Financial Development and Total Factor Productivity:

Evidence from India's manufacturing sector

Zhenhui Xu

College of Business, CBX 14
Georgia College & State University
Milledgeville, GA 31061
Phone: 478 – 445 – 4102
Fax: 478 – 445 – 1535
Email: zhenhui.xu@gcsu.edu

Sudeshna Pal

College of Business, CBX 14
Georgia College & State University
Milledgeville, GA 31061
Phone: 478 – 445 –1240
Fax: 478 – 445 –1535
Email: sudeshna.pal@gcsu.edu

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Abstract

Financial development is widely believed to promote productivity growth. In this paper we use firm data to study the effects of financial development on total factor productivity of India's manufacturing sector between 1990 and 2008. We find evidence that financial development has significantly enhanced firm-level TFP in the sector. The evidence is stronger when micro indicators of financial development are used. The firms in Indian private sector need better access to the banking system, while the firms in the government sector and the foreign sector reveal the need for accessing the capital market. Our results suggest that policies favoring financial development in India should be pursued further in order for the largest democracy in the world to advance its economic growth.

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I. Introduction

There is a large literature on the relationship between finance and economic growth. Numerous studies identify productivity as the main channel through which finance affects economic growth. The idea of financial development affecting productivity can be traced back to Bagehot (1873) and Schumpeter (1912). Many economists believe that financial development is a critical element of growth (e.g., Goldsmith 1969; McKinnon 1973; Shaw 1973; Fry 1978, 1988; Bencivenga and Smith 1991; King and Levine 1993a, 1993b; Levine 2005). Repressive financial systems hinder financial development and result in misallocation of resources, which in turn lower productivity and reduce growth. As the financial system develops, overall economic productivity improves through efficient reallocations of scarce resources from firms with low productivity to those with promising growth prospects.[1]

Studies using cross-country aggregate data tend to find positive effects of various measures of financial development on growth. For example, Beck, Levine and Loayza (2000) and Levine and Zervos (1998) show that financial development has positive and significant effects on total factor productivity (TFP). Empirical evidence at the aggregate level provides support for the notion that financial development promotes productivity. Benhabib and Spiegel (2000) decomposes the relationship between financial development and growth to examine whether financial development affects growth solely through its contribution to factor accumulations or whether it also has a positive impact on TFP. They find that indicators of financial development are correlated with both investment and TFP and that many of the results are sensitive to the inclusion of country fixed effects, indicating that the financial development

[1] See Levine (1997) and Bencivenga, Smith and Starr (1995) for more detailed discussions.

indicators are proxies for broader country characteristics.

Empirical evidence on the link between financial development and productivity is abundant and well documented at the macro level. The evidence of a positive relation between financial development and growth at the micro level has just started to emerge recently. See, for example, Rajan and Zingales (1998), Beck and Levine (2000), Cetorelli and Gambera (2001), and Beck, Demirguc-Kunt and Maksimovic (2005).

In this paper, we use micro firm-level data to examine the effects of financial development on TFP of India's registered manufacturing sector between 1990 and 2008. We choose India as our subject of study for its unique experience in recent years. For more than three decades after its independence in 1947, India adopted a policy of strong government controls over economic activities that significantly hampered its economic growth. In search of prosperity, Prime Minister Indira Gandhi started limited economic reforms in the 1980s. But it was not until 1991 when India encountered a worse-than-ever balance of payments crisis that the Narasimha Rao government and Finance Minister Manmohan Singh initiated breakthrough economic reforms. As a result, India's annual per capita economic growth has more than tripled from 1.26% between 1961 and 1980 to 4.25% between 1981 and 2008.

Financial reforms constituted an important part of the entire reform package, since prior to the 1990s the Indian economy was severely constrained financially and in a state of financial repression. Widespread reforms in the financial sector were initiated to loosen these constraints and increase availability of credit to the Indian manufacturing industry. Our aim is to examine whether this financial development achieved through financial reforms has significant effects on the productivity of India's registered manufacturing sector, which in turn contributed to India's phenomenal economic growth.

Ideally, it will be more informative if we can compare the effects of financial development on TFP of the manufacturing sector before and after the reforms. But due to data constraint, we can only focus our study on the post-reform period. The database, Prowess, obtained from the Center for Monitoring the Indian Economy, only covers the period between 1989 and 2008. With lag, however, the usable observations only cover the period between 1990 and 2008. As a result, we can only analyze the significance of financial development on TFP of India's registered manufacturing sector between 1990 and 2008.

Our results show that since the economic reforms of the 1990s, financial development has had long-term significantly positive effects on the TFP of India's manufacturing sector as a whole. We find strong evidence that financial development has significantly positive long-term effects on firm-level TFP in the private sector, whether we measure financial development at the macro aggregate level or at the micro firm-level. With the aggregate measure, financial development shows significantly positive effects on firm-level TFP of the private sector but has little effect on TFP of state-owned enterprises (SOEs). Nevertheless, we find that these results are an understatement of the true effects of financial development on TFP of India's manufacturing sector. Further investigations using the micro firm-level measures of financial development reveal that while borrowing has little effect on TFP of the SOEs, increased accessibility to equity market significantly improves the TFP of these SOEs, suggesting that having access to the equity market matters more to the SOEs than borrowings. These results provide direct evidence that financial development is a significant source of TFP growth in India's manufacturing sector. They also provide micro-level evidence about the positive effects of financial development after the financial reforms initiated in 1991 and thus shed light on the debate about the role of financial development in India's economic performance. Our results

suggest that policies favoring financial development in India should be pursued further in order for the largest democracy in the world to foster higher economic growth.

The rest of the paper is organized as follows. Section 2 provides a brief review of the literature on financial development and economic growth and India's financial reforms since the 1990s. Section 3 outlines the methodology for estimating firm-level TFP and for testing the effects of financial development on TFP. The data used in our study is explained in section 4, and the empirical results are reported and discussed in Section 5. Section 6 presents a summary and conclusion of our study.

