal sector can hurt growth, but improvement in rural well being can bring in more growth to the economy. Expanding rural roads negatively affects growth in agriculture, which could be because such expansion may involve loss of agricultural land. We argue that a major determinant of the success of rural banking development led growth in India, which is emphasized heavily in the current policy reforms in India, is the development of physical infrastructure and rural well being.

3.1 Introduction

In chapter 2 we discussed the importance of banking sector development in explaining state level growth in output, agricultural output and industrial output in India. In this chapter we examine how and to what extent the introduction of some important state specific characteristics which are linked to banking sector development can improve the understanding of the reasons behind the regional difference in banking development led growth in the key measures of output. Here we examine the role of infrastructure and rural development in explaining the banking development - state level growth link in India. Given this link, we examine how and to what extent infrastructure and rural development in India can explain the regional difference in growth in output, agricultural output and industrial output in a sample of 26 states and union territories (UTs) of India over the period 1999-2008.

Our empirical approach in this study primarily involves an investigation of the relationship between the growth in gross state domestic product (SDP) and the development of commercial and regional rural banking, infrastructure and rural development in the 26 states and UTs of India. We then examine how the same determinants affect the growth in the agricultural component of SDP. Finally, we examine the relationship between the growth in the industrial component of SDP and the development of banking services to the industries, infrastructure and rural well being for the same sample.

The key findings of this chapter is that Scheduled Commercial Bank (SCB) deposits in general have a significant positive impact on the growth of per capita SDP, but the marginal effect of SCB credits on this growth is rather inconclusive. SCB deposits have little or no effect on the growth of per capita agricultural SDP. SCB credits that are channelled through Regional Rural Banks (RRBs) positively affect the growth in the agricultural component of per capita SDP. For the growth in per capita industrial SDP, we find that both SCB credits and deposits have individual significant positive effects. These findings are perfectly consistent with the findings of a reduced form empirical model as in chapter 2. In addition to these, we also find that expansion of road transportation and rail routes improves state level growth, and expansion of informal sector has a negative effect on growth. Improving rural well being can bring in more growth to the economy. Expanding rural roads may hurt growth in agriculture, which could be because such expansion may involve loss of agricultural land. We conduct the empirical estimation using fixed effects panel technique and Generalized Methods of Moments (GMM) technique, and find that these results are robust to the methodology of estimation.

What primarily motivates us in examining the key research question in this chapter is that for a fast growing and predominantly rural economy like India, there is huge disparity in state level infrastructure growth, rural well being and banking development, and there is no study in the literature that attempts to identify their growth effects in a unified growth accounting approach. Identifying the exact state level growth effects of infrastructure, rural well being and banking development would enable one to directly infer policy lessons that are directed towards boosting state level growth and encouraging convergence at the state level. Also, identifying the marginal effect of infrastructure and rural well being on the components of state level growth is in fact equivalent to identifying the channels through which state level growth in production sectors (agriculture and industry) are affected by these, which in turns provides clear policy implications.

There are very few studies in the related literature that attempt to analyze the impact of banking development, infrastructure and rural development on local economic growth of developing countries in a unified framework. Cheng and Degryse (2010) consider the impact of bank and non bank financial development on local economic growth of China, where they give some insight about the relationship between infrastructure and local economic growth of China. They consider infrastructure (rail and road) as conditioning set of variables for regional growth difference in Chinese provinces, but they do not emphasize on the marginal growth effect of these infrastructure. They do not really focus on how variations in these can affect growth or can explain the reasons behind the regional difference in growth of output. They also do not consider the marginal effect of infrastructure on the growth of different sectors of the economy. Among others, Cull and Xu (2000) and Cull and

Xu (2005) examine how the level of bureaucracy has affected in the efficiency of agricultural credit extended towards the state owned enterprises in China.

Canning and Pedroni (2008) investigate the effect of infrastructure on long run economic growth in a panel of countries for 1950-1992. Their results provide clear evidence that in the vast majority of cases infrastructure does induce long run growth effects. They however find that these results can be inconclusive across individual countries and across individual groups of countries. They find that while telephones, electricity generating capacity and paved roads are provided at close to the growth maximizing level on an average, these are under-supplied in some countries and over-supplied in others. Their results also help in explaining why cross section and time series studies have in the past found contradictory results regarding a causal link between infrastructure provision and long run growth.

Boopen (2006) in his paper provides evidence on the importance of transport capital development in promoting economic development for African and island states. His study analyses the contribution of transport capital to growth for two different data sets, namely for a sample of Sub Saharan African countries, and for developing states. In both sample cases, the analysis concluded that transport capital has been a contributor to the economic progress of these countries. Esfahani and Ramirez (2003) in their paper develop a structural model of infrastructure and output growth that takes account of institutional and economic factors that mediate in the infrastructure-GDP interactions. Their cross country estimates of the model indicate that the contribution of infrastructure services to GDP is substantial and in general this level exceeds the cost of provision of those services. Their results also shed light on the factors that shape a country's response to its infrastructure needs and offer policy implications for facilitating the removal of infrastructure inadequacies.

A study by Demurger (2001) provides the empirical evidence on the links between infrastructure investment and economic growth in China. Using panel data from a sample of 24 Chinese provinces for the 1985 to 1998 period this study shows that besides the differences in terms of reforms and openness, geographical location and infrastructure endowment did account significantly for observed differences in growth performances across provinces. His results indicate that transport facilities are a key differentiating factor in explaining the growth gap and point to the role of telecommunication in reducing the burden of isolation.

The current study is motivated by the literature, the state level growth facts, and the series of banking sector reforms undertaken in India. The literature is more or less silent about how these reforms are affecting state level growth in per capita income, and there is literally no study that shows how these affect the components of per capita income in India[15]. This chapter try to give the insights of these issues. We are also interested in the state level growth facts of India, and in this study we attempt to identify clear policy implications that would assist in boosting regional growth and promoting regional convergence in growth in India.

The remainder of the chapter is organized as follows. We present a brief description of the motivation and the context in section *3.2*. In section *3.3* we discuss the empirical methodology and model specifications. Description of data and data sources are presented in section *3.4*. In section *3.5* we discuss the results from fixed effects panel estimation, and in section *3.6* we discuss the results from GMM estimation. In section *3.7* we present the concluding remarks.

3.2 The Context

In conducting a regional level growth study for a fast growing large economy like India, it is primarily essential to explain the regional difference in banking sector development, infrastructure and rural well being. Most of the discussions related to the banking sector development and regional difference in output and its components are in chapter 2 of this thesis. In this section we discuss some important proxies for stocks of physical infrastructure and levels of rural well being in Indian states. The details of the data sources are discussed in section 3.4 to follow.

[15] Chakraborty (2009) studies the link between infrastructure and economic growth in India using micro data, although in that study very less is emphasized on the growth in the key components of state domestic product. A more macro based approach of the infrastructure-growth nexus for India can be found in Sahoo and Das (2010). In a recent paper Chaudhuri and Krishnendu (2009) discuss the impact of corruption in a model with informal and formal credit sources. They argue that different measures of the stock of physical capital can control the corruption affected distribution of formal as well as informal credit.

3.2.1 Physical infrastructure at the state level

In this chapter, we consider the data for 26 states and UTs of India for the period 1999-2008[16]. These are the same regional entities and the same time period that was considered in chapter 2. In table 3.2.1a we present the average growth rate of per capita state domestic product (*sdp*), the growth rate of per capita agricultural state domestic product (*asdp*) and the growth rate of per capita industrial state domestic product (*isdp*) for these states, where the growth rate are in real (2000 prices) terms of SDP and its components[17].

As can be seen in this table, there is a considerable amount of variation in these growth rates across states. The agricultural SDP growth is very high in states such as Bihar, Chattisgarh, Nagaland and Rajasthan. Industrial component of per capita SDP shows high growth in all states except Himachal Pradesh, Jammu and Kashmir, Madhya Pradesh, Manipur, Nagaland, Uttar Pradesh and Andaman & Nicobar Islands. This relatively very high growth in the industrial component of per capita SDP is mainly due to the rapid progress of the service section in India, which for all states and UTs in India accounted for an average growth rate of 15.3% during the last decade, compared to a low 2.9% average growth rate of the manufacturing sector. Generally for manufacturing growth it is the growth in the core large and medium scale infrastructure (e.g. steel, coal and other heavy core infrastructure) that matter. In transitional economies the rapid growth in service sector is generally accompanied by a growth in the transport and other communication related infrastructure and the overall well being of population. This is because if people live well, and they can commute as well as communicate flexibly, they are more mobile which makes their services available to many places. This is the key reason why we consider transport and other communication related infrastructure and the well being

[16] In this chapter we limit the discussion on the context to a discussion on the state level physical infrastructure and rural well being in India. For a discussion on the state level domestic product, its components and banking related facts for India, see section 2.2 of chapter 2 of this thesis.
[17] The industrial component of the SDP is the sum of total manufacturing and total services component of SDP. The agricultural component involves all output from agriculture and allied activities.

of rural population (72% of Indian total population) as important determinants of state level growth in income and its components.

Table 3.2.1a: Real growth rates (in %) of the 26 states and union territories' 1999-2008 (2000 prices).

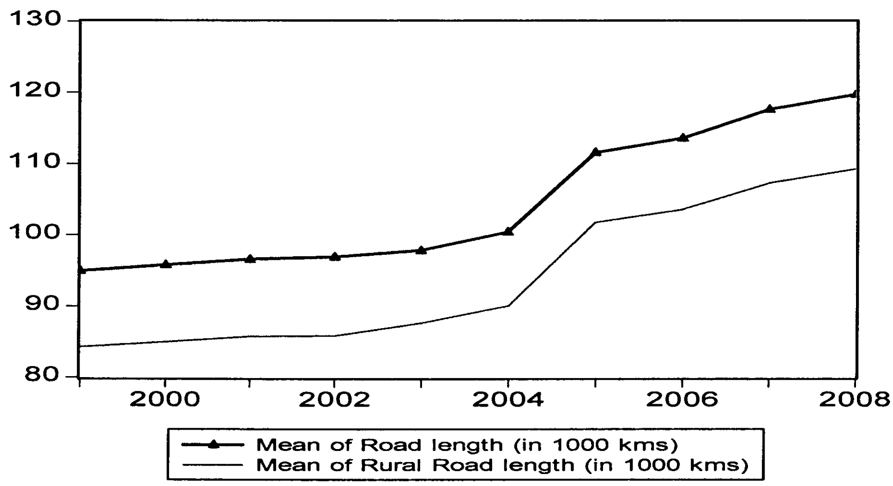
	State/UT (Region)	*sdp* growth	*asdp* growth	*isdp* growth
1	Andhra Pradesh (Southern)	7.79	5.79	8.08
2	Assam (North Eastern)	4.85	0.92	7.00
3	Bihar (Eastern)	8.12	6.66	7.79
4	Jharkhand (Eastern)	5.52	2.31	7.06
5	Goa (Western)	6.48	-0.561	7.40
6	Gujarat (Western)	7.84	9.11	7.89
7	Haryana (Northern)	9.19	3.18	10.95
8	Himachal Pradesh (Northern)	6.50	5.42	5.75
9	Jammu & Kashmir (Northern)	4.51	2.59	4.91
10	Karnataka (Southern)	6.77	-0.286	9.01
11	Kerala (Southern)	7.85	0.425	8.49
12	Madhya Pradesh (Central)	3.02	2.08	3.24
13	Chattisgarh (Central)	8.10	6.03	8.95
14	Maharashtra (Western)	6.01	4.17	6.67
15	Manipur (North Eastern)	4.75	2.87	3.26
16	Meghalaya (North Eastern)	6.79	4.73	6.67
17	Nagaland (North Eastern)	6.40	8.49	4.77
18	Orissa (Eastern)	7.05	2.75	8.36
19	Punjab (Northern)	4.92	2.62	5.80
20	Rajasthan (Northern)	4.85	8.30	6.37
21	Tamil Nadu (Southern)	6.18	1.42	7.29
22	Tripura (North Eastern)	6.24	3.47	6.44
23	Uttar Pradesh (Central)	4.97	2.19	5.43
24	Uttarkhand (Central)	8.71	1.98	9.33
25	West Bengal (Eastern)	5.84	2.51	6.36
26	Andaman & Nicobar Island (Eastern)	5.88	-0.283	4.87

Source: Author's own calculations from data collected from Handbook of Indian Statistics, various issues.

According to the *Studies and Surveys* of the Federation of Indian Chambers of Commerce and Industry (FICCI), growth in the six core infrastructure industries of India (finished steel, cement, crude petroleum, petroleum refinery, coal and power) registered an increase of output of 2.5% in September 2010 as compared to an increase of 4.3% during the same month a year before. This drop in the growth rate allegedly was due to shrinkage in the output of petroleum refinery and coal sector. This decline in core infrastructure sector lagged behind the decline in industrial sector. According to Reserve Bank of India (RBI) reports the prevailing growth trends in these sectors (especially the power generation sector) needs to be improved for a sustained recovery in growth in the industrial sector.

In this chapter, we consider state level data for three types of infrastructure, namely, roads (and rural roads), electricity and rail routes. Our conjecture is that these basic measures of infrastructure can explain the variation in state level growth in income and its components. Roads and rural roads are central to transportation of goods and services, which is why their role in determining regional growth is widely known. In figure 3.2a we present the cross sectional means of road length and the cross sectional mean of rural road lengths (both in 1000 kms) for the 26 states and UTs in our sample for 1999-2008[18].

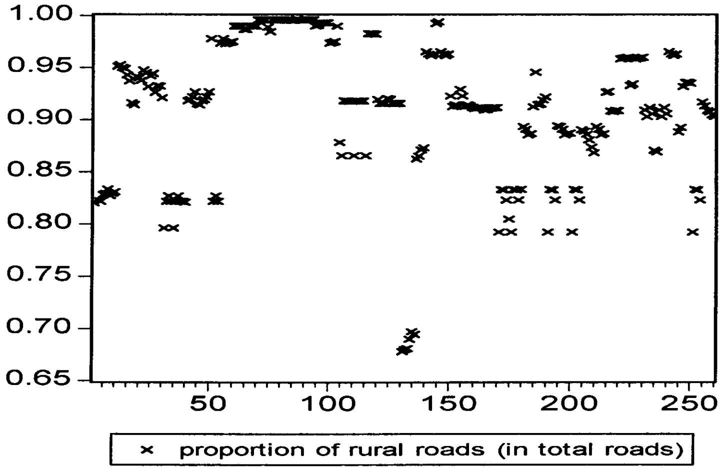
Figure 3.2a: Mean of road length and mean of rural road lengths for 26 states and UTs of India, 1999-2008 (length in 1000 kms on the vertical axis, time on the horizontal axis).



[18] The roads here are the branch roads of the state and national highways that serve as the main roads for intra-district movements within one state. They traverse the length and breadth of a district to connect the areas of production and marketing in the district to one another and to the national highways, and therefore they are the key means of local transportation of goods and services. The rural roads are the total rural roads including parts of district roads for which lower specifications are prescribed and the village roads. The village roads serve as the feeder roads of the other highways as well as the roads for inter village movements.

