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Are Foreign Banks Bad for Development Even If They Are Efficient? Evidence from the Indian Banking Industry

By: Sumon Bhaumik and Jenifer Piesse

Are foreign banks active in emerging credit markets?
Evidence from the Indian banking industry[*]

Sumon Kumar Bhaumik

Queen's University Belfast,

Jenifer Piesse[**]

King's College London, and

University of Stellenbosch, RSA

Abstract:

Using bank-level data from India, for six years (1995-96 to 2000-01), we show that while foreign banks have high credit-deposit ratios, the domestic banks experienced much greater improvements in technical efficiency in the context of credit. The most significant improvements in technical efficiency are registered by the domestic *de novo* banks. There is weak evidence that foreign banks may be bullish only with respect to blue chip borrowers. Together with recent literature on the Indian banking system, these results emphasise the dominance of competition rather than changes in ownership-mix as a policy objective for banks in an emerging market economy.

JEL classification: G21, O16

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1. Background

1.1   Ownership and Performance

It has long been argued that private ownership of firms leads to better intra-firm allocation of resources, and leads to the existence of more efficient firms. In this respect, there is remarkable convergence of opinion among public choice theorists (Niskasen, 1971; Levy, 1987; Estrin and Perotin, 1991) and property rights theorists (Alchian, 1965; de Alessi, 1980). The argument in favour of private ownership of productive assets has been further bolstered by the argument that managers of privately owned firms can be induced to perform efficiently by way of takeover threats (Manne, 1965; Fama, 1980), but that managers of state owned firms are immune to this form of inducement or disciplining (Vickers and Yarrow, 1980). Finally, economists have argued that if contracts are incomplete, managers of a privately owned firm are likely to prove more innovative in dealing with business challenges than managers of state owned firms (Grossman and Hart, 1986; Hart and Moore, 1990; Hart, Shleifer and Vishny, 1997).

While empirical evidence, especially from China and the transition economies of the former Soviet block, indicate that privately owned firms often are more productive and better performing than state owned firms (Ehrlich *et al.*, 1994; Zhang, Zhang, and Zhao 2001; Claessens and Djankov, 2002), the debate on this issue is by no means over. Agency theorists argue that a privately owned firm may not be productive or be able to perform well because of conflict of interest between different groups of stakeholders within the firm (Jensen and Meckling, 1976). Indeed, empirical evidence suggests that private firms may not always take decisions that are consistent with the principle of profit or value maximisation. There is, for

example, a vast literature on mergers and acquisitions (M&A) that suggests that, more often than not, M&A fails to add to performance of the predator and target firms (Asquith and Kim, 1982; Jensen and Ruback, 1983; Ravenscraft and Scherer, 1987; Agarwal, Jaffee and Mandelker, 1992; Rhoades, 1994), presumably because the decisions driving M&A are based on factors that maximize the payoffs of the managers rather than maximizing the value of the target and the predator firms (Morck, Shliefer and Vishny, 1990). It has, therefore, been argued by some economists that privatisation of state owned firms is not necessarily a panacea, and that, as an alternative to privatisation, state owned firms can be rendered efficient by way of competition and implementation of hard budget constraints (Caves and Christensen, 1980; Borcherding *et al.*, 1982; Millward, 1988; Jacobsson, 1991; Sjostrom and Weitzman, 1996; Borajas, Steiner and Salazar, 2000; Brown and Earle, 2000; Januszewski, Koke and Winter, 2002; Isik and Hasan, 2003).

Expectedly, the empirical aspect of the debate has not remained restricted within the manufacturing sector, and several papers have examined the link between ownership, competition and performance among financial intermediaries like banks. However, almost the entire literature linking ownership to performance deals with the agency aspect of ownership, i.e., the impact of separation between management and ownership on the performance of banks (e.g., Gorton and Schmid, 1999; Hirshey, 1999). The empirical evidence from the handful of studies that analyse the relative performance of state owned and private sector banks suggests that the relationship between ownership and performance can be weak (e.g., Sarkar, Sarkar and Bhaumik, 1998), especially in emerging markets where private ownership *per se* may not manifest profit maximization, and that competition can induce state owned

banks to bridge the performance gap with the privately owned banks (Bhaumik and Dimova, 2004).[2]