2. Review of the literature and the 1991 Financial Reform in India

In this section, we present a brief review of the literature on the role of financial development in economic growth and a summary of India's financial reforms of the 1990s.

2.1 Financial Development, Financial Reforms and Firm Productivity

A majority of economists believe that finance is a critical element of growth (e.g., Schumpeter 1911; Goldsmith 1969; McKinnon 1973; Shaw 1973; Fry 1978, 1988; Bencivenga and Smith 1991; King and Levine 1993a, 1993b; Levine 2005). But they differ in opinions about the direction of causality between finance and economic growth. Some regard finance as the handmaiden to industry and commerce, and they believe that financial development simply follows economic growth and has very little effect on it (e.g., Robinson 1952; Lucas 1988; Stern 1989). Based on this view, the lack of financial development is simply a manifestation of the lack of demand for financial services. As the real sectors of the economy grow, the demand for various financial services will rise and thus be met by the financial sector. For example, Lucas (1988, p. 6) argues that "the importance of financial matters is very badly overstressed."

Chandavarkar (1992, p. 134) went a step further to claim that "none of the pioneers of development economics … even list finance as a factor of development." But others disagree. In earlier time-series studies, Jung (1986) and Demetriades and Hussein (1996) use the ratio of money to GDP as a measurement of financial development and find that the direction of causality between financial development and economic growth frequently runs both ways, especially for developing economies. Neusser and Kugler (1998) find a stronger positive impact of finance on growth when financial development is measured by the value-added provided by the financial system instead of simple measures of the size of the financial system. Using more comprehensive measures of financial development, Rousseau and Wachtel (1998) find strong evidence of causality running from financial development to economic growth. In a broader study, Xu (2000) adopted a VAR approach to investigate the effects of financial development on investment and economic growth for a sample of 41 countries over the period between 1960 and 1993. The empirical results in his study reject the hypothesis that finance simply follows economic growth. Instead, they suggest that financial development is important for long-run growth. For more detailed discussion of the role of financial development on economic growth, see, for example, Levine (2005) and the references therein.

Some studies also highlight the link between financial development and productivity growth. For instance, Patrick (1966) shows that in developing countries the creation of financial institutions and the supply of credits to productive sectors improve the performance of those sectors thereby leading to economic growth. When assessing the effect of four different indicators of financial development on three growth indicators, one of which is TFP, King and Levine (1993a) find positive and significant effects of all four financial development indicators on TFP for 80 countries for the period 1960-1989. Levine and Zervos (1998) find that the initial

level of stock market liquidity is a significant long-run predictor of TFP growth. Benhabib and Spiegel (2000) find that indicators of financial development are correlated with both investment and TFP growth, although the indicators that are correlated with TFP growth differ from those that encourage investment. Other studies also find that financial development helps predict the long run growth of TFP (e.g., Neusser and Kugler 1998; Beck and Levine 2000; Cetorelli and Gambera 2001; Calderón and Liu 2003; and Beck, Demirguc-Kunt and Maksimovic 2005).

It is well recognized that productivity growth is a crucial element of economic growth. For example, Easterly and Levine (2001) find that with the exclusion of the covariance term TFP growth accounts for more than 60% of output growth, while physical capital alone accounts only for less than 25% of the cross-country variation in per capita GDP, even with different measures of capital. In a similar study, Klenow and Rodriguez-Clare (1997) find that TFP growth accounts for about 90% of the cross-country growth differences.

Financial development can affect productivity growth through various channels. It is well-known that a repressed financial system impedes growth because financial distortions can lead to resource misallocations, significantly raise transaction costs of doing business and result in inefficiency (Fry 1980, 1997). Using China and India as an example, Hsieh and Klenow (2009) shows that lower TFP of developing countries can be explained by resource misallocation across firms. Specifically, they find that the calculated gains of manufacturing TFP are 25-40% in China and 50-60% in India when capital and labor are hypothetically reallocated to equalize marginal products to the extent observed in the US. Barth, Caprio and Levine (2005) find revealing statistics that the governments in financially repressive low-income countries reject nearly half of the applications submitted by banks seeking to enter their banking sector, whereas the rejection rate for financially developed high-income countries is only about five percent.

Besides, countries with repressed financial systems and government banking tend to have higher levels of corruption (Kaufmann, Kraay and Zoido-Lobaton 1999). As the financial system develops, households are able to substitute out of unproductive tangible assets into productive financial assets, and thus the total real supply of credit rises. The increase in the supply of real credit in the economy can help firms enhance the quantity and quality of their investment and improve productivity. Hence, overall efficiency and productivity in the economy will improve.

In addition, financial development promotes productivity growth through technological innovations. Schumpeter (1911) acknowledges that a developed and well functioning financial system would efficiently allocate funds to sectors that successfully produce innovative products or production processes and thereby increases productivity. Greenwood and Smith (1997) argue that well-developed financial markets, by lowering transaction costs, promote transactions resulting in greater specialization and productivity gains. Rajan and Zingales (1998) test this hypothesis and find that firms with greater need for external finance grow relatively faster in countries that have more developed financial markets. Jeanneney, Hua and Liang (2006) examine data from 29 Chinese provinces and find that financial development significantly contributed to TFP growth mostly through its positive effect on efficiency during the period between 1993 and 2001. More recently, with a firm-level dataset, Dabla-Norris, Kersting and Verdier (2010) find strong evidence that the positive effect of innovation on firm productivity is mediated through the financial systems and firms enjoy the maximum benefits from innovation in countries with a well-developed financial system.