For the full sample period there has been an average increase in the road and rural road lengths for the 26 states and UTs that we consider. The average road length per capita and rural road length per capita for these states and UTs during the sample period is equal to 0.00345 kms and 0.0032 kms, respectively. The road length per capita for the relatively high growing states such as Kerala, Karnataka, Himachal Pradesh and Gujarat are above the average road length of 0.00345, and overall sample standard deviation for this variables is equal to only 0.0000004 (similar low dispersion is in rural road per capita). Mainly due to this low variation in this variable, in the regressions instead of this variable we use the road length per square km and the rural road length per square km. The average road length per square km and rural road length per square km for the full sample are equal to 0.981 km (*st. dev.* 0.871) and 0.889 km (*st. dev.* 0.757), respectively, implying that approximately 90% of the roads in these states and UTs are rural roads. This is understandable, because according to the 2001 census the proportion of rural population in total population of India is equal to 72.2%. In figure 3.2b we present the scatter plot of the proportion of rural roads in total roads for our sample.

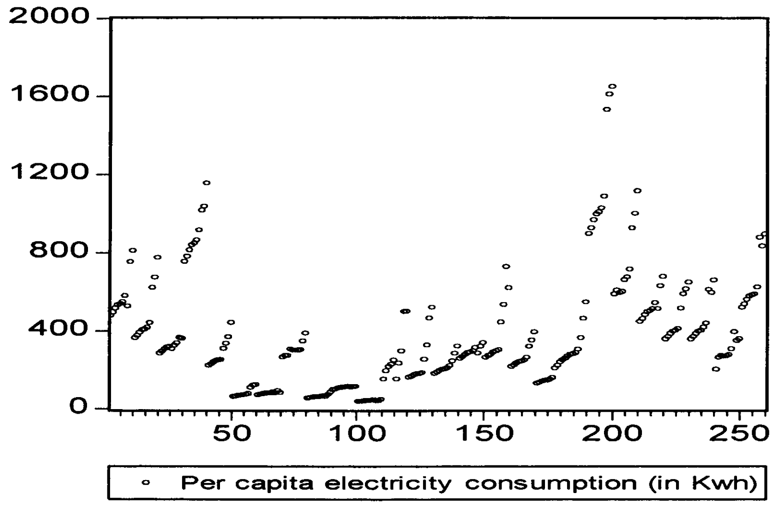
Figure 3.2b: Scatter plot of the proportion of rural road in total roads for 26 states and UTs of India, 1999-2008 (proportion on the vertical axis, sample points on the horizontal axis).



Clearly, majority of the states in our sample have a very high (over 85%) proportion of rural roads in total road length. For Rajasthan, Orissa, Madhya Pradesh, Kerala, Jammu and Kashmir, Bihar, Andhra Pradesh, Assam and other North Eastern states (Meghalaya, Tripura, Nagaland, Manipur) this proportion is well over 90%. For states which are predominantly service industry based, such as Maharashtra, Gujarat, Karnataka and Tamil Nadu, this proportion is around 83%. For predominantly agriculture based states such as Punjab, Uttar Pradesh and West Bengal this proportion is also lower than the average (around 84%).

Consumption of electricity is an important determinant for industrial as well as aggregate productivity, well being and communication, all of which can strongly influence growth in income. In figure 3.2c we present the scatter plot of per capita electricity consumption for our sample.

Figure 3.2c: Scatter plot of per capita electricity consumption for 26 states and UTs of India, 1999-2008 (kilo watts on the vertical axis, sample points on the horizontal axis).

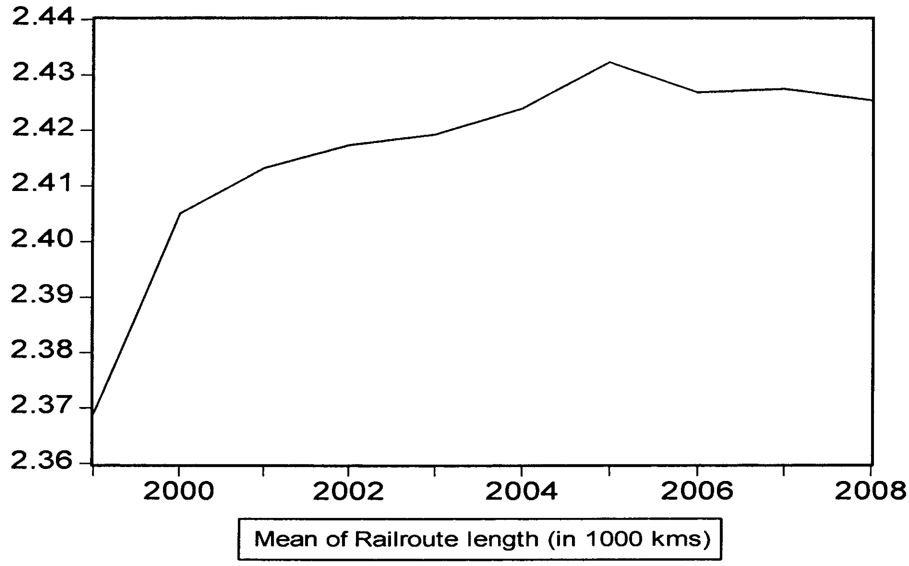


We find considerable amount of variation in the 26 states and UTs in terms of consumption of electricity. States in which there is a relatively larger share of urban population and/or industry (e.g. Haryana, Maharashtra, Gujarat. Tamil Nadu) the average per capita electricity consumption for the sample period is very high, generally over 500 kwh (kilo watts). For these states the 2003-2009 average growth rate of SDP is well over 7%. Goa, which is a state that has one of the main sea ports in India, has the highest per capita electricity consumption (average over 100 kwh), and has experienced an average growth rate of over 9% during 2003-2009. Relatively larger states (in terms of population and area) that are predominantly agriculture based have very low per capita electricity consumption. Large states with low average growth rate of SDP (under 7% for 2003-2009) such as Uttar Pradesh, Madhya

Pradesh, Assam, and West Bengal also has experienced very low average per capita electricity consumption (under 300 kwh). For heavily ruralised states such as Nagaland, Bihar and Manipur this figure is less than 100 kwh.

We consider another important transport infrastructure which is the rail system. Our proxy for this is the length of rail routes in the 26 states and UTs. There are, however, no rail communication in Meghalaya (a state) and Andaman & Nicobar Island (A UT) which are in our sample, so we consider this variable for the remaining 24 states. The total length of rail routes shows considerable amount of variation, both across states and over time for each state. In figure 3.2d we present its cross section average measured in 1000 kms for the entire sample period. The length of rail routes is the sum of narrow and meter gauged rail routes.

Figure 3.2d: Mean of rail route length for 24 states and UTs of India, 1999-2008 (length in 1000 kms on the vertical axis, time on the horizontal axis).

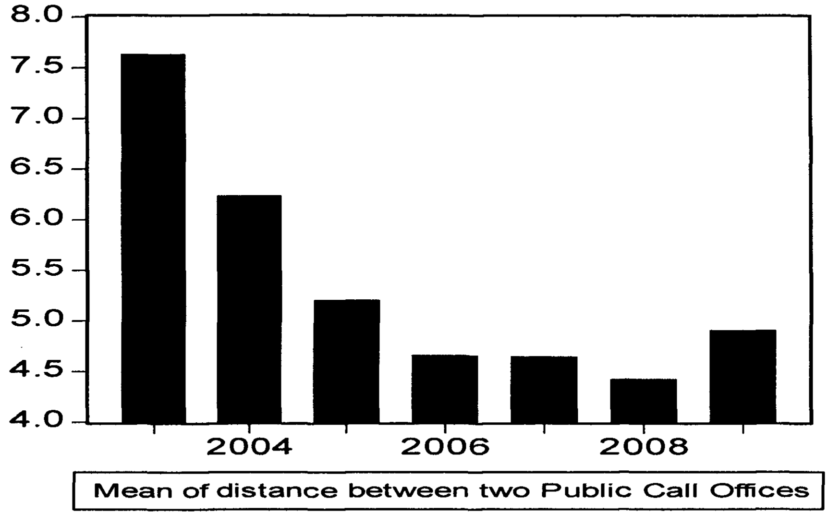


Rail transport, which is the most common mode of long-distance transportation in India, forms an important part of infrastructure for 28 states and 3 UTs. The rail network in India traverses the length and breadth of the country, covering a total length of 64015 kms, and currently is the fourth largest railway network in the world. The annual average transport of Indian railways is approximately 6 billion passengers and well over 350 million tonnes of freight. The average annual growth of rail routes in all states of India for the period 2001-2008 was accounted for approximately 0.9%, while for our sample of 24 states this growth rate for the sample period is equal to 0.7%. Due to an expansion policy undertaken by the Indian Ministry of Rail during the early nineties, there has been considerable amount of increase in both the rail network and rail infrastructure. Rail routes in India do not only perform transportation, they are also keys to many other forms of electronic communication such as rural telegraph network, postal delivery and low pass band telecommunication.

In this study we would have liked to include telecommunication as an explanatory infrastructure variable in the growth regression, but due to data limitations this is not possible. The Infrastructure Statistics 2010 only reports telecommunication data for 2003-2009, and the concerned ministry (Ministry of Telecommunication and IT) reports were not useful in collecting state-wise back data which our sample requires (i.e. data for 1999-2002). Based on the 2003-2009 data on telecommunication, we are however able to present some insights of this infrastructure sector here.

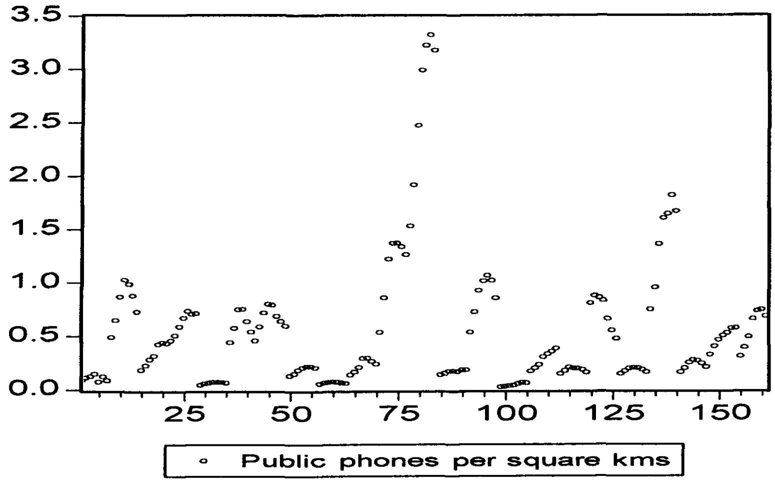
Most rural (and urban) areas are connected to the rest of India through two popular modes of telecommunication, namely, PCO (Public Call Offices) and Public Telephones. The 2003-2009 data on PCO suggest that for the 23 major states in India the mean area between two PCOs is around 5.38 square kms, and its standard deviation for these states is equal to 6.83. For relatively not so well populated and connected states (e.g. Jammu & Kashmir) this (mean) figure is as high as 17 square kms. Other states which have longer distance between two PCOs include Jharkhand (5.4 sq kms), Uttarkhand (6.1 sq kms), Rajasthan (5.7 sq kms), Orissa (5.9 sq kms), Madhya Pradesh (5.9 sq kms), and regions in the North East (18 sq kms). There has, however been an improvement in the PCO infrastructure. For all states the mean area between two PCOs show a declining trend over the period 2003-2009, as may be seen in figure 3.2e.

Figure 3.2e: Mean of distance between two Public Call Offices for 23 states and UTs of India, 2003-2009 (distance in square kms on the vertical axis, time on the horizontal axis).



This improvement in PCO network has resulted in more PCOs per square km, and its mean increased from 0.12 in 2003 to 0.54 in 2009. Its variation across the 23 states has dropped by 33% between these years, showing that this particular mode of communication is developing quickly in rural India. There has also been an improvement in the number of villages that are covered with public phones. In figure 3.2f we present the scatter plot of public phones per square kms in the 23 major states for 2003-2009.

Figure 3.2f: Scatter plot of public phones per square km, 23 states, 2003-2009 (number on vertical axis, sample points on horizontal axis).

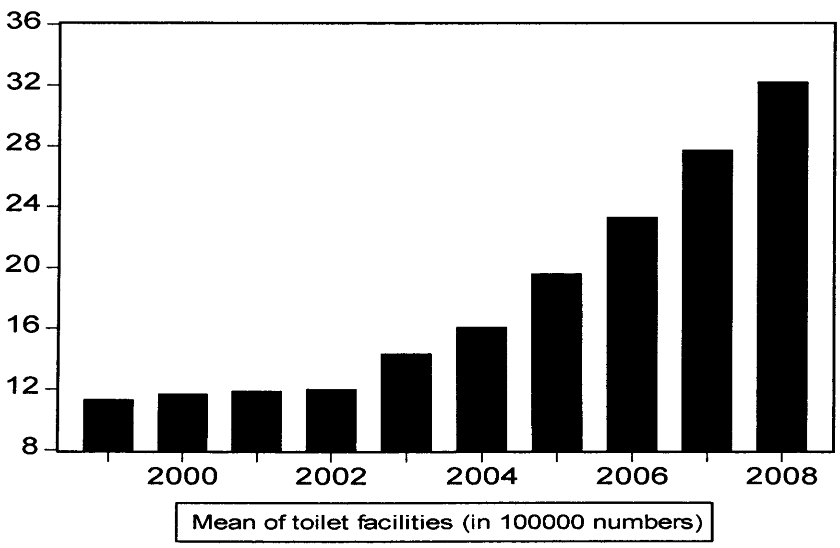


The average number of public phones per square km is generally quite high (around 1.7) in the relatively more production oriented states, such as Haryana, Punjab, Uttar Pradesh, West Bengal and Tamil Nadu. For states that are more service oriented, such as Maharashtra, Karnataka, Gujarat and Goa, this figure is generally low (around 0.2). According to the reports of the concerned ministry, the number of cellular phones and household as well as commercial landlines are much larger in these states. For most other states, the average number of public phones per square km is around its mean (for all states, around 0.7).