1.2 A Bank as an Intermediary

An important lacuna in the literature examining the link between ownership, competition and performance of banks is that it fails to recognise the fact that a bank is not similar to a manufacturing or even a services sector firm. Unlike a manufacturing or services sector firm, a bank helps mobilize domestic savings for subsequent investment in various on-going and new projects, and thereby also serves as the conduit for transmission of monetary policy. Indeed, it is now stylised in the literature that the intermediary role of the banks plays an important role in fostering economic growth, even though in some countries a well-functioning credit market has also had the unwelcome effect of fostering growth by way of debt accumulation rather than by way of improving total factor productivity (Gertler and Gilchrist, 1993; Ketkar, 1993; Ma and Smith, 1996; Bulir, 1998; Caranza, 2000; Acemoglu, 2001; Bell and Rousseau, 2001; Da Rin and Hellman, 2002; Jeong, Kymn and Kymn, 2003). In other words, while for manufacturing and services sector firms the best possible use of productive resources remains the objective of rational owners/managers and the size of the output *per se* is less important, both the size of the output (i.e., credit) and the allocation of this output matter in the case of banks.

The aforementioned literature linking ownership and competition to performance of banks focuses on the allocative efficiency of credit. If bank credit is allocated to the most productive projects, the probability of project failure and, therefore, probability of banks losing money on their advances is not significant. The ability of banks to allocate credit to the

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[2] Some studies have examined the impact of ownership and liberalization on cost efficiency of banks, and have found that private banks are more cost efficient than state owned banks (e.g., Kumbhakar and Sarkar, 2003)

most productive projects at a low cost to themselves, in turn, is believed to be dependent on their ownership structure and the extent of competition they face. Specifically, it is believed that even though private ownership of banks is not necessarily a panacea in so far as financial performance and productivity is concerned, by and large, a state owned bank is likely to be less capable of – and, perhaps, less inclined to – accurately assess the risk associated with individual projects and borrowers (e.g., Banerjee and Duflo, 2001). In other words, the allocative efficiency of credit increases with the increase in the relative size of privately owned banks in the banking industry of a country.

However, private ownership of banks does not necessarily have a similar salutary impact on the volume of credit disbursed by the banking sector. It is by now stylised that if profit maximising banks, facing an uncertain economic environment, are apprehensive about the possibility of adverse selection with respect to their loan portfolio, they are likely to ration credit and refuse credit to potentially risky borrowers (Stiglitz and Weiss, 1981). Indeed, in emerging markets, where many of the projects are inherently risky because of unfavourable macroeconomic and market conditions, as well as because of factors related to the political economy of regulations governing credit disbursal and contract enforcement, banks have been known to effect credit rationing (e.g., Ma and Smith, 1996). The extent of credit rationing exercised by a bank is clearly an increasing function of its degree of risk averseness. Since privately owned banks are more likely to be risk averse about contingencies that impact on their balance sheets and profitability than state owned banks, given that the management of these banks are held responsible for their financial health by the private owners, private banks may be less willing to expand their credit disbursal in an emerging economy than state owned banks. The problem of credit disbursal is likely to be even more acute for foreign banks that are subject to stricter market discipline in their countries of origin.

In other words, while corporate governance and corporate finance theorists may argue that state owned banks are, on average, less cost efficient and less profitable than their private sector counterparts, and that therefore they should be privatised, a policymaker who has to take into consideration the growth potential of an economy, of which the volume of credit disbursed is an important determinant, may be more hesitant to abolish state owned banks. This hesitancy may be even more pronounced in countries like India, where nationalisation of banks in 1969 and the subsequent increase in the width and depth of the credit market are viewed as a key ingredient of economic growth and development since (Ketkar, 1993; Bell and Rousseau, 2001).

1.3 Foreign Banks and Credit Disbursal

The dilemma for policymakers is most acute in the context of foreign banks. Empirical evidence from emerging markets suggest that these banks, on average, perform better than the domestic banks (e.g., Sarkar, Sarkar and Bhaumik, 1998), and contribute to the improvement of operative efficiency of the banking sector as a whole (e.g., Borjas, Steiner and Salazar, 2000). At the same time, there is continuing concern that foreign banks are unwilling to take risk (in emerging markets) that would adversely affect their balance sheets and global credit ratings. This apprehension is aggravated by evidence from Latin America which suggests that foreign banks are less inclined to have exposure to small and medium industries (Clarke, Cull, D'Amato and Molinari, 1999; Clarke, Cull, and Peria 2001; Clarke, Cull, Peria and Sanchez, 2002). In other words, some policymakers are concerned that in emerging markets credit disbursal by foreign banks lag, rather than lead, economic growth such that these banks benefit from, rather than play a role in, fostering economic growth in these countries.