2.2 India's Financial Reforms in the 1990s

India's pre-reform financial sector can be described as a classic example of financial repression. "The sector was characterized, *inter alia*, by administered interest rates, large pre-

emption of resources by the authorities and extensive micro-regulations directing the major portion of the flow of funds to and from financial intermediaries" (Mohan 2004, p 851). Strict government controls and regulations created strong entry barriers. In the absence of competition, India's financial sector became inefficient and underdeveloped and resulted in severe credit constraints for other sectors of the economy, especially the private sector (Mohan 2004; Thomas 2006). The capital market was also rigidly controlled, and companies had very limited access to the market. Financial repression imposes substantial direct costs on financial development in India through the level of real interest rates, which in turn negatively affect the country's long term economic growth (Demetriades and Luintel, 1997).

India's financial reforms, launched in 1991 and implemented in stages, were aimed at financial development. Widespread reforms pervaded the banking system, capital markets and the insurance business. Banking system reforms included various liberalization policies, such as relaxing controls on interest rates and the sanction of large loans by the Reserve Bank of India, and policies that promoted competition, such as designing liberal norms for entry of private and foreign banks and insurance companies and allowing inflow of foreign direct investment in the financial sector. The reforms also included measures to improve "financial soundness", like capital adequacy requirements, stronger vigilance of the banking sector and several institutional and legal measures to improve bank efficiency (Ahluwalia 2002; Mohan 2004).

These reforms led to the expansion of private and foreign banks in India while lowering the share of public banks in total assets. Table 1 presents a summary of selected indicators from the banking sector (Ghosh 2006). The share of public banks in total assets declined from 92% in 1990-91 to 75% in 2003-04; meanwhile, the share of private sector banks went up from 4% in 1990-91 to 19% in 2003-04. After the reforms, the banking sector became more competitive as

the ten-firm concentration ratio reduced from 92.86 in 1991-92 to 62.99 in 2004-05 (Thomas 2006). The reforms significantly loosened financial constraints for the firms in India's manufacturing sector (Ghosh 2006). The post-reform era was marked not only by augmented competitions in the banking sector but also by substantial improvements in the capital market as well. After the reform, there have been substantial growth in the number of stock exchanges, the number of listed stocks, market capitalizations, trading volumes, and increased transparency, safety and efficiency accompanied massive reductions in transaction costs in the capital market. As a result, Indian firms were able to shift more easily from debt financing to equity financing during the period (e.g., Love and Peria 2005; Shirai 2004).

But there are debates concerning the policies that are believed to have spurred India's economic growth. Delong (2003) maintains that although conventional wisdom usually traces the recent surge in India's growth to the reforms in the 1990s, the aggregate growth data reveal otherwise, i.e., the acceleration of economic growth in India occurred in the early or mid-1980s, long before the crisis of 1991. Rodrik and Subramanian (2004) point out that India's productivity surge actually started in 1980, more than a decade before the reforms in the 1990s. They argue that popular claims, such as trade liberalization, public investment and increased domestic demand, a favorable external environment, or improved agricultural performance (the green revolution), were "inadequate or unsatisfactory" (p. 16) in explaining India's productivity performance since 1980. Instead, they contend that an attitude shift toward pro-business policies by the government in the early 1980s, i.e., favoring the interests of existing business rather than new entrants or consumers, triggered the productivity surge in India. According to Panagariya (2004), however, the growth in the 1980s was fragile and unsustainable; it was the reforms in the 1990s that led to India's recent, more sustainable growth.

3. The Methodology

To investigate the effects of financial development on TFP in India's registered manufacturing sector for the post-reform era, we first estimate an industry-level production function at the 2-digit NIC level using the method proposed by Levinsohn and Petrin (2003), which allows us to construct the Hicks-neutral TFP at the firm-level. We then employ various measures of financial development to estimate their effects on firm-level TFP using the GMM technique for dynamic panels with lagged dependent variable.

TFP is often computed by approximating the weighted sum of the inputs from the estimation of the Cobb-Douglas production function based on the neoclassical growth model, i.e.,

$$y_{it} = \beta_o + \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + \varepsilon_{it}\,, \qquad (1)$$

where y_{it} is the log of output from firm i at time t, l_{it} is the log of labor, k_{it} is the log of capital, ω_{it} is a state variable measuring productivity, and ε_{it} is measurement error or a shock to productivity that is unforeseeable during the period when labor can be adjusted. Both ω_{it} and ε_{it} are unobservable.

Olley and Pakes (1996) argue that the OLS estimates of (1) are biased because a firm's choice of variable inputs may depend on the firm's beliefs of the state variable ω_{it} when those inputs are used. If there is a serial correlation in ω_{it}, then variable inputs such as labor, raw materials, etc. in period t will be positively correlated with ω_{it}. To overcome the bias in the OLS estimates, they propose the following partially linear model

$$y_{it} = \beta_o + \beta_a a_{it} + \beta_l l_{it} + \beta_k k_{it} + h_t(i_{it}, a_{it}, k_{it}) + \varepsilon_{it}\,, \qquad (2)$$

where $\omega_{it} = h_t(i_{it}, a_{it}, k_{it})$, a_{it} is the age of firm i at time t, and i_{it} is firm i's investment at time t. Now the unobservable productivity variable, ω_{it}, in (1) is expressed as a function of observables. With the control for ω_{it}, the production function can be estimated using semiparametric methods.

Levinsohn and Petrin (2003) point to "the evidence from firm-level datasets that suggest investment is very lumpy (that is, that there are substantial adjustment costs). If this is true, the investment proxy may not smoothly respond to the productivity shock, violating the consistency condition" (Petrin, Poi and Levinsohn 2004, p. 113) and propose the following modified model.

$$y_{it} = \beta_o + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \omega_{it} + \varepsilon_{it}, \qquad (3)$$

where m_{it} is the log of the intermediate input such as raw material, power, and electricity expenditures. The demand for the intermediate inputs m_{it} is assumed to depend on the firm's state variable, k_{it} and ω_{it}, namely,

$$m_{it} = m_t(k_{it}, \omega_{it}).$$

Levinsohn and Petrin (2003) show that if the demand for intermediate input is monotonically increasing with ω_{it}, it can serve as a valid proxy for the unobservables. Hence, the unobservable productivity ω_{it} can be expressed as a function of two observable variables k_{it} and m_{it}, i.e.,

$$\omega_{it} = m_t(k_{it}, m_{it}).$$

After substituting the above expression into equation (3), the production function can be estimated using semiparametric methods.