3.2.2 Rural well-being at the state level

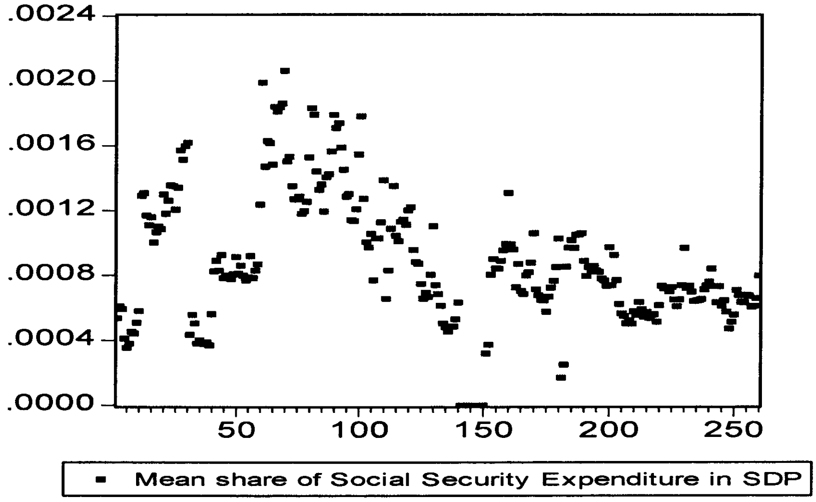
In this chapter, we capture the level of well being of rural households by two indicators, the level of sanitation, which is proxied by the number of rural households having access to toilet facilities, and the real value of social sector expenditure by state governments. This short listing is for data reasons, and we acknowledge that there are many other proxies that one can possibly use in order to measure rural well being.

Figure 3.2g: Mean of Toilet facilities for 26 states and UTs of India, 1999-2008 (in 100000 numbers on the vertical axis, time on the horizontal axis).



In figure 3.2g we present the mean of access to toilet facilities (by the number of rural households in 100000) for the 26 states in our sample for the period 1999-2008. There is a clear trend of improvement in sanitation arrangement for rural households during the sample period. In general the states in the South region have the maximum average sanitation arrangements. For Kerala, Andhra Pradesh and Tamil Nadu (all in South region) on an average over 3 million households have access to toilet facilities. For the other relatively larger states, such as West Bengal, Uttar Pradesh, Madhya Pradesh and Maharashtra this average is over 2 million (highest for Uttar Pradesh, equal to 6 million), while for allegedly least developed states like Assam and Bihar, this average is just over 1 million.

Figure 3.2h: Scatter plot of the proportion of social sector expenditure by state government in SDP, both at 2000 prices, for 26 states and UTs of India, 1999-2008 (proportion on vertical axis, sample points on horizontal axis).



The other proxy that we use is the ratio of social sector expenditure to SDP, both evaluated at 2000 prices. Its scatter plot is in figure 3.2h. The social sector expenditure in India includes expenditure on safe drinking water provision, sanitation provision, housing provision, welfare provisions for socially deprived casts, urban development, and provision of relief on natural calamities. It is often argued that India lags behind the rest of the world in terms of social sector expenditure. The total combined expenditure of central and state governments on social services in 2008-09 was 6.72% of GDP at current prices. This is too low when compared to what some of the western countries spend on their people. Germany leads others by spending a significant 25% of its GDP on social services that include education, sports, art and culture, medical and public health, family welfare, social security and nutrition.

France is a close second with an expenditure of 23% of GDP while UK and US come third and fourth with 13% and 12%, respectively (IMF reports).

Table 3.2.2a: Summary statistics of growth rates in infrastructure and rural well being proxies for the 26 states and union territories, 1999-2008.

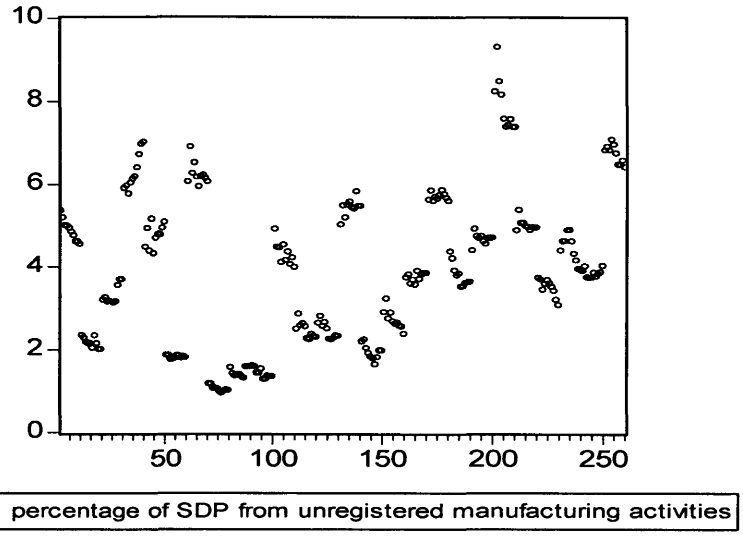
	Growth in Sanitation	Growth in Social Sector Exp.	Growth in Road length	Growth in Rural Road length	Growth in Rail routes	Growth in Electricity Consmp.
Mean	0.123	0.129	0.034	0.040	0.007	0.056
S.D.	0.190	0.395	0.128	0.161	0.038	0.113
Max	0.423	0.767	0.181	0.708	0.433	0.469
Min	-0.050	-0.468	-0.385	-0.406	-0.088	-0.887

In table 3.2.2a we present the mean growth rates of the infrastructure variables and the rural well being variables. The average growth rate of both rural well being variables are very high, implying that during our sampling period the government has been keen to improve rural well being. The average growth rate of road lengths and rural road lengths are 3.4% and 4%, respectively. Both the growth rate of rail routes and its variation across the states is very low. Rapid development of the service sector posed higher demands of electricity across all states, which is why the average growth rate of electricity consumption is 5.6% for the sample period. We observe higher than average growth rate in electricity consumption demand in relatively larger states such as Maharashtra, Uttar Pradesh, Madhya Pradesh and in relatively more service oriented states such as Tamil Nadu and Andhra Pradesh.

3.2.3 The informal sector and System Losses in Infrastructure

In this chapter we consider two proxies in order to account for informal sector and the system loss in infrastructure. For the informal sector, we consider the share of unregistered manufacturing in SDP for the 26 states and UTs, and its scatter plot is in figure 3.2i.

Figure 3.2i: Scatter plot of the percentage of SDP originating from unregistered manufacturing activities, at 2000 prices, for 26 states and UTs of India, 1999-2008 (percentage on vertical axis, sample points on horizontal axis).



The mean share of unregistered manufacturing sector in SDP for the full sample is equal to 3.92%, and this series has a rather large variance (equal to 3.232). For most states in the north east region mean share of unregistered manufacturing in SDP is lower than the full sample average, such as Meghalaya (1.1%), Assam (1.7%), Nagaland (1.4%) and Tripura (1.3%). However, for some industrial states such as Haryana, Tamil Nadu, Gujarat the mean share is well over 4%. For Gujarat, the mean share of informal sector is around 8.2%.

In India in recent years a number of rural as well as urban development projects have been undertaken in order to increase the production of electricity. However, due to a significant amount of losses in transmission and distribution, the actual consumption of electricity in states and UTs is much lower than the actual potential of generating electricity. In figure 3.2j we present the mean of potential electricity generation capacity and the mean of electricity consumption, both measured in giga watts. The figures are for the state aggregate. There is an increasing gap between the potential electricity and electricity consumption, indicating that there is an increasing trend of the transmission and distribution loss in electricity supply. We measure this system loss and hold it as the proxy for system loss in infrastructure. In figure 3.2k we present the scatter plot of the percentage of this system loss for the full sample.

Figure 3.2j: Mean of electricity generation capacity and mean of electricity consumption for 26 states and UTs of India, 1999-2008 (Giga watts on the vertical axis, time on horizontal axis).

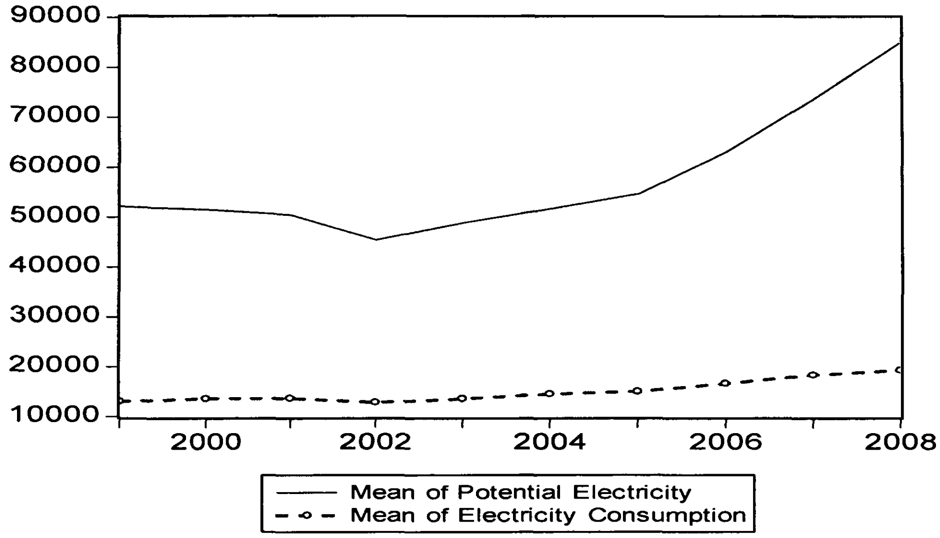
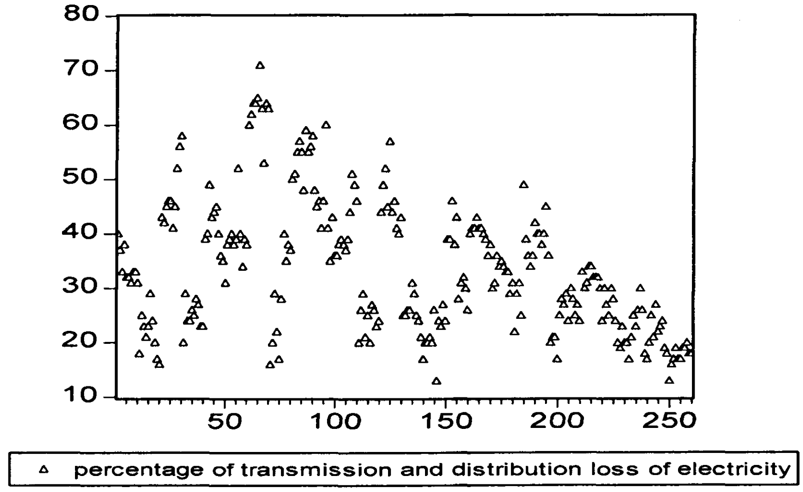


Figure 3.2k: Scatter plot of the percentage of transmission and distribution losses in electricity for 26 states and UTs of India, 1999-2008 (percentage on vertical axis, sample points on horizontal axis).



For all 26 states and UTs, the 1999-2008 average system loss is 33.16%, but its variance is considerably high (equal to 12.173). For states in the southern region such as Andhra Pradesh, Karnataka, Kerala and Tamil Nadu, the average system loss is well below the 33.16% full sample average, and for all these states during 1999-2008 there is a clear trend of declining system loss (i.e. an improvement in electricity transmission and distribution system). The worst case of system loss in electricity supply is in the north east region, where for Assam, Manipur, Nagaland and Meghalaya the average system loss is well above the full sample average with an increasing trend. For West Bengal, Uttar Pradesh, Maharashtra, Punjab and Orissa the system loss is steady during the sample period, and the average is below the full sample average.

3.3 Specification of the Empirical Models

The main aim in this chapter is to examine the impact of banking sector development, infrastructure and rural well being on state level economic growth in India. For this we start with a specification of fixed effects panel model controlling for state and time fixed effects, following King and Levine (1993 & 1993a):

$$\gamma_{i,t} = a_0 y_{i,t-1} + a_1 \gamma_{ki,t} + a_2 bd_{i,t-1} + \phi Con_{i,t} + \theta_i + \zeta_t + \varepsilon_{i,t} \qquad (1)$$

where $\gamma_{i,t}$ is the growth rate of real per capita gross state domestic product (*sdp*), $\gamma_{ki,t}$ is the growth rate of real per capita capital stock, *bd* is the (log of) banking development indicator of either scheduled commercial banks or regional rural banks, *Con* is the vector of conditioning set of variables where we include the indicators of infrastructure and rural well being (associated with a vector of parameters ϕ), θ_i is a set of state dummy variables, ζ_t is a set of time dummy variables, and ε are stochastic disturbance terms which are independently and identically distributed with zero mean and constant variance equal to σ_ε, all for state i in period t, $i = 1,2,....,N; t = 1,2,....................T$[19].

In addition to (1), we estimate other growth equations that are similar to (1) using different measures of growth in state level per capita income in order to

[19] Throughout the chapter we will denote per capita variables of the state domestic product by lower case letters, and aggregate variables with upper case letters. For instance, *sdp*, *asdp* and *isdp* denote the per capita SDP, per capita SDP from agriculture and per capita SDP from industry, respectively, while *SDP*, *ASDP* and *ISDP* denote their aggregates.

examine the impact of rural financial development on agricultural growth and industrial growth in income. For this, we estimate

$$\gamma_{agi,t} = b_0 y_{agi,t-1} + b_1 \gamma_{ki,t} + b_2 bd_{i,t-1} + \tau Con_{i,t} + \theta_{agi} + \zeta_{agt} + \varepsilon_{agi,t} \qquad (2)$$

where $\gamma_{agi,t}$ is the growth rate of real per capita gross state domestic product from agriculture (*asdp*), τ is the vector of parameters associated with the conditioning set of variables in (2), θ_{agi} is a set of state dummy variables, ζ_{agt} is a set of time dummy variables, and ε_a are independently and identically distributed error terms with zero mean and constant variance equal to $\sigma_{\varepsilon a}$, all for state i in period t, $i = 1,2,....,N; t = 1,2............................T$. For growth in the industrial sector, we estimate

$$\gamma_{mi,t} = c_0 y_{mi,t-1} + c_1 \gamma_{ki,t} + c_2 bd_{i,t-1} + \lambda Con_{i,t} + \theta_{mi} + \zeta_{mt} + \varepsilon_{mi,t} \qquad (3)$$

where $\gamma_{mi,t}$ is the growth rate of real per capita gross state domestic product from industry (*isdp*), λ is the vector of parameters associated with the conditioning set of variables in (3), θ_{mi} is a set of state dummy variables, ζ_{mt} is a set of time dummy variables, and ε_m are independently and identically distributed error terms with zero mean and constant variance equal to $\sigma_{\varepsilon m}$, all for state i in period t, $i = 1,2,....,N; t = 1,2,........................T$.

We conduct a likelihood ratio test for the redundancy of the fixed effects in the same way we did for the models in chapter 2[20]. We also conduct standard Wald test in order to validate some important hypotheses regarding the joint significance of some

[20] If the null hypothesis of redundant fixed effects is true, the test statistic follows approximately a chi square distribution with degrees of freedom equal to $(N-1)$ for cross section fixed effects (N is equal to the total number of cross sections in the estimation sample), $(T-1)$ for period fixed effects (T is equal to the total number of years in the estimation sample), and $(N-1)+(T-1)$ for cross section and period fixed effects jointly. Failure to reject the null hypothesis would imply that the fixed effects (cross section, period, or cross section and period jointly, where applicable) are redundant.

of the conditioning set of variables that represent infrastructure and well being, and the joint significance of banking development and the conditioning set of variables.