The key problem associated with empirical analyses involving Latin American countries is that these countries have experienced major macroeconomic shocks throughout

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the 1970s, 1980s and 1990s. As a consequence, it is difficult to think of banks' behaviour in these countries as being typical, or applicable to banks in countries with stable macroeconomic environments. However, a systematic study of the lending behaviour of foreign banks in non-Latin American economies, especially in relation to that of domestic banks, is conspicuous by its absence.[3] We address this lacuna in the literature using Indian banking data for the six year period between financial years 1995-96 and 2000-01, inclusive, and stochastic frontier analysis.[4] Specifically, we estimate an efficient frontier for Indian banks with respect to their ability to disburse credit, and calculate the distance between each bank and this frontier, the size of the gap being the measure of a bank's "efficiency" (or inefficiency) relative to the frontier. The econometric methodology allows us to simultaneously explain the variation in this efficiency across banks. Finally, we are able to track the efficiency of the foreign banks operating in India over time.

Our results suggest that while the foreign banks operating in India have had a high credit-deposit ratio during the entire 6-year period – indeed, significantly higher than those of the domestic banks, their performance was mixed with respect to technical efficiency. Indeed, while all but one of the *de novo* domestic private banks experienced an improvement in technical efficiency between 1996-97 and 2000-01, the fortunes of the foreign banks was

[3] Indeed, the only systematic study of a bank's lending behaviour in the context of an emerging market suggests that even public sector banks may ration credit to a section of the domestic firms (Banerjee and Duflo, 2001), and this adds to the confusion about the credit market behaviour of foreign banks relative to the domestic banks.

[4] The Indian banking sector is marked by the presence of three different types of banks, namely, the state owned banks, the domestic private sector banks (incumbent and de novo) and foreign banks. The Indian government has recently amended its regulations governing foreign direct investment to allow foreign banks up to 74 percent stake in the equities of domestic banks, and the Indian banking sector is expecting a significant level of cross-border acquisitions, with foreign banks buying controlling stakes in the small yet profitable private domestic banks. Indeed, ING Bank has already expressed interest in a few domestic private banks.

decidedly mixed, with at least half of them experiencing a decline in technical efficiency. In other words, while the foreign banks are bullish in the Indian credit market, as evident from their high credit-deposit ratios, many of them are clearly not extending credit to the extent that is consistent with the quantity and quality of their resources and the borrower pool at their disposal. Given the mixed performance of the foreign banks with respect to technical efficiency, the importance of learning in the context of credit markets, and the possibility of demand side constraints like availability of a significant absolute number of high quality borrowers, the foreign banks deserve the benefit of the doubt. Nevertheless, the mixed performance with respect to technical efficiency also raises some questions about the ability and/or willingness of the foreign banks to extend credit to borrowers across the risk spectrum. Policy implications are discussed in greater detail later in the paper.

The rest of the paper is organised as follows: Section 2 provides a brief summary of the evolution of the Indian banking industry. Section 3 describes the empirical methodology associated with stochastic frontier analysis. The model specifications are discussed in Section 4, and the data and choice of models in Section 5. Section 6 presents the results, and Section 7 presents some concluding comments.

2. Evolution of the Indian Banking Sector

Independent India inherited a weak financial system. Commercial banks mobilized household savings through demand and term deposits, and disbursed credit primarily to large corporations.[5] Indeed, between the years 1951 and 1968, the proportion of credit going to industry and trade increased from an already high 83 percent to 90 percent. This increase was at the expense of some crucial segments of the economy like agriculture and the small-scale

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[5] This was due to the fact that the commercial banks were controlled by a handful of people through interlocking of directorships, and these people were entrenched in the corporate sector (Ghosh, 1988).

industrial sector. This skewed pattern of credit disbursal, and perhaps the spate of bank failures during the 1960s[6], forced the government to resort to nationalization of banks in 1969.