The coefficients for k_{it} and m_{it} are recovered using GMM methods with the identification

assumption that productivity is governed by a first-order Markov process (Olley and Pakes 1996), i.e.,

$$\omega_{it} = E[\omega_{it} \mid \omega_{it-1}] + \eta_{it},$$

where η_{it} is an innovation to productivity that may be correlated with l_{it} but uncorrelated with k_{it}. The approach described above provides consistent estimates of the production function in (3), and the firm-level TFP can be obtained by subtracting firm *i*'s predicted output from the actual output at time t.

Once the firm-level TFP is obtained, we estimate the following baseline specification to examine the effects of financial development on firm-level TFP in India's manufacturing sector,

$$TFP_{it} = \beta_t \boldsymbol{FD}_t + \boldsymbol{controls} + \nu_{it} \qquad (4)$$

where TFP_{it} is the Hicks-neutral TFP of firm *i*, $\boldsymbol{FD}_t$ is the proxy measuring financial development, ***controls*** stand for the control variables, and ν_{it} is the iid error term.

The link between financial development and growth is well documented at the macro level (e.g., Beck, Levine and Loayza 2000a, 2000b). In discussing the cost of financial repression, Demetriades and Luintel (1997, p 381) point out that the success of economic policies largely depends on the effectiveness of the institutions that implement them. Because of wide differences in such institutions from country to country, it is not surprising to find that financial development causes economic growth in one country but not in another. There are a few studies in the literature indicating that financial development in India led to economic growth, not the other way around. Bhattacharya and Sivasubramanian (2003) find evidence that financial development in India resulted in GDP growth, for the period between 1970–1971 and 1998–1999.

More recently, Acharya, Amanulla and Joy (2009) adopt the Pedroni panel cointegration test and fully modified least squares regression to examine the relationship between financial development and economic growth in Indian states. They also find evidence of unidirectional causality from financial development to real GDP growth. These findings are consistent with the view that India's breakthrough economic reforms of the 1990s result in its recent impressive economic growth. But to mitigate the simultaneity problem between financial development and TFP growth, however, we use the lagged variable for financial development in our regressions.

The control variables for estimating equation (4) include firm's age, age-squared, an index for openness, and dummies for annual fixed effects, which are commonly used in other studies in the literature. The age of a firm and age-squared are used for controlling firm heterogeneities. Age is measured by the number of years a firm is in operation. It is set to zero if a firm enters an industry for less than a year. The index of openness and annual dummies are used to control for the effect of trade-related macroeconomic shocks on firms. It is possible that the economic reform in 1991 and in 1992, the Asian economic crisis towards the end of 1997, and the Y2K syndrome may affect firm TFP in the manufacturing sector. Hence, we include annual dummies for 1991, 1992, 1998, and 2000 to control for the unobservable annual macroeconomic shocks that are common to all firms in those years.

Finally, we control for ownership categories like private-ownership as a group, various forms of private-ownership, government-ownership as a group, and central/state government ownerships. For comparisons, we run separate regressions based on ownership categories and report the results individually.

In estimations, we adopt the GMM technique for dynamic panels with lagged dependent variable (Arellano and Bond 1991). We first examine the role of financial development on TFP

of India's manufacturing sector using a popular measure of financial development at the macro level. Then, we use micro measures of financial development at the firm-level to explore further the broad role of financial development on TFP.

4. The Data

The data used in this study include output, capital, labor, measures of intermediate inputs, firm age, firm size, ownership categories, and measures of financial development. The firm-level data are collected from Prowess, which is obtained from the Center for Monitoring the Indian Economy, covering the period between 1989 and 2008. The Prowess database contains information from the income statements and balance sheets of publicly listed companies in India's registered manufacturing sector. Those companies account for a majority of economic activity in the industrial sector.

Output is measured by the value of total sales that includes income earned by the company from the sale of industrial goods as well as their raw materials, byproducts, stores and waste. Capital is measured by gross fixed assets of a firm that includes both tangible assets, such as land, building, plant, and machinery, and intangible assets, such as goodwill assets, software, etc. Labor, which is a freely moving variable in the estimation of the production function, is measured by compensation to employees that includes all cash and payments in kind made by a company to its employees.

In estimating firm-level TFP, we include firm size as a control variable. Firm size is measured according to the following criteria: small if average sales are less than 18.5 (median sales) over the sample period, large if average sales are more than 1231 (i.e., in the top one percent of the distribution), and medium if average sales are in between small and large (Topalova and Khandelwal, 2010).

To measure intermediate inputs, we use the combined value of raw materials, power and fuel consumptions. Raw materials are the sum of expenses on raw materials, stores, spares and tools used up by firms in the production process. Power and fuel include expenses made by the firms on power, fuel and water. The sum of these three variables is used as the proxy in the estimation of the production function.

In the literature, several indicators have been used to measure the level of financial development; each focuses on one aspect.[2] Among them, the size of the formal financial sector relative to economic activity is the most widely used (Goldsmith 1969; McKinnon 1973; King and Levine 1993a, 1993b; Xu 2000). Underlying this popular practice is the belief that the supply of financial services in any economy is positively related to the size of the financial intermediary sector. As the size of the financial intermediary sector grows, so does the supply of financial services. Hence, the level of liquid liabilities in an economy is an appropriate proxy for measuring the level of financial development at the macro level. Following this common practice, we use the share of liquid liabilities of the formal financial sector to GDP as a proxy for financial development at the national level. The data were collected from the Reserve Bank of India.