A major issue in this approach to estimating growth equations such as (1), (2) and (3) is the potential endogeneity. We control for endogeneity between state level finance, infrastructure, rural well being and growth by using the system Generalized Method of Moments (GMM) estimator (proposed by Arellano and Bover, 1995). For instance, regression of equation (1) is extended into a system of panel regression as follows:

$$\gamma_{i,t} = \beta_0 y_{i,t-1} + \beta_1 \gamma_{ki,t} + \beta_2 bd_{i,t-1} + \theta_i + \zeta_t + \varepsilon_{i,t} \tag{4.1}$$

$$\begin{aligned} y_{i,t} - y_{i,t-1} = \beta_0 (y_{i,t-1} - y_{i,t-2}) + \beta_1 (k_{i,t} - k_{i,t-1}) + \beta_2 (bd_{i,t-1} - bd_{i,t-2}) \\ + \psi\left(Con_{i,t} - Con_{i,t-1}\right) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \end{aligned} \tag{4.2}$$

where ψ is the vector of parameters associated with the conditioning set of variables in the GMM estimation. A system estimator jointly estimates the regression in levels as in (4.1) and the regression in differences as in (4.2). In order to correct for endogeneity, we employ the lagged first differences of the explanatory variables as instruments for the equation in levels (4.1) and the lagged values of the explanatory variables in levels as instruments for the equation in differences (4.2). We follow the same approach for controlling for the endogeneity for equation (2) and equation (3), and for these two equations the GMM equivalent will be referred to by (5) and (6), respectively. For the GMM estimation we are assuming that the lagged differences of banking development and other conditioning set of variables (that include proxies of infrastructure and rural well-being) are good instruments for explaining subsequent levels and the lagged levels of banking development and other conditioning set of variables are good instruments for explaining subsequent first differences.

In order to test the validity of this approach, we employ the standard Sargan test (details of this test are discussed in chapter in section 2.3)[21]. In addition to the Sargan test, we also employ standard Wald test in the GMM estimations in order to test a group of hypotheses that involve the joint significance of the conditioning set of variables and the joint significance of banking development and the conditioning set of variables.

3.4 Data and variables

Data are mainly collected from online sources. In section 2.4 of Chapter 2, we have discussed the data source and some details of the data for state domestic product, its components and commercial banking at the state level. For empirical estimation of the growth regressions in this chapter, we use the same data (and processing technique) for these variables. In addition, in this chapter we use data on infrastructure, rural well being and informal sector activities. We discuss the infrastructure and informal sector related data in 3.4.1. In section 3.4.2 we discuss the proxies and data related to rural well being.

3.4.1 Data on Infrastructure and informal sector

Data on the State wise distribution of per capita electricity consumption can be found in *Infrastructure Statistics 2010*, available online in the reports section of the National Data Warehouse of MOSPI. This data is originally collected from All India Electricity Statistics, published by the Ministry of Power of the Government of India. However, the data is not for continuous years, and thus this source is not really useful for our purpose. We collect data on state wise available electricity potential and the percentage of transmission and distribution loss from the Planning Commission website for 2002-2008. For 1999-2001, we collect the same from the various issues of

[21] If the null hypothesis is true, the Sargan test statistic follows approximately chi square distribution. Failure to reject the null hypothesis would imply that the over-identifying restrictions are true, i.e. the instruments are valid. In our study, we hold the financial development indicators and the proxies for infrastructure and rural well-being as the instruments. Thus failure to reject the null hypothesis for the Sargan test would imply that these are good instruments for the GMM estimation.

the Central Electricity authority's *General Review*. We use the two series (potential electricity and percentage of loss) in order to compute the state wise actual aggregate use of electricity (figure 3.2j). We then divide this by the state wise population in order to derive per capita consumption of electricity, which we convert in kilo watts (the scale is 1 giga watt = 1000000 kilo watts).

Data on state wise rail routes (both in kms and in square kms) are available from the Infrastructure Statistics 2010 (MOSPI) for 2003-2008. For the remaining years of the sample, we collect this data from the various reports of the Ministry of Railways of the Government of India. For the regressions, we use the state wise rail routes in km per 1000 squared kms. The same data source gives us the state wise length of roads and rural roads for 2003-2008, and the remainder we collect from various reports of the Basic Road Statistics of the Ministry of Road Transport & Highways of the Government of India. For the regression, we convert the length of roads and rural roads in kms per square km using the total area of the state in square kms. Because of incompleteness of data, we cannot use telecommunication as a proxy for communication infrastructure. We use two proxies to account for informal sector and system loss. We use the percentage of electricity lost due to transmission and distribution failure in order to account for a measure of system loss. For the informal sector activity, we take the share of unregistered manufacturing sector in SDP as a proxy.

3.4.2 Data on rural well being

We use two proxies in order to account for the level of rural well being. We use the share of social sector expenditure in SDP and a measure of sanitation per square km. The state government expenditure on social sectors is available from the handbook. We use wholesale price index on all commodities to convert this series for all states and UTs into real series (at 2000 prices).

Data on sanitation is collected from the Ministry of Rural Development of the Government of India (also available in the Infrastructure Statistics 2010 of MOSPI reports). This data is the number of rural households that have access to toilet facilities. For the regression we convert this series into number of rural household per square km of the state that have access to toilet facilities.

3.4.3 Banking and other data

All banking-related data and other data are same as we have explained in chapter 2 of this thesis. As we did in chapter 2, here also we use the SDP data and the banking data to create eight proxies that account for the level of banking development in the states of India. In real terms, these are different measures of the proportion of bank deposits and credits to the measures of SDP, and therefore they account for the level of banking development from both the supply side and the demand side. For deposits, we create the indicators $BD1 = \frac{SCBDP}{SDP}, BD3 = \frac{RRBDP}{ASDP}$ and $BD7 = \frac{RRBDP}{ISDP}$, where SCBDP and RRBDP denote the real value of the total deposits of the SCBs and the RRBs, respectively. For credits, we create the indicators $BD2 = \frac{SCBCRD}{SDP}$ and $BD4 = \frac{RRBCRD}{ASDP}$, where SCBCRD and RRBCRD denote the real value of the total credits by the SCBs and the RRBs, respectively. We also create $BD5 = \frac{AGRCRD}{SDP}, BD6 = \frac{INDCRD}{SDP}$ and $BD8 = \frac{RRBCRD}{ISDP}$, where AGRCRD and INDCRD denote the real values of the agricultural credit by the SCBs and the industrial credit by the SCBs, respectively[22].

3.4.4 Summary statistics of state level data

The summary statistics of SDP and its components and the banking related data are in tables 2.4.3a and 2.4.3b of chapter 2. In this section, we present the summary statistics of the infrastructure and rural well being related data in table 3.4.4a.

[22] For the financial development indicators we use upper case letters for their actual value, while in the regressions (and in section 3.3 where we define the empirical specifications) we use lower case letters to denote their logarithmic values.

Table 3.4.4a: Summary statistics of Infrastructure and rural well being related data for the 26 states and union territories, 1999-2008.

	Rural hhs' access to toilet (*SAN*, 100000)	Road length (*ROAD*, 1000 kms)	Rural road length (*RROAD*, 1000 kms)	Rail route length (*RAILRT*, 1000 kms)	Per capita electricity (*PCE*, kwh)	Real Social Sector exp (*SS*, INR, cr)
Mean	18.02	104.53	94.08	2.41	378.70	57.80
SD	21.94	90.39	81.77	2.33	284.38	52.57
Max	139.56	345.01	331.21	8.79	1651.10	278.14
Min	0.19	0.99	0.96	0.00	38.27	0.00
Obs	260	260	260	260	260	260

	SAN	*ROAD*	*RROAD*	*PCE*	*RAILRT*	*SS*
SAN	1	0.68	0.66	0.01	0.62	0.79
ROAD	0.68	1	0.99	-0.02	0.79	0.81
RROAD	0.66	0.99	1	-0.02	0.76	0.79
PCE	0.01	-0.02	-0.02	1	0.02	0.13
RAILRT	0.62	0.79	0.76	0.02	1	0.84
SS	0.79	0.81	0.79	0.13	0.84	1

As we can see from the correlation matrix, road lengths have a negative correlation with per capita electricity consumption. A clearer picture of this negative correlation (and potentially others) can be observed if one considers the correlation between the growth rates of these variables, which show some interesting correlation properties. For instance, we find that there is negative correlation between the growth in road length and the growth in rail route length. This may be due to the fact that given the area of a state, increasing the length of roads is only possible at the cost of decreasing the other transport related infrastructure (e.g. rail route). Similarly we find that the correlation between the growth rate of transport infrastructure of any form (e.g. rail route or road length) is negatively correlated with the growth rate in the other infrastructure (e.g. electricity) and with the growth rate of the rural well being variables (e.g. social service expenditure or sanitation). This is perhaps because the trade off related to state level resources.

Table 3.4.4b: Correlation matrix of SDP growth rates and growth in rural well being proxies.

	γ	γ_{ag}	γ_m	γ_k	*ss*	*san*
γ	1	0.696	0.729	-0.007	0.012	0.252
γ_{ag}	0.696	1	0.182	-0.039	-0.015	0.053
γ_m	0.729	0.182	1	0.019	-0.060	0.276
γ_k	-0.007	-0.039	0.019	1	0.015	-0.081
ss	0.012	-0.015	-0.060	0.015	1	0.037
san	0.252	0.053	0.276	-0.081	0.037	1

Table 3.4.4c: Correlation matrix of SDP growth rates and growth in infrastructure proxies.

	γ	γ_{ag}	γ_m	γ_k	*road*	*rroad*	*rail*	*elec*
γ	1	0.711	0.735	-0.001	0.012	0.006	-0.087	0.052
γ_{ag}	0.711	1	0.157	-0.018	-0.040	-0.036	-0.061	-0.092
γ_m	0.735	0.157	1	0.044	-0.002	-0.010	-0.078	0.164
γ_k	-0.001	-0.018	0.044	1	-0.018	-0.022	0.067	0.007
road	0.012	-0.040	-0.002	-0.018	1	0.976	-0.004	-0.068
rroad	0.006	-0.036	-0.010	-0.022	0.976	1	-0.005	-0.079
rail	-0.087	-0.061	-0.078	0.067	-0.004	-0.005	1	-0.030
elec	0.052	-0.092	0.164	0.007	-0.068	-0.079	-0.030	1

We present the correlation matrix of the dependent variables and the growth in rural well being proxies in table 3.4.4b, and the correlation matrix of the dependent variables and the growth in the infrastructure proxies in table 3.4.4c. Notice that the data exhibits some interesting correlations between the growth rates of different variables. There is a 0.037 correlation coefficient between the growth in sanitation and the growth in social sector expenditures, which is as expected. The growth in road length and the growth in rural road length are strongly positively correlated, and both these growth rates are positively correlated with the growth in per capita SDP. We observe negative correlation between the growth rates of both road length and rural road length with the growth rate in per capita ASDP, which indicates the trade off of agricultural land (and labour) for paving new roads. There is a clear positive correlation between Industrial SDP growth and growth in electricity consumption, which is also as expected.

3.4.5 List of variables and key empirical hypotheses

We conduct the analysis on three sets of models using two approaches. In fixed effects panel estimation, we use growth rate in real per capita SDP, growth rate in real per capita agricultural SDP and growth rate in real per capita industrial SDP as dependent variables for model (1), (2) and (3), respectively. We do the same for model (4), (5) and (6) when we use the system GMM estimation technique. In table 3.4.5a we list all variables and their roles (and symbols) that are used in this chapter.

For all three sets of models, we use the growth in per capita capital stock as one of the regressors. We also use the (logarithm of) lagged value of per capita SDP, per capita ASDP and per capita ISDP as regressors for models (1&4), (2&5) and (3&6), respectively. In addition to these, similar to chapter 2 we use the (logarithm of) lagged values of banking development proxy and their combinations as regressors. The variables which are measured per square km (i.e. road, rural road, rail route and sanitation) are used with a squared term and with logarithms as regressors. The three ratios are used without logarithms.

Apart from the technical hypotheses (as discussed in section 3.3), we are also interested in a number of empirical hypothesis. As we did in chapter 2, here also we test the null hypothesis of zero marginal growth effect of the supply side and the demand side of banking development. In this chapter we test this only for the fixed effects panel estimations.

For the same set of estimations, we also compute the marginal growth effect of the infrastructure and the rural well being related variables that are in squared term (i.e. the ones for which we believe there is a second order effect). These are the variables which are measured per square km. In order to demonstrate the computational technique for this marginal effect, consider a (post estimation) version of (1):

$$\gamma_{i,t} = \hat{b}_0 y_{i,t-1} + \hat{b}_1 k_{i,t} + \hat{b}_2 bd_{i,t-1} + \hat{\xi}_1 rd_{i,t-1} + \hat{\xi}_2 (rd_{i,t-1})^2 + others \quad (7)$$

Table 3.4.5a: List of variables, their role and symbol used in econometric estimations.

Variable	Role	Symbol
Growth rate in real sdp/real asdp/real isdp	Dependent variables	$\gamma / \gamma_{ag} / \gamma_m$
Real sdp/real asdp /real isdp *	Lagged regressors	$y_{t-1} / y_{agt-1} / y_{mt-1}$
Growth rate in real per capita capital stock	Regressor	$\gamma_{k\,t}$
*Banking development indicator 1 (SCB deposit/SDP)**	Lagged regressor	$bd1_{t-1}$
*Banking development indicator 2 (SCB credit/SDP)**	Lagged regressor	$bd2_{t-1}$
*Banking development indicator 3 (RRB deposit/ASDP)**	Lagged regressor	$bd3_{t-1}$
*Banking development indicator 4 (RRB credit/ASDP)**	Lagged regressor	$bd4_{t-1}$
*Banking development indicator 5(AGR credit/SDP**	Lagged regressor	$bd5_{t-1}$
*Banking development indicator 6 (IND credit/SDP)**	Lagged regressor	$bd6_{t-1}$
*Banking development indicator 7 (RRB deposit/ISDP)**	Lagged regressor	$bd7_{t-1}$
*Banking development indicator 8 (RRB credit/ISDP)**	Lagged regressor	$bd8_{t-1}$
*Per capita electricity consumption**	Lagged regressor	pce_{t-1}
*Length of rail route per square km**	Lagged regressor	rl_{t-1}
*Length of road per square km**	Lagged regressor	rd_{t-1}
*Length of rural road per square km**	Lagged regressor	rrd_{t-1}
proportion of electricity lost in T&D	Regressor	$Sloss$
Proportion of unregistered manufacturing in real SDP	Regressor	$Infrm$
*No. of rural households per sq. km with access to toilets**	Lagged regressor	sn_{t-1}
Ratio of real Social sector expenditure in real SDP	Lagged regressor	SSY_{t-1}

*logarithm in regression

Notice that the marginal growth effect of the variable $rd_{i,t-1}$ in (7) is[23] $\frac{\partial \gamma_{i,t}}{\partial rd_{i,t-1}} = \hat{\xi}_1 + 2\hat{\xi}_2 rd_{i,t-1}$. The marginal growth effect of road infrastructure in this model is therefore variable, and it depends on the level of the road length for state i in period t and estimates of the two parameters ξ_1 and ξ_2. Using the same technique, we compute the marginal growth effect of sanitation, rural roads and rail network for the models where they are included. We do not compute this marginal effect for all specifications, but only do it for the specifications where either the estimated parameters for these variables are statistically significant, or the model has the best coefficient of variation or the least information criterion, or both.