The main thrust of nationalization was social banking, with the stated objective of increasing the geographical coverage of the banking system, and extension of credit to the priority sectors.[7] This phase of banking in India was characterized by administered interest rates, and the government and/or Reserve Bank of India's (RBI) intervention with respect to credit disbursal. Further, a significant part of the banks' deposit base was pre-empted to support government expenditure through statutory measures like the cash reserve ratio (CRR) and the statutory liquidity ratio (SLR).[8] There is little doubt that the twin objectives of nationalization had been met by the last decade of the twentieth century. The number of branches of the nationalized banks increased from 8,262 in 1969 to 60,220 on the eve of the first wave of liberalisation of the banking sector in 1991, and the emergence of a large number of rural branches helped widen the delivery points for rural credit (Sarkar and Agarwal, 1997).[9]

However, despite the successes of bank nationalization in India, the banking sector remained mired in problems, and was incompatible with the increasing emphasis on a market

[6] Bank failures and mergers led to a decline in the number of banks from 566 in 1951 to 90 in 1968 (India Banking Yearbook, 1995).

[7] Priority sectors include agriculture, agricultural processing, the transport industry, and small-scale industries.

[8] The CRR requires banks to maintain a specified fraction of their total time and demand deposits as cash balances with the RBI. The SLR, on the other hand, requires them to invest a specified proportion of time and demand deposits in government securities and quasi-government securities like bonds issued by the Industrial Development Bank of India (IDBI). As late as 1991, the magnitudes of CRR and SLR were 15 percent and 38.5 percent respectively.

[9] The approximate population per branch declined from 64,000 to 14,000 over the same time period, even as the population grew at an average of over 2 percent per annum.

economy. As late as 1990, interest rates were still fixed by the RBI, directed credit was still in vogue, and government ownership of 88.5 percent of the banking industry (measured in terms of deposit base) created enormous moral hazard problems for the depositors and the banks' management alike. The crisis in the banking industry was manifested in the financial performance of the banks; while the gross operating profit of scheduled commercial banks as a proportion of total assets rose marginally from 0.8 percent in the 1970s to 1.5 percent in 1990s, the net profit of these banks declined.

With economic reform emerging as the primary agenda of the central government in 1990, the banking-financial sector in India underwent a significant degree of liberalization from the early 1990s. Between 1992 and 1997, interest rates were liberalized, and banks were allowed to fix lending rates subject to a cap of 400 basis points over the prime lending rate (PLR). Further, the CRR was reduced to 9.5 percent by 1997, and the SLR was reduced to 25 percent. Banks were further encouraged to increase the returns on their operating assets when, in 1994-95, they were allowed to invest in equity. At the same time, in pursuance of the recommendations of the first Narasimham Committee, the entry of new banks and the expansion of branching networks of existing banks were deregulated.[10] At the same time, banks were asked to maintain a risk-weighted capital adequacy ratio of 8 percent, mark assets to market, identify problem loans on their balance sheets, and make provisions for bad loans. This phase of reforms was completed by March 31, 1998.[11]

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[10] Between 1991-92 and 1996-97, the number of domestic private banks and foreign banks rose from 23 to 34, and from 23 to 39, respectively. In keeping with this, between June 1993 and March 1997, the number of branches of domestic private and foreign banks rose from 3,887 to 4,535, and from 141 to 181 respectively.

[11] The fiscal and financial years in India run from April 1 to March 31 of the following year.

But while the increasing competition in the banking industry led to product innovation and quality competition, major problems continued to persist.[12] Profitability of nationalized banks continued to be a problem, and the ratio of net profits to total assets of these banks remained at 0.77 percent, lower than the corresponding ratio for domestic private (1.04 percent) and foreign banks (0.97 percent). Even more worrying was the fact that the net nonperforming assets (NPA) of scheduled commercial banks continued to rise, reaching Rupees 237,610 million in 1997-98.[13] The public sector banks contributed to about 89.4 percent of the net NPAs. In view of these developments, between 1997 and 2000, the central government and the RBI set up two different committees to provide guidelines for the second generation reforms for the banking sector: the second Narasimham Committee and the Varma Committee, the terms of reference of the latter being the development of guidelines for treating weak public sector banks.