The firm-level financial variables include financial service expenses, authorized equity capital, and borrowings from the Prowess database. A summary of the three variables at the 2-digit NIC level for selected years are reported in Table 2. We note from the data that the values of these three variables increased for a majority of the firms in India's manufacturing sector for the period between 1989 and 2008.[3] They reflect the following two changes. First, the firms' ability to access the banking system and the capital markets has improved during the sample

[2] See, for example, King and Levine (1992) for a discussion of those financial indicators.

[3] Table 2 shows a few outliers. But NIC 23 is the oil, gas and refinery industry. For NIC 24 in 1995, the large average value results from a drug company's (Fine Drugs and Chemicals Ltd.) full commercial orientations in that year.

period. As discussed earlier, the continuous improvement in financial environment for borrowings and accessibility to the capital market over time should positively impact firm-level TFP. Second, because of increased market orientations as a result of financial reforms, the financial service expenses for the firms are also increased. These increases are more likely to reflect higher true opportunity costs of financing but can negatively impact firm-level TFP.

The Prowess database classifies all companies into Government Sector and Private Sector and further subgroups of Central Government, State Government, Indian Private Sector, Foreign Private Sector, Co-operative Sector and Joint Sector. We estimate our model for specific ownership groups. Table 3 presents a summary of the sample data.

5. Empirical Results

To obtain firm-level TFP, we estimate the production function discussed in Section 3 at the 2-digit NIC level by employing the bootstrap with 250 reiterations using STATA. Petrin, Poi and Levinsohn (2004) suggest that electricity, raw materials, or fuel consumptions can be used as a proxy for intermediate goods in estimating the production function. We choose to use the sum of raw materials and power and fuel consumptions as our proxy for the following reason.[4] We also include firm size as a control variable for firm heterogeneity. For the 21 industries at the 2-digit NIC level, the estimate for the dummy variable small is negative for all industries, of which 19 are statistically significant at least at the 10% level. The dummy variable large for six of the 21 industries is omitted in regressions due to the absence of large firms in the industries or insufficient usable observations. Those six industries include NIC17, NIC18, NIC19, NIC20, NIC33 and NIC36. The estimate carries a positive sign for the remaining industries. But it is statistically

[4] Although raw materials and power and fuel consumptions are all intermediate inputs, they reflect different aspects of a firm. The choice of one rather than another may be arbitrary and can introduce a bias in estimations, and it may be more appropriate to use the sum of those intermediate inputs as a proxy.

significant for only three industries (NIC15, NIC 28 and NIC34). TFP at the firm level is obtained by subtracting firm *i*'s predicted output from the actual output at time t after we recover the values of the estimates in equation (3).

In Section 3, TFP is assumed to follow a Markov process. As such, OLS estimations can be inconsistent with the assumption and the estimates can be inaccurate. Hence, we adopt the GMM technique for dynamic panels with lagged dependent variable (Arellano and Bond 1991). The Arellano–Bond differenced GMM estimation, which was first proposed by Holtz-Eakin, Newey and Rosen (1988), allows us to resolve the problem of weak instruments in the fixed effect model.[5] We also include the year of incorporation as an additional instrument to increase efficiency in estimations.

The results using the macro indicator of financial development are reported in Table 4. From Table 4, the estimates for the lagged TFP are all statistically significant at the 1% level. They are all positive, except for the government sector as a whole and the firms owned by state governments. This affirms that TFP follows a Markov process is a valid assumption. The estimates for age are significantly positive for all sectors and the Indian private sector but negative for the cooperative-joint sectors, while those for age-squared are significantly negative for all sectors, all private sectors and Indian private sector but positive for the cooperative-joint sectors. The estimate for openness is significantly negative at the 5% level for the foreign private sector, suggesting that foreign private firms were negatively impacted by India's trade liberalization in the 1990s. The estimate is also negative for the firms owned by the central government and the firms in the cooperative and joint sectors. But it is statistically insignificant.

The variable, FD, is the lagged macro indicator of financial development. The estimates for the long-run effects of FD on firm's TFP are positive and significant at least at the 10% level for all

[5] With weak instruments, the fixed-effects instrument variable estimators obtained using OLS may be biased.

the firms in the manufacturing sector, the private sector, the Indian private sector, and the foreign sector, suggesting that financial development has overall positive impacts on firm's TFP in these sectors. Yet the estimates are statistically insignificant for the government sector, the firms owned by the central government and the state government, indicating different effects of financial development on TFP under different ownership categories. Specifically, a 1% improvement in the financial system measured by available liquidity in the economy will raise TFP in Indian private sector and the private sectors as a whole by about 17 units and in the foreign private sector by about 4.35 units. Hence, there is evidence that financial development has an overall positive effect on firm's TFP in India's manufacturing sector and strong evidence that financial development has significantly positive effects on firm's TFP in the private sector.

To explore if there are short-run effects of financial development on firm-level TFP, we create a dummy for the period 1992–1993. The estimates for the FD (dummy) suggest that the short-run intermediate effect of financial reforms on TFP is absent, which is not surprising to us because financial development is more of a long-run policy and takes time to be effective.

We note, however, that the macro indicator of financial development has its limitations since it can only measure one aspect of financial development. Since banks tend to be more risk averse, the role of monitoring investment project through banking systems appears to be advantageous for long-term sound projects requiring sequential financing. But this makes banking systems less flexible to finance those projects that require venture capital and other forms of financing. Compared to banking systems, capital markets are more efficient, flexible and less risk-averse. Therefore, we use micro indicators of financial development at the firm-level to explore further the broad role of financial development on TFP of India's manufacturing sector. Specifically, we consider three lagged financial variables at the firm level. They are

financial service expenses, authorized equity capital, and borrowings; each captures one aspect of the impact of financial development on the firms. The results are reported in Table 5.