For both sets of estimations (fixed effects and GMM), we test joint restrictions on a number of parameters. We test the validity of the infrastructure variables and the rural well being variables in squared terms. We also test the joint significance of banking related proxy and the social sector expenditure variable. We test if per capita electricity consumption and system loss are jointly significant as explanatory variables. We also test if all infrastructure variables and the system loss proxy are jointly statistically significant. In all these tests we use the standard Wald test.

3.5 Results from fixed effects panel estimation

For model (1), we use six specification that involve banking development indicators $bd1_{t-1}, bd2_{t-1}, bd3_{t-1}$ and $bd4_{t-1}$ and their combinations. In table 3.5.1A we summarize the results from fixed effects panel estimation of these six specifications. We report the estimated coefficient and its associated p-value (based on White cross section standard errors). All specifications are estimated using both cross section and period fixed effects. In table 2.5.1A we report the important statistics related to model selection (adjusted R^2 and Akaike Information Criterion), the F-statistic (and its associated p-value) for the overall significance of the estimated parameters, and the log of the likelihood function associated with every specifications. In the same table

[23] The variable $rd_{i,t-1}$ is the (lagged value of) logarithm of road length per square km.

we also report the Chi-square test statistics (and their associated p-values) related to the joint significance of the cross section fixed effects, the period fixed effects and the cross section and period fixed effects together.

Table 3.5.1A: Summary of Fixed effects Panel estimation of model 1, dependent variable is real per capita SDP growth.

	1(a)	*1(b)*	*1(c)*	*1(d)*	*1(e)*	*1(f)*
y_{t-1}	-0.5463 [0.000]	-0.5529 [0.000]	-0.5399 [0.000]	-0.4923 [0.000]	-0.5307 [0.000]	-0.4952 [0.000]
γ_{kt}	-0.0021 [0.341]	-0.0023 [0.430]	-0.0022 [0.468]	-0.0037 [0.302]	0.0010 [0.101]	0.0032 [0.105]
$bd1_{t-1}$	0.0186 [0.078]				0.0257 [0.006]	
$bd2_{t-1}$		0.0047 [0.455]				0.0047 [0.107]
$bd3_{t-1}$			0.0769 [0.000]		0.0808 [0.000]	
$bd4_{t-1}$				0.0510 [0.131]		0.0489 [0.106]
pce_{t-1}	0.0001 [0.007]	0.0001 [0.008]	0.0001 [0.001]	0.0001 [0.006]	0.0001 [0.005]	0.0001 [0.009]
rl_{t-1}	0.2065 [0.000]	0.1808 [0.000]	0.2909 [0.000]	0.2198 [0.000]	0.3255 [0.000]	0.2120 [0.000]
rl^2_{t-1}	-0.0176 [0.010]	-0.0151 [0.016]	-0.0225 [0.001]	-0.0161 [0.007]	-0.0262 [0.001]	-0.0158 [0.009]
rd_{t-1}	0.0004 [0.330]	0.0004 [0.344]	0.0001 [0.687]	0.0002 [0.666]	0.0002 [0.658]	0.0002 [0.620]
rd^2_{t-1}	-0.0000 [0.484]	-0.0000 [0.487]	-0.0000 [0.879]	-0.0000 [0.801]	-0.0000 [0.864]	-0.0000 [0.765]
Sloss	0.0004 [0.493]	0.0003 [0.636]	0.0004 [0.493]	0.0008 [0.263]	0.0007 [0.197]	0.0009 [0.172]
Infrm	-0.1117 [0.000]	-0.1131 [0.0000]	-0.1101 [0.000]	-0.1107 [0.000]	-0.1081 [0.000]	-0.1106 [0.000]
sn_{t-1}	0.0010 [0.052]	0.0011 [0.041]	0.0011 [0.020]	0.0011 [0.055]	0.0013 [0.027]	0.0012 [0.045]
sn^2_{t-1}	-0.00008 [0.006]	-0.00009 [0.005]	-0.00008 [0.001]	-0.00008 [0.020]	-0.00009 [0.006]	-0.00008 [0.023]
SSY_{t-1}	0.0038 [0.057]	0.0084 [0.072]	-0.0043 [0.209]	0.0002 [0.311]	0.0185 [0.015]	-0.0032 [0.328]
Observations	216	216	207	207	207	207
$\bar{R}^2$	0.533	0.526	0.563	0.535	0.578	0.534
AIC	-3.613	-3.598	-3.661	-3.598	-3.693	-3.593
ln-likelihood	469.82	468.05	440.40	433.60	444.85	434.13

Notes: p-values (based on White cross section standard errors) in parentheses. For specifications 1(a-b) we remove two states because there are no rail routes in these (Meghalaya and A&N Islands), and for specifications 1(c-f) we remove three states because there are no rail routes and RRBs in these (No RRB in Goa and A&N Islands). Cross section and period fixed effects used in all specifications.

For all six specifications, we find that the lagged per capita SDP has significant negative marginal effect on the growth of per capita SDP. However, for all specifications we find that the marginal effect of per capita capital stock growth on per capita SDP growth is insignificant. This finding is in line with our conjecture about the recent growth in SDP in Indian states; as we have discussed following the figure 2c in subsection 2.2.1 of chapter 2, the rapid development of the service sector did not contribute in the growth of per capita stock of physical capital, which is why growth in this variable is not a significant component of the growth in per capita SDP. We find that lagged SCB deposits have significant marginal effect on per capita SDP growth. The net marginal effect of SCB deposits is equal to 0.0257+0.0808=0.1065, and it is statistically significant. In every model per capita electricity has statistically significant positive net growth effect. The same holds in general for the length of rail route per square km. In all of the models informal sector has negative significant effect (as one would predict). Both rural well being proxies, access to toilets and social sector expenditure in real SDP have significant marginal effect on growth. In table 3.5.1B we present the diagnostic tests for redundancy of fixed effects. For all specifications all fixed effects are significant, so they are important and not redundant.

Table 3.5.1B: Summary of redundant fixed effects test for model 1 (null hypothesis: fixed effects are redundant).

Specification	Effects Test	Statistic (d.f.)	Prob.	Decision
1(a)	Cross Section Chi-square	167.46 (23)	0.0000	*Reject null*
	Period Chi-square	93.848 (8)	0.0000	*Reject null*
	Cross Section/Period Chi-square	210.666 (31)	0.0000	*Reject null*
1(b)	Cross Section Chi-square	164.05 (23)	0.0000	*Reject null*
	Period Chi-square	103.83 (8)	0.0000	*Reject null*
	Cross Section/Period Chi-square	208.31 (31)	0.0000	*Reject null*
1(c)	Cross Section Chi-square	171.74 (22)	0.0000	*Reject null*
	Period Chi-square	60.274 (8)	0.0000	*Reject null*
	Cross Section/Period Chi-square	205.97 (30)	0.0000	*Reject null*
1(d)	Cross Section Chi-square	154.01 (22)	0.0000	*Reject null*
	Period Chi-square	33.975 (8)	0.0000	*Reject null*
	Cross Section/Period Chi-square	187.73 (30)	0.0000	*Reject null*
1(e)	Cross Section Chi-square	179.58 (22)	0.0000	*Reject null*
	Period Chi-square	60.09 (8)	0.0000	*Reject null*
	Cross Section/Period Chi-square	210.60 (30)	0.0000	*Reject null*
1(f)	Cross Section Chi-square	154.86 (22)	0.0000	*Reject null*
	Period Chi-square	33.61 (8)	0.0000	*Reject null*
	Cross Section/Period Chi-square	187.26 (30)	0.0000	*Reject null*

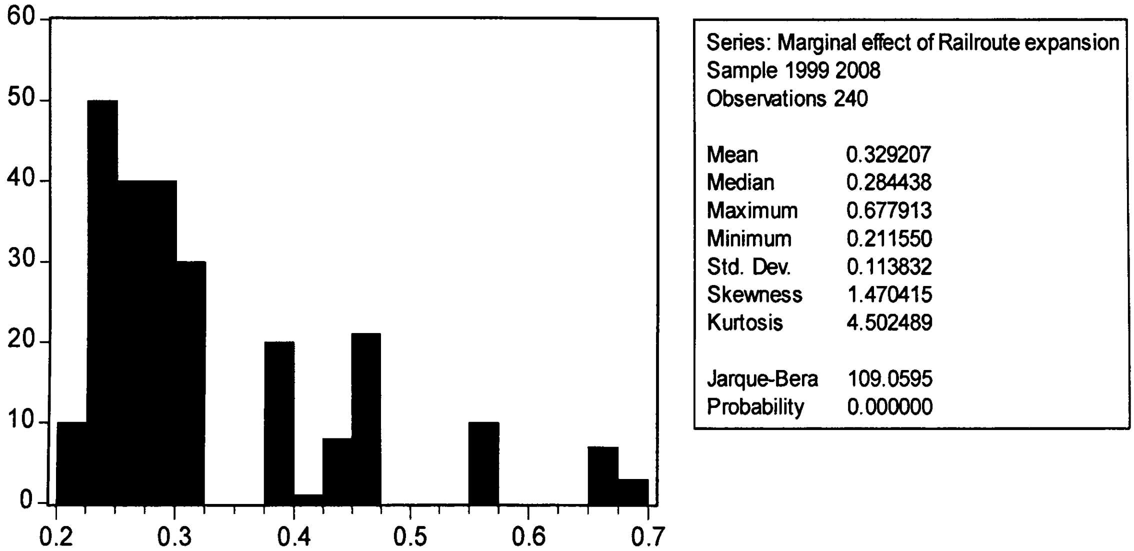
In table 3.5.1C we present the test result summary of the key hypotheses. All the squared terms are jointly significant. In 1(b) the banking development and social sector expenditure are not jointly significant. As we found in chapter 2, the growth effect of deposits is statistically significant but the growth effect of credits is not. We also find that per capita electricity and system loss in electricity are jointly statistically significant, and the same holds for all the infrastructure variables.

Table 3.5.1C: Summary of coefficient restrictions test for model 1 (F statistic [p-value]).

Null hypothesis	*1(a)*	*1(b)*	*1(c)*	*1(d)*	*1(e)*	*1(f)*
Coef. est. for rl_{t-1}, rl^2_{t-1}, rd_{t-1}, rd^2_{t-1}, sn_{t-1}, sn^2_{t-1} *are all zero*	18.60 [0.000]	23.12 [0.000]	390.54 [0.000]	61.59 [0.000]	190.01 [0.000]	33.66 [0.000]
Coef. est. for bd_{t-1} *and* SSY_{t-1} *are all zero*	2.79 [0.063]	1.953 [0.144]	25.94 [0.000]	5.778 [0.003]	16.239 [0.000]	3.374 [0.019]
Growth effect of SCB deposits is equal to zero	3.140 [0.078]	-	36.93 [0.000]	-	39.36 [0.000]	
Growth effect of SCB credits is equal to zero		0.547 [0.455]	-	2.194 [0.138]	-	2.434 [0.118]
Coef. est. for pce_{t-1} *and Sloss are both zero*	4.081 [0.018]	3.998 [0.019]	5.349 [0.005]	4.321 [0.014]	4.285 [0.015]	3.743 [0.025]
Coef. est. for rl_{t-1}, rl^2_{t-1}, rd_{t-1}, rd^2_{t-1}, pce_{t-1}, *Sloss are all zero*	17.336 [0.000]	23.451 [0.000]	269.20 [0.000]	74.41 [0.000]	41.322 [0.000]	46.052 [0.000]
All coef. est. are zero	6.798 [0.000]	6.635 [0.000]	7.305 [0.000]	6.623 [0.000]	7.559 [0.000]	6.488 [0.000]

In figure 3.5.1a we present a histogram that shows the net marginal growth effect of rail routes when we use specification 1(e). We choose this specification because this is the best model in terms of highest adjusted R squared and lowest AIC. The net marginal growth effect of rail routes is equal to 0.32, which means more rail routes positively affect growth in SDP.

Figure 3.5.1a: Histogram of marginal growth effect of rail route expansion, computed from 1(e).



The results summary of fixed effects panel estimation for model (2)'s seven specifications are reported in table 3.5.2A. The structure of the summary is as same as in table 3.5.1A. For this model, our dependent variable is the growth in per capita ASDP. We find significant negative marginal effect of the lagged per capita ASDP, and insignificant marginal effect of per capita capital stock growth for all seven specifications. Specification 2(f), where we use $bd1_{t-1}$ and $bd3_{t-1}$ together as explanatory variables, has the highest $\overline{R}^2$ and the lowest AIC. For all specifications we find statistically significant cross section and period fixed effects. Except for $bd1_{t-1}$ which represents the lagged ratio of SCB deposits to SDP, the other banking development indicators perform poorly as explanatory variables for this model. Among the infrastructure indicators only rural roads and rail routes are generally statistically significant. Among the proxies for rural well being informal sector and sanitations are generally significant. We present the diagnostic tests for redundancy of fixed effects in table 3.5.2B, and these tests validate the use of fixed effects in this estimation.

Table 3.5.2A: Summary of Fixed effects Panel estimation of model 2, dependent variable is real per capita ASDP growth.