From Table 5, the estimates for the lagged TFP are still statistically significant at the 1% level for all sectors, except for the cooperative-joint sectors, suggesting that firm-level TFP does follow a Markov process. The estimate for openness remains negative for the foreign private sector. But it is now statistically significant at the 1% level. In addition, the estimate is significantly negative at the 10% for the firms owned by the central government. They suggest that the firms in the foreign private sector and those owned by the central government were negatively impacted by India's trade liberalization in the 1990s. We consider such negative effects having a positive implication because most likely they result from increased competitions from other firms in other sectors after the trade liberalization in the 1990s.

The estimates for financial service expenses are all significantly negative at least at the 10% level, except for the firms owned by the central government. Since India's financial reforms are depicted by financial liberalization and deregulations, financial service expenses reflect more accurately the true opportunity cost of a firm's financing as financial systems depend more on the market force than government interventions. If the firms face binding budget constraints, higher financial service expenses are likely to affect firm's TFP negatively. Therefore, the insignificant estimate for the firms owned by the central government is interesting because it implies nonbinding budget constraints faced by those firms. Kornai (1980, 1986) coined such nonbinding budget constraints as the "soft budget constraint" syndrome. Using data envelopment analysis for a sample of 67 Indian SOEs, 63 private sector and 27 foreign sector enterprises on a comparative basis, Majumdar (1998) found a significant slack in resource utilization in the SOEs resulting from "soft budget constrains." Our results provide additional evidence supporting

earlier finding in the literature about "soft budget constraints" faced by Indian SOEs, especially the firms owned by the central government.

The estimates for the dummies of the financial variables are all statistically insignificant, suggesting financial development is a long-term process. Yet the estimates for borrowings are significantly positive at the 1% level for all sectors, all private sectors and Indian private sector. They confirm that better financial environment and easy access to banking systems by the firms in those sectors have enhanced the productivity of those firms. The estimates for authorized equity capital are significantly positive under all estimations, except for the cooperative-joint sectors. It is worth noting that financial development as measured by the number of shares in authorized equity capital has positive effects on the firms in India's manufacturing sector, whether we consider the entire sector as a whole or individual sector under different categories. Therefore, the results in Table 4 are an understatement of the true effects of financial development on firm-level TFP because of the limitations of the macro indicator of financial development. They signify the importance of alternative forms of financing to the firms in India's manufacturing sector. For example, our results reveal great needs for the firms in Indian private sector to have better access to the banking system. But for SOEs and foreign private firms, they depend more on accessing India's capital markets than the banking system.

6. Summary

Empirical evidence on the link between financial development and productivity is abundant in the literature. But most studies measure financial development at the macro level. In this paper, we use firm-level data to examine the effects of financial development on TFP of India's registered manufacturing sector between 1990 and 2008. We choose India as our subject of study for its unique experience in recent years. India is one of the largest emerging economies

in the world. But its economic growth had stagnated for decades after independence in 1947. Most researchers consent that it is the economic reforms of the 1990s that prompted India's recent impressive economic growth.

Using the methodology of Levinsohn and Petrin (2003), we first obtain consistent estimates of the parameters of the production functions at the 2-digit NIC level. We then examine the effects of financial development on firm productivity using the GMM technique for dynamic panels with lagged dependent variable proposed by Arellano and Bond (1991).

Based on our results, there is strong evidence of positive effects of financial development on firm productivity in India's manufacturing sector. The macro indicator of financial development appears to suggest that financial development has enhanced firm-level TFP in the private sector but it has no effect on the TFP in the government sector. But we find this is an understatement. When firm-level financial variables are used, financial development is found to have significantly positive effects on firm productivity in both private and government sectors. Our results indicate that alternative forms of finance have different impact on the productivity of these firms. Specifically, the need to have better access to the banking system is greater for the firms in Indian private sector than SOEs and foreign private firms; the latter depend more on their access to India's capital market than the banking system.

Since the firms in the government sector, Indian private sector and foreign private sector account for more than 99% of the firms in the manufacturing sector, our results provide direct evidence that financial development is a significant source of TFP growth at the firm-level in India's manufacturing sector. They also provide micro-level evidence for the effectiveness of India's financial reforms in the 1990s and thus shed light on the debate about appropriate policy complements in India's economic reforms.

Table 1: Summary of the banking industry: 1990-91 to 2003-04 (in Rs. billion)[1]

Year/Bank group	1990-91			1996-97			2003-04		
	SOB	Pvt	Foreign	SOB	Pvt	Foreign	SOB	Pvt	Foreign
Number of banks	28	25	23	27	34	42	27	30	33
Total asset	2929	119	154	5563	606	561	14714	3673	1363
Total deposit	2087	94	85	4493	498	373	12268	2685	798
Total credit	1306	50	51	2202	281	265	6327	1709	605
Credit-deposit ratio	0.63	0.52	0.6	0.49	0.56	0.71	0.52	0.64	0.76
Share (in %)									
Total asset	92	4	4	83	9	8	75	19	6
Total deposit	92	4	4	84	9	7	74	16	10
Total credit	93	4	3	80	10	10	73	20	7
Total income	246	11	15	536	74	76	1376	332	130
Of which:									
interest income [2]	239	9.3	12.7	465	64	62	1095	255.4	90
	(97.2%)	(84.5%)	(84.7%)	(86.8%)	(86.5%)	(81.6%)	(79.6%)	(76.9%)	(69.2%)
Total expenditure	241	10.7	13	540	61	56	1211	297	108
Net profit	5	0.3	2	71	13	20	165	35	22

1. SOB, Pvt, and Foreign stand for state-owned banks, private sector banks and foreign sector banks, respectively. The information is taken from Ghosh (2006).
2. The percentages were added by the authors.