	2(a)	*2(b)*	*2(c)*	*2(d)*	*2(e)*	*2(f)*	*2(g)*
$y_{ag,t-1}$	-0.8520 [0.000]	-0.8350 [0.000]	-0.9621 [0.000]	-0.9438 [0.000]	-0.8202 [0.000]	-0.9648 [0.000]	-0.9538 [0.000]
γ_{kt}	-0.0052 [0.809]	-0.0097 [0.684]	-0.0286 [0.304]	-0.0289 [0.296]	-0.0149 [0.582]	-0.0189 [0.331]	-0.0262 [0.239]
$bd1_{t-1}$	0.0609 [0.031]					0.0543 [0.014]	
$bd2_{t-1}$		0.0083 [0.751]					0.0075 [0.751]
$bd3_{t-1}$			-0.0484 [0.476]			-0.0297 [0.637]	
$bd4_{t-1}$				-0.0286 [0.300]			-0.0331 [0.151]
$bd5_{t-1}$					0.0148 [0.589]		
pce_{t-1}	-0.0000 [0.429]	-0.0000 [0.436]	0.000009 [0.102]	0.000009 [0.132]	-0.00005 [0.397]	0.00006 [0.242]	0.00008 [0.106]
rl_{t-1}	-0.1887 [0.429]	-0.2572 [0.121]	-0.3912 [0.027]	-0.3359 [0.092]	-0.2792 [0.132]	-0.3043 [0.047]	-0.3500 [0.057]
rl^2_{t-1}	0.0231 [0.108]	0.0296 [0.060]	0.0433 [0.005]	0.0380 [0.032]	0.0315 [0.054]	0.0347 [0.008]	0.0387 [0.025]
rrd_{t-1}	0.0011 [0.018]	0.0012 [0.011]	0.0015 [0.004]	0.0015 [0.002]	-0.0012 [0.007]	-0.0013 [0.009]	-0.0014 [0.003]
rrd^2_{t-1}	0.00002 [0.062]	0.00002 [0.057]	0.00002 [0.034]	0.00001 [0.081]	0.00002 [0.044]	0.00002 [0.043]	0.00002 [0.029]
Sloss	0.0017 [0.244]	0.0011 [0.415]	0.0009 [0.524]	0.0007 [0.602]	0.0009 [0.599]	0.0017 [0.175]	0.0009 [0.407]
Infrm	-0.1526 [0.001]	-0.1559 [0.001]	-0.1576 [0.000]	-0.1553 [0.001]	-0.1554 [0.001]	-0.1558 [0.000]	-0.1553 [0.001]
sn_{t-1}	0.0025 [0.064]	0.0025 [0.063]	0.0006 [0.095]	0.0006 [0.098]	0.0025 [0.058]	0.0010 [0.138]	0.0007 [0.194]
sn^2_{t-1}	-0.00008 [0.332]	-0.00008 [0.327]	0.00002 [0.728]	0.00002 [0.730]	-0.00008 [0.322]	0.00005 [0.537]	0.00001 [0.688]
SSY_{t-1}	0.0523 [0.072]	0.0340 [0.231]	0.0236 [0.287]	0.0278 [0.201]	0.0345 [0.241]	0.0536 [0.075]	0.0335 [0.055]
Observations	216	216	207	207	216	207	207
$\bar{R}^2$	0.499	0.482	0.548	0.547	0.482	0.560	0.546
AIC	-1.810	-1.777	-1.928	-1.925	-1.777	-1.951	-1.918
ln-likelihood	258.85	255.00	253.29	252.99	254.91	256.78	253.24

Notes: p-values (based on White cross section standard errors) in parentheses. For specifications 2(a-b) and 2(e) we remove two states because there are no rail routes in these (Meghalaya and A&N Islands), and for specifications 2(c-d) and 2(f-g) we remove three states because there are no rail routes and RRBs in these (No RRB in Goa and A&N Islands). Cross section and period fixed effects used in all specifications.

Table 3.5.2B: Summary of redundant fixed effects test for model 2 (null hypothesis: fixed effects are redundant).

Specification	Effects Test	Statistic (d.f.)	Prob.	Decision
2(a)	Cross Section Chi-square	170.03 (23)	0.0000	*Reject null*
	Period Chi-square	31.88 (8)	0.0001	*Reject null*
	Cross Section/Period Chi-square	198.15 (31)	0.0000	*Reject null*
2(b)	Cross Section Chi-square	162.26 (23)	0.0000	*Reject null*
	Period Chi-square	36.72 (8)	0.0000	*Reject null*
	Cross Section/Period Chi-square	190.89 (31)	0.0000	*Reject null*
2(c)	Cross Section Chi-square	165.67 (22)	0.0000	*Reject null*
	Period Chi-square	39.82 (8)	0.0000	*Reject null*
	Cross Section/Period Chi-square	203.44 (30)	0.0000	*Reject null*
2(d)	Cross Section Chi-square	165.98 (22)	0.0000	*Reject null*
	Period Chi-square	31.52 (8)	0.0001	*Reject null*
	Cross Section/Period Chi-square	203.30 (30)	0.0000	*Reject null*
2(e)	Cross Section Chi-square	156.50 (23)	0.0000	*Reject null*
	Period Chi-square	29.47 (8)	0.0003	*Reject null*
	Cross Section/Period Chi-square	186.58 (31)	0.0000	*Reject null*
2(f)	Cross Section Chi-square	170.91 (22)	0.0000	*Reject null*
	Period Chi-square	35.65 (8)	0.0000	*Reject null*
	Cross Section/Period Chi-square	208.93 (30)	0.0000	*Reject null*
2(g)	Cross Section Chi-square	165.98 (22)	0.0000	*Reject null*
	Period Chi-square	31.52 (8)	0.0001	*Reject null*
	Cross Section/Period Chi-square	203.12 (30)	0.0000	*Reject null*

We present the test result summary of the key hypotheses related to the results in table 3.5.2A in table 3.5.2C. Once again we find that all the squared terms are jointly significant. We find that only for 2(a) the net growth effect of commercial bank deposits is positive and statistically significant, and there is no significant marginal growth effect of credits. Electricity and system loss in electricity are not generally jointly significant in this model, but all the infrastructure variables are jointly statistically significant.

In figure 3.5.2a we present the histogram of the agricultural growth effect of rural road expansion when we use the results of 2(f). There is significant negative marginal effect on agricultural growth for expansion of rural roads, equal to -0.0011. This is potentially because expansion of rural roads requires allocation of more land which results in a drop in agricultural production. In figure 3.5.2b we present the histogram that shows the agricultural growth effect of sanitation (again using the results of specification 2(f)). It is clear that net agricultural growth effect of sanitation is positive and significant. It has a mean equal to 0.0012.

Table 3.5.2C: Summary of coefficient restrictions test for model 2 (F statistic [p-value]).

Null hypothesis	*2(a)*	*2(b)*	*2(c)*	*2(d)*	*2(e)*	*2(f)*	*2(g)*
Coef. est. for rl_{t-1}, rl^2_{t-1}, rrd_{t-1}, rrd^2_{t-1}, sn_{t-1}, sn^2_{t-1} *are all zero*	7.214 [0.000]	9.902 [0.000]	4.047 [0.000]	4.921 [0.000]	8.864 [0.000]	3.369 [0.003]	5.022 [0.000]
Coef. est. for bd_{t-1} *and* SSY_{t-1} *Are all zero*	4.743 [0.009]	0.728 [0.484]	9.947 [0.000]	1.323 [0.268]	0.769 [0.464]	11.167 [0.000]	3.750 [0.012]
Growth effect of SCB deposits is equal to zero	4.685 [0.030]	-	0.5081 [0.475]	-	-	0.2190 [0.639]	-
Growth effect of SCB credits is equal to zero	-	0.1002 [0.751]	-	1.076 [0.299]	0.2901 [0.589]	-	0.5590 [0.454]
Coef. est. for pce_{t-1} *and Sloss are both zero*	3.102 [0.047]	1.597 [0.205]	2.034 [0.134]	1.979 [0.141]	1.480 [0.230]	2.207 [0.113]	1.473 [0.232]
Coef. est. for rl_{t-1}, rl^2_{t-1}, rrd_{t-1}, rrd^2_{t-1}, pce_{t-1}, *Sloss are all zero*	17.433 [0.000]	19.797 [0.000]	11.813 [0.000]	31.046 [0.000]	20.972 [0.000]	9.768 [0.000]	9.728 [0.000]
All coef. est. are zero	6.049 [0.000]	5.722 [0.000]	6.947 [0.000]	6.917 [0.000]	5.914 [0.000]	7.098 [0.000]	6.748 [0.000]

Figure 3.5.2a: Histogram of marginal agricultural growth effect of rural road expansion, computed from 2(f).

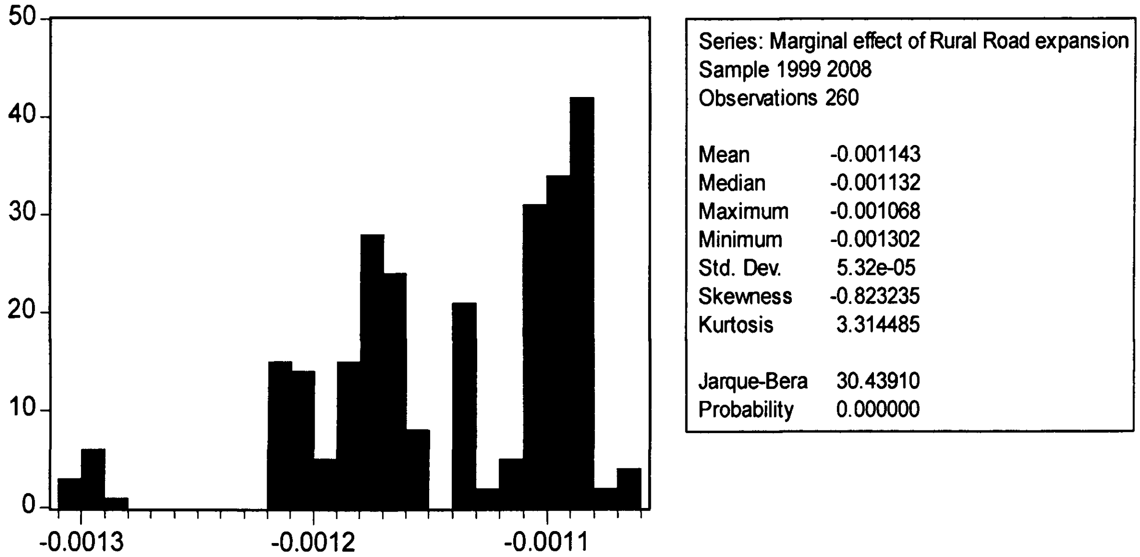
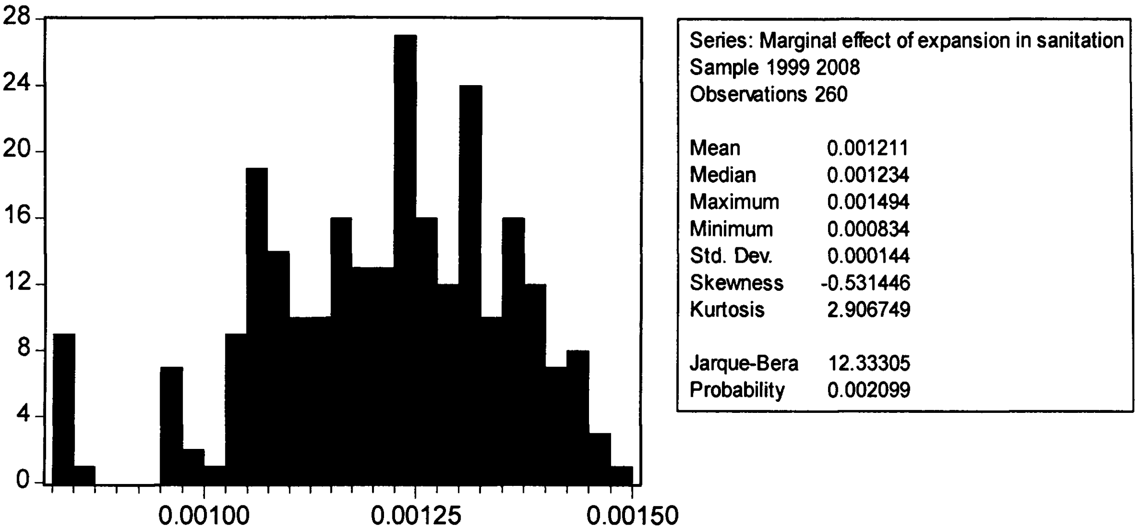


Figure 3.5.2b: Histogram of marginal agricultural growth effect of more sanitation, computed from 2(f).



The summary of results from fixed effects panel estimation of model (3), for which our dependent variable is growth in per capita ISDP, is reported in table 3.5.3A. The fixed effects redundancy tests summary and hypotheses test summary are in table 3.5.3B and 3.5.3C, respectively. For this model, specification 3(b) has the highest $\overline{R}^2$ and the lowest AIC. For all specifications the cross section and the period fixed effects are statistically significant. For this model, we find that the marginal effect of SCB deposits on growth of industries is positive and statistically significant at the 10% level for specification 3(b) and 3(g). Among the infrastructure indicators only rail routes are generally statistically significant. Same holds for informal sector and the second order effect of sanitation.

From table 3.5.3C we can conclude that all the squared terms are jointly significant, and only for 3(b) marginal industrial growth effect of credit is positive and statistically significant. Electricity and system loss in electricity are not jointly significant, and except for 3(a) all the infrastructure variables are jointly statistically significant. We present the histograms of marginal industrial growth effect of rail expansion and road expansion in figures 3.5.3a and 3.5.3b, respectively. These show that both such expansions can positively affect growth in industrial output.

Table 3.5.3A: Summary of Fixed effects Panel estimation of model 3, dependent variable is real per capita ISDP growth.

	3(a)	*3(b)*	*3(c)*	*3(d)*	*3(e)*	*3(f)*	*3(g)*
y_{mt-1}	-0.2888 [0.000]	-0.2975 [0.000]	-0.2841 [0.000]	-0.2629 [0.000]	-0.2878 [0.000]	-0.2837 [0.000]	-0.2826 [0.000]
γ_{kt}	0.0034 [0.067]	0.0041 [0.108]	0.0025 [0.278]	0.0031 [0.273]	0.0024 [0.299]	0.0053 [0.562]	0.0068 [0.432]
$bd1_{t-1}$	0.0127 [0.204]					0.0151 [0.148]	
$bd2_{t-1}$		0.0079 [0.059]					0.0098 [0.007]
$bd7_{t-1}$			-0.0222 [0.087]			-0.0173 [0.269]	
$bd8_{t-1}$				0.0127 [0.592]			0.0065 [0.791]
$bd6_{t-1}$					0.0035 [0.696]		
pce_{t-1}	0.00005 [0.133]	0.00006 [0.140]	0.00003 [0.430]	0.00004 [0.302]	0.00005 [0.150]	0.00002 [0.165]	0.00003 [0.415]
rl_{t-1}	0.2420 [0.012]	0.2106 [0.023]	0.2005 [0.054]	0.2417 [0.020]	0.2321 [0.010]	0.2227 [0.059]	0.2209 [0.053]
rl^2_{t-1}	-0.0222 [0.015]	-0.0200 [0.021]	-0.0187 [0.041]	-0.0214 [0.013]	-0.0211 [0.014]	-0.0210 [0.044]	-0.0204 [0.030]
rd_{t-1}	0.0001 [0.058]	0.0002 [0.109]	0.0001 [0.171]	0.00009 [0.487]	0.0001 [0.294]	0.0001 [0.327]	0.0001 [0.135]
rd^2_{t-1}	-0.00001 [0.180]	-0.00002 [0.274]	-0.00000 [0.866]	-0.00000 [0.882]	-0.00000 [0.858]	-0.00000 [0.902]	-0.00000 [0.853]
Sloss	-0.00007 [0.851]	-0.00008 [0.844]	-0.0001 [0.748]	-0.0001 [0.799]	-0.0002 [0.568]	0.00009 [0.804]	0.0001 [0.748]
Infrm	-0.0592 [0.000]	-0.0599 [0.000]	-0.0621 [0.000]	-0.0622 [0.000]	-0.0603 [0.000]	-0.0615 [0.000]	-0.0626 [0.000]
sn_{t-1}	0.0004 [0.256]	0.0004 [0.199]	0.0004 [0.405]	0.0004 [0.339]	0.0004 [0.183]	0.0005 [0.203]	0.0006 [0.202]
sn^2_{t-1}	-0.00005 [0.022]	-0.00005 [0.016]	-0.00005 [0.066]	-0.00005 [0.073]	-0.00005 [0.011]	-0.00006 [0.058]	-0.00006 [0.046]
SSY_{t-1}	0.0112 [0.269]	0.0108 [0.102]	0.0159 [0.079]	0.0089 [0.409]	0.0141 [0.212]	0.0075 [0.223]	0.0020 [0.289]
Observations	216	216	207	207	216	207	207
$\overline{R}^2$	0.486	0.489	0.473	0.471	0.480	0.479	0.483
AIC	-3.874	-3.880	-3.889	-3.886	-3.863	-3.898	-3.904
ln-likelihood	500.35	500.99	465.11	464.68	499.01	467.02	467.66

Notes: p-values (based on White cross section standard errors) in parentheses. For specifications 3(a-b) and 3(e) we remove two states because there are no rail routes in these (Meghalaya and A&N Islands), and for specifications 3(c-d) and 3(f-g) we remove three states because there are no rail routes and RRBs in these (No RRB in Goa and A&N Islands). Cross section and period fixed effects used in all specifications.

Table 3.5.3B: Summary of redundant fixed effects test for model 3 (null hypothesis: fixed effects are redundant).

Specification	Effects Test	Statistic (d.f.)	Prob.	Decision
3(a)	Cross Section Chi-square	110.89 (23)	0.0000	*Reject null*
	Period Chi-square	103.16 (8)	0.0001	*Reject null*
	Cross Section/Period Chi-square	177.23 (31)	0.0000	*Reject null*
3(b)	Cross Section Chi-square	112.10 (23)	0.0000	*Reject null*
	Period Chi-square	108.18 (8)	0.0000	*Reject null*
	Cross Section/Period Chi-square	178.02 (31)	0.0000	*Reject null*
3(c)	Cross Section Chi-square	104.93 (22)	0.0000	*Reject null*
	Period Chi-square	72.58 (8)	0.0000	*Reject null*
	Cross Section/Period Chi-square	158.90 (30)	0.0000	*Reject null*
3(d)	Cross Section Chi-square	101.14 (22)	0.0000	*Reject null*
	Period Chi-square	49.30 (8)	0.0001	*Reject null*
	Cross Section/Period Chi-square	153.25 (30)	0.0000	*Reject null*
3(e)	Cross Section Chi-square	106.68 (23)	0.0000	*Reject null*
	Period Chi-square	114.09 (8)	0.0003	*Reject null*
	Cross Section/Period Chi-square	176.53 (31)	0.0000	*Reject null*
3(f)	Cross Section Chi-square	108.66 (22)	0.0000	*Reject null*
	Period Chi-square	67.82 (8)	0.0000	*Reject null*
	Cross Section/Period Chi-square	159.35 (30)	0.0000	*Reject null*
3(g)	Cross Section Chi-square	106.75 (22)	0.0000	*Reject null*
	Period Chi-square	50.38 (8)	0.0001	*Reject null*
	Cross Section/Period Chi-square	155.49 (30)	0.0000	*Reject null*

Table 3.5.3C: Summary of coefficient restrictions test for model 3 (F statistic [p-value]).

Null hypothesis	*3(a)*	*3(b)*	*3(c)*	*3(d)*	*3(e)*	*3(f)*	*3(g)*
Coef. est. for rl_{t-1}, rl^2_{t-1}, rd_{t-1}, rd^2_{t-1}, sn_{t-1}, sn^2_{t-1} *are all zero*	5.269 [0.000]	5.429 [0.000]	15.143 [0.000]	14.810 [0.000]	4.362 [0.000]	8.537 [0.000]	9.970 [0.000]
Coef. est. for bd_{t-1} *and* SSY_{t-1} *are all zero*	3.442 [0.034]	3.632 [0.028]	1.690 [0.187]	3.182 [0.043]	2.424 [0.091]	3.220 [0.024]	3.397 [0.019]
Growth effect of SCB deposits is equal to zero	1.618 [0.203]	-	2.959 [0.085]	-	-	0.008 [0.925]	-
Growth effect of SCB credits is equal to zero	-	3.594 [0.058]	-	0.287 [0.591]	0.152 [0.695]	-	0.426 [0.513]
Coef. est. for pce_{t-1} *and Sloss are both zero*	1.157 [0.316]	1.121 [0.328]	0.324 [0.723]	0.561 [0.571]	1.043 [0.354]	0.401 [0.669]	0.488 [0.614]
Coef. est. for rl_{t-1}, rl^2_{t-1}, rd_{t-1}, rd^2_{t-1}, pce_{t-1}, *Sloss are all zero*	1.546 [0.165]	1.879 [0.086]	2.782 [0.013]	3.850 [0.001]	4.825 [0.000]	2.012 [0.066]	3.262 [0.004]
All coef. est. are zero	5.793 [0.000]	5.847 [0.000]	5.399 [0.000]	5.362 [0.000]	5.681 [0.000]	5.409 [0.000]	5.464 [0.000]

Figure 3.5.3a: Histogram of marginal industrial growth effect of rail route expansion, computed from 3(b).

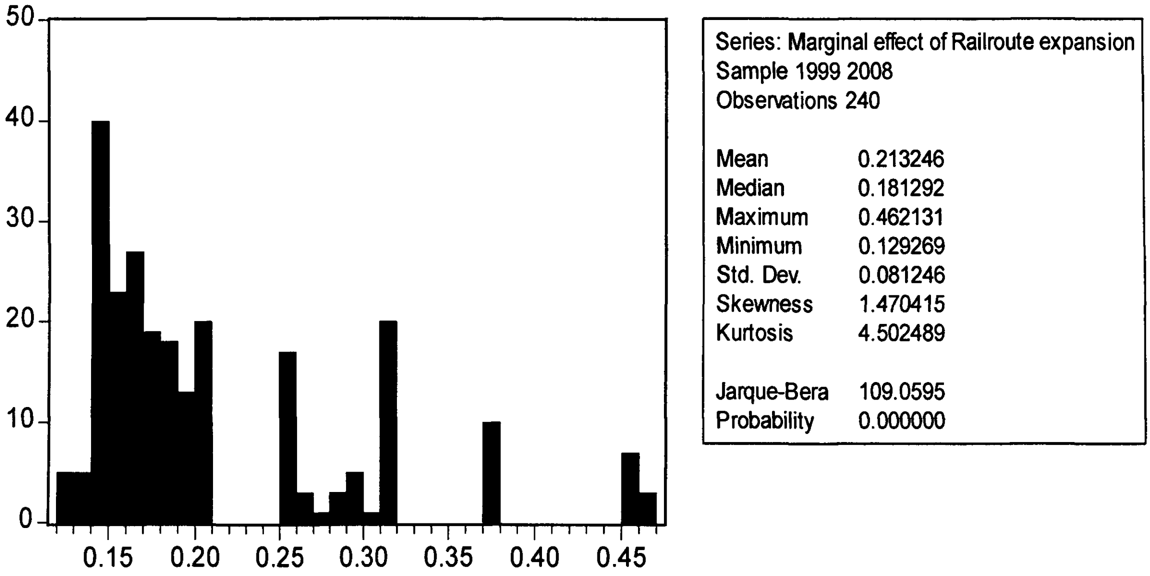
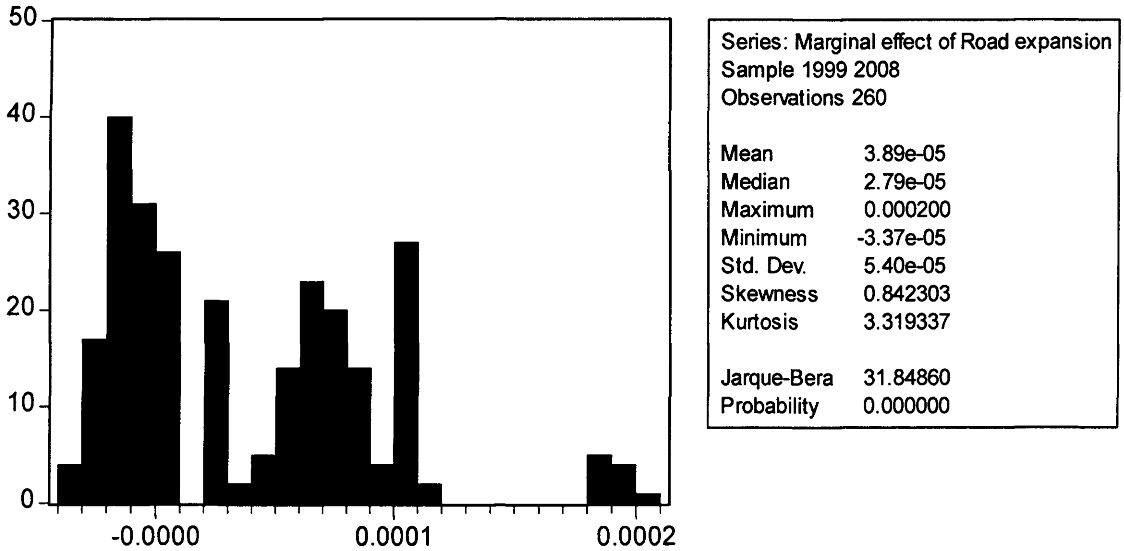


Figure 3.5.3b: Histogram of marginal industrial growth effect of road expansion, computed from 3(b).



3.6 Results from GMM estimation

In this section we discuss the results from system GMM estimation of models (4), (5) and (6). The system GMM estimation is a dynamic panel estimation where we set the explanatory variables as instruments, and test whether these instruments are the correct choice.

Table 3.6.1A: Summary of GMM estimation of model 4, dependent variable is real per capita SDP growth.

	4(a)	*4(b)*	*4(c)*	*4(d)*	*4(e)*	*4(f)*
y_{t-1}	-0.8637 [0.000]	-0.8624 [0.000]	-0.8519 [0.000]	-0.8660 [0.000]	-0.8471 [0.000]	-0.8356 [0.000]
γ_{kt}	0.0015 [0.109]	0.0012 [0.105]	0.0019 [0.445]	0.0015 [0.566]	0.0026 [0.110]	0.0021 [0.106]
$bd1_{t-1}$	0.0189 [0.000]				0.0178 [0.000]	
$bd2_{t-1}$		0.0035 [0.361]				0.0031 [0.215]
$bd3_{t-1}$			0.0380 [0.076]		0.0349 [0.101]	
$bd4_{t-1}$				-0.0088 [0.635]		-0.0072 [0.512]
pce_{t-1}	-0.0000 [0.298]	-0.0000 [0.697]	-0.0000 [0.670]	-0.0000 [0.719]	-0.0000 [0.588]	-0.0000 [0.423]
rl_{t-1}	0.2138 [0.085]	0.2049 [0.089]	0.2142 [0.097]	0.1968 [0.102]	0.2123 [0.099]	0.2029 [0.078]
rl^2_{t-1}	-0.0186 [0.094]	-0.0181 [0.095]	-0.0184 [0.119]	-0.0171 [0.129]	-0.0181 [0.121]	-0.0113 [0.106]
rd_{t-1}	-0.0001 [0.662]	-0.0001 [0.631]	-0.0002 [0.541]	-0.0001 [0.689]	-0.0002 [0.611]	-0.0001 [0.513]
rd^2_{t-1}	0.00000 [0.449]	0.00000 [0.434]	0.00000 [0.309]	0.00000 [0.435]	0.00000 [0.359]	0.00000 [0.419]
Sloss	0.0001 [0.712]	0.0002 [0.653]	0.0004 [0.310]	0.0004 [0.287]	0.0003 [0.361]	0.0001 [0.561]
Infrm	-0.1594 [0.000]	-0.1592 [0.000]	-0.1560 [0.000]	-0.1566 [0.000]	-0.1560 [0.000]	-0.1591 [0.000]
sn_{t-1}	0.0020 [0.037]	0.0020 [0.041]	0.0022 [0.029]	0.0021 [0.034]	0.0023 [0.023]	0.0023 [0.016]
sn^2_{t-1}	-0.00001 [0.030]	-0.00001 [0.031]	-0.00001 [0.025]	-0.00001 [0.026]	-0.00001 [0.023]	-0.00001 [0.020]
SSY_{t-1}	0.0105 [0.285]	0.0100 [0.210]	-0.0028 [0.709]	0.0089 [0.042]	-0.0033 [0.767]	0.0101 [0.164]
Observations	182	182	168	168	168	168
Instr. Rank	48	48	48	48	49	49
J-statistic	28.775	30.295	31.383	32.021	25.553	31.484
[p-value]	[0.371]	[0.301]	[0.255]	[0.231]	[0.334]	[0.251]
Sum squared residuals	0.157	0.159	0.141	0.144	0.139	0.143

Notes: p-values (based on White cross section standard errors) in parentheses. 2SLS weighing matrix. Period fixed effects used in all specifications.

A summary of results from the GMM estimation of model (4) is presented in table 3.6.1A. For all specifications, based on the Sargan test we fail to reject the null hypothesis that the instruments as a group are exogenous, i.e. they are valid instruments. As we found earlier in model (1) estimations using fixed effects panel method, the GMM estimation of model (4) also suggests that lagged per capita SDP has significant negative effect while growth in per capita capital stock has insignificant effect of growth of per capita output. We find that in the GMM estimation of model (4), the coefficient estimates for $bd1_{t-1}$ is positive and statistically significant at the 5% level. Given specification 4(a), this finding is consistent with the findings of specifications 1(a), i.e. the aggregate SCB deposits have a strictly positive and significant impact on growth of per capita SDP. The coefficient estimates for the banking development indicators in specifications 4(c) and 4(d), i.e. the ones that include RRB deposits and credits, are statistically insignificant. Among the infrastructure indicators rail routes, per capita electricity and roads all are insignificant. Among rural development indicators sanitation has positive and significant effect in all six specifications and informal sector has negative and significant effect.

Table 3.6.1B: Summary of coefficient restrictions test for model 4 (F statistic [p-value]).