Table 2: Average Values of Firm-level Financial Variables at NIC 2 digit [1]
(selected years)

	F	A	B	F	A	B	F	A	B	F	A	B	F	A	B	F	A	B
	N15			**N16**			**N17**			**N18**			**N19**			**N20**		
1990	2.2	6.9	17.3	3	7.9	24.4	2.4	6.8	18.7	2.2	6.8	18.2	2.1	6.3	16.4	2.9	6.7	21.1
1995	2.2	7.2	17.5	3.4	9.5	24.8	2.4	7.5	20.1	1.9	6.7	14.9	2.1	6	16.1	2.2	6.8	19.7
2000	2.7	7.9	21.9	4.7	9.1	24.4	3.3	7.8	24.4	2	7.7	17.8	2.3	7.4	17.6	2.8	7.6	24.8
2008	3.9	8.5	32.5	6.1	9.3	36.2	4	10.3	43.1	2.7	7.7	22.3	2.5	7.8	21.7	3.6	12.1	34.7
	N21			**N23**			**N24**			**N25**			**N26**			**N27**		
1990	2.2	6.6	17.2	3.1	7.3	25.2	2.5	6.8	19.9	2.4	6.9	19.1	3.3	6.9	26.4	2.4	7.9	19.2
1995	2.4	6.7	18.2	5.1	33	48.2	2.8	538	20.4	2.1	6.9	17.4	4.7	12	39.1	2.3	8.5	22.5
2000	3.5	12	25.7	6.8	39	109	3.6	9.9	26.9	3.2	8.6	22.8	7.3	21	53.2	3.8	10.6	28.4
2008	3.4	9.9	30.9	19	118	402	3.5	12.8	33.9	3.1	8.4	26.1	5.7	20	61.5	6.5	15.3	57.9
	N28			**N29**			**N30**			**N31**			**N32**			**N33**		
1990	2.1	6.8	17.6	2.8	8.1	20.8	2.2	7	16.8	2.6	7.1	19.3	2.4	7.2	18.4	2.2	6.6	17.6
1995	2	6.5	14.7	3	8.3	21.4	2.4	6.6	16.9	2.6	8	18.7	2.5	8.5	20.6	1.8	6.2	14.6
2000	2.8	7.5	19.1	3.1	9.2	22.1	2.2	6.8	14.4	4	9.3	27.6	3.4	10	24	2.3	8.4	18.6
2008	2.6	8.3	21.4	3.1	14	23.1	3.1	10.1	25.4	3.8	10	28.8	2.5	10	22.4	2.5	8.7	20.8
	N34			**N35**			**N36**											
1990	2.4	6.9	18.7	3	6.7	26.8	2.2	7.2	17.5									
1995	2.6	7.7	19.5	3.8	11	23.5	2	6.7	18.4									
2000	4.1	22	37.9	3.6	16	31.7	2.7	7.2	22.3									
2008	3.8	14	42.4	4.8	16	69	3.3	8.1	38.1									

1. The values are the average at the 2-digit NIC level for selected years. There seems to be a few outliers. But NIC 23 is the oil, gas and refinery industry. For NIC 24 in 1995, the large average value results from a drug company's (Fine Drugs and Chemicals Ltd.) full commercial orientations in that year. Nxx is the 2-digit NIC code. F= Financial Services Expenses; A = Authorized Equity Capital; B = Borrowings.

Source: Prowess Database from Center for Monitoring the Indian Economy and authors' calculations

Table 3
Data Information

Panel A:

	N	Mean	Std Dev	Minimum	Maximum
Total Revenue	48505	238.32	2906.36	0.01	270582.38
Gross Fixed Assets	48505	143.66	1094.61	0.01	65966.92
Employee Compensations	48505	12.55	87.32	0.01	8069.15
Raw Material and Power & Fuel Consumption	48505	112.42	1091.35	0.02	101993.33
Firm Age	48505	24.50	20.34	1.00	180.00
Firm Level TFP	48505	4.71	71.27	0.00	10630.66
Macro FD	48505	56.89	10.72	43.06	78.62
Openness	48505	14.14	4.61	7.10	24.00
Financial Expenses	48505	4.19	16.62	0.01	911.36
Authorized Equity Capital	48505	59.74	7120.50	0.01	1400000.00
Borrowing	48505	37.70	182.35	0.01	15022.29

Panel: B

	Number of Firms	Large	Medium	Small	Number of Industries at the 2-digit NIC
Government Sector	231	18	134	79	17
Central Government	136	18	84	34	16
State Government	95	0	50	45	12
Private Sector	8263	72	4281	3910	21
Indian Private Sector	7731	46	3919	3766	21
Foreign Private Sector	487	22	336	129	20
Cooperative Sector	11	1	8	2	4
Joint Sector	34	3	18	13	9
Total	8494	90	4415	3989	21

Table 4
The Effects of Macro Financial Development on Firm-level Productivity [1]
(Arellano-Bond linear dynamic panel-data estimators)