Null hypothesis	*4(a)*	*4(b)*	*4(c)*	*4(d)*	*4(e)*	*4(f)*
Coef. est. for rl_{t-1}, rl^2_{t-1}, rd_{t-1}, rd^2_{t-1}, sn_{t-1}, sn^2_{t-1} *are all zero*	2.266 [0.039]	1.713 [0.121]	3.284 [0.004]	2.603 [0.019]	3.483 [0.003]	2.466 [0.026]
Coef. est. for bd_{t-1} *and* SSY_{t-1} *are all zero*	1.874 [0.156]	1.811 [0.166]	2.064 [0.130]	0.332 [0.717]	22.90 [0.000]	2.492 [0.062]
Coef. est. for pce_{t-1} *and Sloss are both zero*	0.117 [0.889]	0.104 [0.900]	0.547 [0.579]	0.587 [0.557]	0.477 [0.621]	0.573 [0.564]
Coef. est. for rl_{t-1}, rl^2_{t-1}, rd_{t-1}, rd^2_{t-1}, pce_{t-1}, *Sloss are all zero*	1.161 [0.329]	1.021 [0.413]	2.026 [0.065]	1.641 [0.139]	2.120 [0.054]	1.582 [0.156]

In table 3.6.1B we present the results summary of all the diagnostic tests. We find that all the squared terms are generally jointly significant. Only for 4(e) we find that $bd1_{t-1}$ and SSY_{t-1} are jointly statistically significant. For the same specification we find that the infrastructure related variables jointly significantly affect growth.

Table 3.6.2A: Summary of GMM estimation of model 5, dependent variable is real per capita ASDP growth.

	5(a)	*5(b)*	*5(c)*	*5(d)*	*5(e)*	*5(f)*	*5(g)*
y_{agt-1}	-1.2958 [0.000]	-1.2964 [0.000]	-1.3526 [0.000]	-1.4323 [0.000]	-1.2838 [0.000]	-1.3543 [0.000]	-1.4400 [0.000]
γ_{kt}	-0.0063 [0.720]	-0.0110 [0.516]	-0.0193 [0.148]	-0.0194 [0.121]	-0.0147 [0.334]	-0.0143 [0.241]	-0.0177 [0.126]
$bd1_{t-1}$	0.0405 [0.040]					0.0350 [0.029]	
$bd2_{t-1}$		0.0010 [0.245]					0.0037 [0.346]
$bd3_{t-1}$			0.0155 [0.174]			0.0119 [0.098]	
$bd4_{t-1}$				0.0869 [0.022]			0.0891 [0.030]
$bd5_{t-1}$					0.0190 [0.095]		
pce_{t-1}	-0.00000 [0.565]	-0.00000 [0.568]	0.00005 [0.106]	0.00006 [0.113]	-0.00000 [0.277]	0.00007 [0.109]	0.00006 [0.167]
rl_{t-1}	0.0551 [0.817]	0.0525 [0.625]	0.0204 [0.516]	0.0098 [0.661]	0.0358 [0.277]	0.0193 [0.399]	0.0004 [0.891]
rl^2_{t-1}	-0.0091 [0.640]	-0.0095 [0.423]	-0.0063 [0.466]	-0.0063 [0.456]	-0.0084 [0.455]	-0.0057 [0.496]	-0.0056 [0.467]
rrd_{t-1}	-0.0007 [0.090]	-0.0007 [0.096]	-0.0009 [0.081]	-0.0008 [0.127]	-0.0008 [0.108]	-0.0009 [0.099]	-0.0008 [0.134]
rrd^2_{t-1}	0.00002 [0.050]	0.00002 [0.049]	0.00002 [0.044]	0.00002 [0.066]	0.00002 [0.032]	0.00002 [0.083]	0.00002 [0.074]
Sloss	0.0005 [0.583]	0.0006 [0.536]	0.0008 [0.481]	0.0006 [0.544]	0.0005 [0.599]	0.0007 [0.516]	0.0006 [0.543]
Infrm	-0.2762 [0.000]	-0.2675 [0.000]	-0.2686 [0.000]	-0.2656 [0.000]	-0.2649 [0.000]	-0.2683 [0.000]	-0.2652 [0.000]
sn_{t-1}	0.0035 [0.018]	0.0034 [0.025]	0.0022 [0.104]	0.0022 [0.105]	0.0035 [0.028]	0.0024 [0.100]	0.0022 [0.109]
sn^2_{t-1}	-0.00001 [0.065]	-0.00001 [0.080]	-0.00008 [0.297]	-0.00008 [0.271]	-0.00001 [0.084]	-0.00009 [0.127]	-0.00008 [0.253]
SSY_{t-1}	0.00001 [0.165]	0.0036 [0.191]	-0.0317 [0.402]	-0.0106 [0.273]	0.0020 [0.349]	0.0339 [0.092]	-0.0111 [0.325]
Observations	182	182	168	168	182	168	168
Instrument Rank	48	48	48	48	48	49	49
J-statistic [p-value]	40.285 [0.048]	41.829 [0.034]	34.769 [0.144]	34.842 [0.142]	41.330 [0.038]	33.173 [0.191]	34.522 [0.151]
Sum squared residuals	1.200	1.213	0.815	0.799	1.210	0.806	0.799

Notes: p-values (based on White cross section standard errors) in parentheses. 2SLS weighing matrix. Period fixed effects used in all specifications.

In table 3.6.2A and table 3.6.2B we report the summaries of the GMM estimation results for model (5) and its related diagnostic tests. The dependent variables is the growth in real per capita agricultural output. Based on the Sargan test for all specification in table 3.6.2A, we fail to reject the null hypothesis concerning the validity of over identifying restrictions in these estimations. The Sargan tests therefore validate the choice of instruments for all specifications. As we found before, we find significant negative impact of lagged per capita agricultural SDP and insignificant impact of growth in per capita capital stock on the growth in per capita agricultural SDP. The coefficient estimate for aggregate SCB deposits is statistically significant at the 10% level for specifications 5(a) and 5(f), while that of aggregate SCB credits are statistically insignificant for specifications 5(b) and 5(g). The coefficient estimates for $bd3_{t-1}$ that concerns SCB deposits in RRBs is insignificant in specification 5(c), and only marginally significant in specification 5(f). The SCB credits that are channelled through RRBs however have significant impact on the growth of per capita ASDP, as confirmed by the estimations of specifications 5(d) and 5(g). Priority sector lending to agriculture by SCBs have marginal significant impact on the growth of per capita ASDP, as can be seen in specification 5(e). Except rural roads in squared term in 5(a) and 5(d), all other infrastructure indicators are insignificant. Informal sector has negative and significant effect in all models. Sanitation has positive and significant effect in 5(a), 5(b) and 5(e).

Table 3.6.2B: Summary of coefficient restrictions test for model 5 (F statistic [p-value]).

Null hypothesis	*5(a)*	*5(b)*	*5(c)*	*5(d)*	*5(e)*	*5(f)*	*5(g)*
Coef. est. for rl_{t-1}, rl^2_{t-1}, rrd_{t-1}, rrd^2_{t-1}, sn_{t-1}, sn^2_{t-1} *are all zero*	1.914 [0.081]	1.752 [0.112]	1.003 [0.425]	0.9001 [0.496]	1.785 [0.100]	1.055 [0.392]	0.885 [0.507]
Coef. est. for bd_{t-1} *and* SSY_{t-1} *are all zero*	2.147 [0.120]	0.010 [0.988]	0.738 [0.479]	5.370 [0.005]	2.326 [0.071]	2.942 [0.035]	2.476 [0.063]
Coef. est. for pce_{t-1} *and Sloss are both zero*	0.489 [0.613]	0.544 [0.581]	0.312 [0.732]	0.237 [0.789]	0.465 [0.628]	0.275 [0.759]	0.243 [0.784]
Coef. est. for rl_{t-1}, rl^2_{t-1}, rrd_{t-1}, rrd^2_{t-1}, pce_{t-1}, *Sloss are all zero*	1.154 [0.333]	1.121 [0.352]	1.137 [0.343]	1.070 [0.383]	1.210 [0.303]	1.066 [0.385]	1.052 [0.393]

Table 3.6.3A: Summary of GMM estimation of model 6, dependent variable is real per capita ISDP growth.

	6(a)	*6(b)*	*6(c)*	*6(d)*	*6(e)*	*6(f)*	*6(g)*
y_{mt-1}	-0.6560 [0.000]	-0.6209 [0.000]	-0.6500 [0.000]	-0.6453 [0.000]	-0.6553 [0.000]	-0.6502 [0.000]	-0.6122 [0.000]
γ_{kt}	0.0064 [0.063]	0.0096 [0.092]	0.0024 [0.079]	0.0030 [0.164]	0.0056 [0.343]	0.0043 [0.520]	0.0086 [0.143]
$bd1_{t-1}$	0.0113 [0.007]					0.0010 [0.009]	
$bd2_{t-1}$		0.0105 [0.035]					0.0113 [0.032]
$bd7_{t-1}$			-0.0244 [0.446]			-0.0262 [0.401]	
$bd8_{t-1}$				0.0045 [0.579]			0.0008 [0.459]
$bd6_{t-1}$					0.0065 [0.065]		
pce_{t-1}	-0.00001 [0.753]	-0.00001 [0.665]	-0.00003 [0.540]	-0.00003 [0.518]	-0.00001 [0.707]	-0.00003 [0.515]	-0.00003 [0.423]
rl_{t-1}	0.2228 [0.103]	0.1995 [0.117]	0.1923 [0.155]	0.2027 [0.147]	0.2237 [0.123]	0.1898 [0.160]	0.1757 [0.140]
rl^2_{t-1}	-0.0175 [0.224]	-0.0159 [0.215]	-0.0150 [0.255]	-0.0156 [0.247]	-0.0178 [0.212]	-0.0146 [0.267]	-0.0135 [0.257]
rd_{t-1}	-0.0003 [0.320]	-0.0003 [0.361]	-0.0004 [0.245]	-0.0004 [0.229]	-0.0004 [0.229]	-0.0003 [0.297]	-0.0003 [0.343]
rd^2_{t-1}	0.000009 [0.097]	0.000008 [0.099]	0.000001 [0.094]	0.000001 [0.094]	0.00001 [0.127]	0.000001 [0.090]	0.000003 [0.094]
Sloss	-0.00005 [0.099]	-0.00002 [0.167]	-0.00007 [0.089]	-0.00006 [0.096]	-0.00005 [0.098]	-0.0001 [0.097]	-0.00007 [0.081]
Infrm	-0.0647 [0.000]	-0.0636 [0.000]	-0.0689 [0.000]	-0.0696 [0.000]	-0.0656 [0.000]	-0.0679 [0.000]	-0.0669 [0.000]
sn_{t-1}	0.0013 [0.102]	0.0013 [0.119]	0.0013 [0.192]	0.0013 [0.187]	0.0012 [0.210]	0.0014 [0.183]	0.0014 [0.186]
sn^2_{t-1}	-0.00008 [0.243]	-0.00008 [0.265]	-0.00008 [0.220]	-0.00008 [0.218]	-0.00008 [0.243]	-0.00009 [0.216]	-0.00008 [0.233]
SSY_{t-1}	0.0394 [0.000]	0.0367 [0.000]	0.0417 [0.000]	0.0344 [0.006]	0.0384 [0.000]	0.0414 [0.008]	0.0305 [0.004]
Observations	182	182	168	168	182	168	168
Instrument Rank	48	48	48	48	48	49	49
J-statistic [p-value]	21.423 [0.766]	21.830 [0.745]	24.978 [0.575]	25.243 [0.560]	21.330 [0.770]	24.988 [0.575]	25.216 [0.562]
Sum squared residuals	0.178	0.174	0.151	0.152	0.179	0.150	0.149

Notes: p-values (based on White cross section standard errors) in parentheses. 2SLS weighing matrix. Period fixed effects used in all specifications.

The GMM estimation results summary for model (6) is presented in Table 3.6.3A. Dependent variable for this estimation is the growth in per capita industrial SDP. Except for the growth in per capita capital stock and the marginal effect of industrial credit by SCBs, the findings are generally similar to the findings of fixed effects panel estimation of model (3). The Sargan tests for all seven specifications once again confirm the validity of the instruments and the approach. The lagged per capita ISDP has a significant negative impact on growth of per capita ISDP for all specifications.

The coefficient estimates for $bd1_{t-1}$ and $bd2_{t-1}$ are positive and statistically significant for all the specifications where these are used as explanatory variables. The coefficient estimates that are related to RRB credits are statistically insignificant. For specification 6(e) we find significant (at the 10% level) positive marginal growth effect of priority sector industrial credit, where the effect is equal to 0.006. Thus except for the significant marginal effect of priority sector lending in industry, the findings are generally similar to those of model (3). Results related to infrastructure indicators and rural development are same as we have got in fixed effect estimation case.

Table 3.6.3B: Summary of coefficient restrictions test for model 6 (F statistic [p-value]).

Null hypothesis	*6(a)*	*6(b)*	*6(c)*	*6(d)*	*6(e)*	*6(f)*	*6(g)*
Coef. est. for rl_{t-1}, rl^2_{t-1}, rd_{t-1}, rd^2_{t-1}, sn_{t-1}, sn^2_{t-1} *are all zero*	1.118 [0.353]	0.898 [0.496]	1.116 [0.355]	1.150 [0.335]	1.220 [0.298]	1.171 [0.324]	0.942 [0.466]
Coef. est. for fd_{t-1} *and* SSY_{t-1} *are all zero*	8.998 [0.000]	10.444 [0.000]	5.159 [0.006]	4.059 [0.019]	7.842 [0.000]	3.111 [0.028]	2.757 [0.044]
Coef. est. for pce_{t-1} *and Sloss are both zero*	0.061 [0.940]	0.102 [0.902]	0.211 [0.809]	0.226 [0.797]	0.083 [0.919]	0.248 [0.780]	0.350 [0.704]
Coef. est. for rl_{t-1}, rl^2_{t-1}, rd_{t-1}, rd^2_{t-1}, pce_{t-1}, *Sloss are all zero*	1.159 [0.330]	1.042 [0.399]	1.097 [0.366]	1.001 [0.427]	1.360 [0.233]	1.070 [0.383]	0.777 [0.588]

3.7 Conclusion

In this chapter we use a standard growth accounting approach in order to examine the relationship between banking development, infrastructure, rural well being and local economic growth in India in a sample of 26 states and union territories (UTs) over the period 1999-2008. Our regressions show that there is clear evidence of growth effects of development in commercial and rural banking and development in infrastructure and rural well being. For banking development in India, the state level growth effects are generally same as we found in chapter 2 where we used a reduced form approach in examining the banking development-growth nexus. Similar to the findings in chapter 2, in this chapter we find that deposits of commercial banks in general have a significant positive impact on the growth of per capita SDP, but domestic savings and mobilization of domestic savings through commercial banks do not significantly affect the state level growth in the agricultural component of SDP. The marginal growth effect of SCB credits is mixed. Credits that are channelled through rural banks positively affect the growth in the agricultural and industrial components of per capita SDP.

The new findings in this chapter include the marginal growth effects of infrastructure and rural well being in India. We find that among the infrastructure indicators roads and rail routes in general have positive and significant effect on the growth of per capita SDP. Expansion in rural roads can negatively affect the growth in agriculture apparently because of the trade off associated with agricultural land. We also find that expansion of the informal sector has negative significant effect on growth. Rural well being generally has positive and significant effect on growth. These results suggest that in order to harvest the benefits of rural banking development in India there is a need to emphasize the role of development in the infrastructure and rural well being.

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