	All Sectors	All Gov't Sectors	Central Gov't	State Gov't	All Private Sectors	Indian Private	Foreign Private	Coop-Joint
Lagged TFP	0.400	-0.335	0.345	-0.186	0.401	0.401	0.357	1.310
	(0.01) [2]	(0.03) [2]	(0.03) [2]	(0.05) [2]	(0.01) [2]	(0.01) [2]	(0.02) [2]	(0.43) [2]
Age	0.152	0.006	0.010	0.038	0.147	0.169	0.028	-0.064
	(0.09) [4]	(0.19)	(0.01)	(0.59)	(0.10)	(0.10) [4]	(0.04)	(0.04) [4]
Age-squared	-0.003	0.000	-0.000	0.001	-0.003	-0.004	0.000	0.001
	(0.00) [3]	(0.00)	(0.00)	(0.01)	(0.00) [3]	(0.00) [3]	(0.00)	(0.00) [4]
Openness	0.048	0.463	-0.014	1.237	0.061	0.121	-0.266	-0.029
	(0.28)	(0.39)	(0.02)	(1.23)	(0.29)	(0.32)	(0.09) [2]	(0.06)
D1991	0.834	-0.261	-0.038	-1.020	0.883	0.969	-0.505	-0.039
	(2.06)	(2.93)	(0.18)	(9.18)	(2.14)	(2.42)	(0.59)	(0.42)
D1992	1.364	0.231	-0.099	0.586	1.434	1.712	-0.602	-0.157
	(2.01)	(3.16)	(0.18)	(11.26)	(2.08)	(2.33)	(0.63)	(0.47)
D1998	-0.633	-0.158	0.048	-0.230	-0.649	-0.659	0.020	0.010
	(1.31)	(2.16)	(0.13)	(7.06)	(1.36)	(1.49)	(0.47)	(0.35)
D2000	0.107	-0.264	0.221	-1.137	0.077	0.095	0.207	0.198
	(1.29)	(2.03)	(0.12) [4]	(6.48)	(1.34)	(1.46)	(0.47)	(0.34)
FD	16.492	-14.277	0.369	-29.599	17.007	16.535	4.359	1.662
	(8.12) [3]	(11.61)	(0.68)	(36.52)	(8.39) [3]	(9.17) [4]	(2.57) [4]	(1.75)
FD (Dummy)	-0.067	-0.062	-0.007	-0.151	-0.069	-0.088	-0.028	0.047
	(0.46)	(0.67)	(0.04)	(2.41)	(0.47)	(0.53)	(0.14)	(0.10)
Intercept	-62.925	54.356	-0.849	107.516	-64.939	-63.781	-12.803	-5.816
	(29.28) [3]	(42.03)	(2.45)	(131.44)	(30.25) [3]	(33.09) [3]	(9.16)	(6.38)

1. The estimates reported in this table are the Arellano–Bond (1991) difference GMM estimators. The dependent variable is firm-level TFP at the 2-digit NIC level. FD is a macro measure of financial development discussed in Section 3. The numbers in the parenthesis are standard errors, and the levels of significance are calculated based on the Z-statistic.
2. The estimate is statistically significant at the 1% level.
3. The estimate is statistically significant at the 5% level.
4. The estimate is statistically significant at the 10% level.

Table 5
The Effects of Micro Financial Development on Firm-level Productivity [1]
(Arellano-Bond linear dynamic panel-data estimators)

	All Sectors	All Gov't Sectors	Central Gov't	State Gov't	All Private Sectors	Indian Private	Foreign Private	Coop-Joint
Lagged TFP	0.106	3.564	0.188	4.447	0.106	0.104	0.352	0.592
	(0.01) [2]	(0.10) [2]	(0.05) [2]	(0.13) [2]	(0.01) [2]	(0.01) [2]	(0.02) [2]	(0.47)
Age	0.088	-0.021	0.021	-0.053	0.079	0.089	0.021	-0.061
	(0.11)	(0.11)	(0.02)	(0.31)	(0.11)	(0.12)	(0.05)	(0.07)
Age-squared	-0.002	0.000	0.000	-0.001	-0.002	-0.002	0.000	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Openness	-0.031	0.001	-0.044	-0.195	-0.051	-0.089	-0.269	-0.009
	(0.22)	(0.18)	(0.03) [4]	(0.59)	(0.22)	(0.25)	(0.08) [2]	(0.06)
D1991	0.724	0.247	0.034	0.552	0.792	0.984	-0.668	-0.310
	(2.88)	(2.05)	(0.39)	(5.11)	(3.00)	(3.36)	(1.06)	(1.07)
D1992	2.286	0.204	0.027	-0.135	2.405	2.713	-0.655	-0.287
	(2.26)	(1.97)	(0.35)	(5.48)	(2.34)	(2.63)	(0.80)	(0.93)
D1998	-0.930	0.141	0.025	1.237	-0.954	-0.958	0.039	0.319
	(1.48)	(1.32)	(0.23)	(3.70)	(1.53)	(1.68)	(0.59)	(0.76)
D2000	0.970	0.874	0.021	1.895	1.026	1.225	0.022	0.275
	(1.40)	(1.19)	(0.20)	(3.48)	(1.45)	(1.59)	(0.59)	(0.61)
Financial Expenses	-1.544	-1.586	0.135	-6.781	-1.580	-1.710	-1.294	-0.830
	(0.93) [4]	(0.77) [3]	(0.13)	(2.08) [2]	(0.96) [4]	(1.05) [4]	(0.41) [2]	(0.47) [4]
Authorized Stock	4.245	4.592	0.909	9.970	4.107	4.090	1.249	0.246
	(1.61) [2]	(1.89) [2]	(0.29) [2]	(5.83) [4]	(1.65) [2]	(1.80) [3]	(0.70) [4]	(0.93)
Borrowing	4.212	1.538	-0.116	0.814	4.331	5.209	0.455	0.986
	(1.15) [2]	(1.16)	(0.19)	(3.29)	(1.18) [2]	(1.36) [2]	(0.35)	(0.68)
Financial Expenses (D)	-0.452	-0.034	0.044	-0.297	-0.463	-0.590	0.255	-0.196
	(2.12)	(1.47)	(0.26)	(5.10)	(2.23)	(2.49)	(0.80)	(0.90)
Authorized Stock (D)	0.216	0.395	0.095	0.984	0.160	0.325	0.261	-0.113
	(1.94)	(1.29)	(0.21)	(4.67)	(2.04)	(2.30)	(0.69)	(1.17)
Borrowing (D)	0.435	-0.441	-0.105	-0.709	0.558	0.498	-0.628	0.298
	(2.47)	(1.65)	(0.27)	(6.29)	(2.60)	(2.96)	(0.80)	(1.43)
Intercept	-11.426	-22.089	0.149	-32.643	-10.721	-11.770	2.231	-1.536
	(4.14) [2]	(4.99) [2]	(0.86)	(13.15) [2]	(4.24) [2]	(4.60) [2]	(1.88)	(2.55)

1. See footnote 1 in Table 4 for other information.
2. The estimate is statistically significant at the 1% level.
3. The estimate is statistically significant at the 5% level.
4. The estimate is statistically significant at the 10% level.

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