The second Narasimham Committee undertook its evaluation of the Indian banking sector at a crucial point of time, namely, the currency-banking crisis in South East Asia, and the assertion by the Tarapore Committee that the Indian banking sector should be strengthened to meet international standards before the rupee was made fully convertible in the capital account of the balance of payments. The report of the committee, submitted in 1998, focused on strengthening the foundations of the banking system, as well as on issues like upgrading technology and human resource development.

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[12] The average PLR of banks declined by about 200 basis points between 1991-92 and 1997-98, but most of this decline can be attributed to the cheap money policy followed by the RBI, rather than to price competition among banks.

[13] The volume of gross NPAs has been estimated to be double the volume of net NPAs.

The report stressed two aspects of banking regulation: capital adequacy, and asset classification and resolution of the NPA-related problem.[14] It recommended that the capital adequacy ratio be increased to 9 percent by 2000 and to 10 percent by 2002. It also suggested that measures of capital adequacy should take into account market risk of the banks' assets,[15] including the exchange rate risk of foreign currency held by the banks. Further, it proposed that the entire portfolio of government securities with banks be marked to market within a 3-year period. Finally, the committee suggested that an asset should be classified as "doubtful" if it is in the substandard category for 18 months to begin with, and that this period be reduced to 12 months over time.[16]

In order to reduce the moral hazard associated with government ownership, the committee suggested that banks should not be recapitalised using government funds. However, it acknowledged the fact that the government might have to play a role in the removal of NPAs from the banks' balance sheets by way of asset reconstruction companies (ARCs). Specifically, it felt that the government might have to guarantee the bonds issued by the ARCs, the proceeds from which could then be used to buy the bad assets of the banks at a discount.

Implicitly linking ownership with performance, the second Narasimham Committee suggested a reduction in the minimum stipulated holdings of the government in the equity of

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[14] The committee proposed that the average level of net NPAs as a fraction of credit outstanding for all banks be reduced to 5 percent or less by 2000 and to 3 percent by 2002. For banks with an international presence, the corresponding targets for gross and net NPAs were proposed to be 5 percent and 3 percent, and 3 percent and 0 percent respectively.

[15] In conjunction with this, the banks were encouraged to undertake risk management by way of value at risk modelling.

[16] The committee suggested that the banks be asked to adopt the international standard with respect to income recognition, thereby reducing the relevant time period from 180 days to 90 days.

public sector banks to 33 percent.[17] It also favored separation of monetary policy and bank supervision, and suggested that a supervisory body for banks be formed in line with the Financial Services Authority (FSA) of United Kingdom.

While the second Narasimham Committee proposed reforms that were indubitably good in so far as the health of the banking system is concerned, it stopped short of proposing the closure of public sector banks like United Bank of India, United Commercial Bank and Indian Bank, all of which were clearly underperforming even by the modest standards of the public sector banks. Instead, the unenviable task of formulating a policy to deal with weak public sector banks was left for the Varma Committee.

The Varma Committee concluded that the public sector banks were under pressure because of the prudential norms regarding asset classification and provisioning for NPAs, and because of the intensification of competition subsequent to the first phase of banking sector reforms. However, the committee pointed out that the dismal performance of the weak public sector banks was not merely on account of exogenous shocks, but rather that internal problems like limited number of products, poor risk management systems and mediocre service had also contributed. It concluded that mergers and narrow banking are unlikely to resolve the problem of weak banks. Further, while the committee viewed privatization as perhaps the best course of action, it recognised that the cost of restructuring weak state owned banks to make them attractive to private investors would be prohibitively high.

The committee identified persistence of the large volume of NPAs as the biggest challenge facing the weak public sector banks, and proposed, as did the second Narasimham Committee, that ARCs be used as the vehicle for alleviating this problem. Importantly, the committee categorically stated that the weak banks would have to lower costs by reducing

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[17] The central government has repeatedly attempted to effect such a reduction with the help of appropriate legislation, but the proposal has met with significant resistance from the opposition parties.

the number of staff, an economically sound proposition that has been difficult to implement in light of the Indian political economy.[18] It proposed that the staff strength of weak public sector banks be reduced by 25 percent. Moreover, it argued that if VRS fails to reduce the operating cost of these banks, there should be across-the-board wage cuts for their employees.[19] Once again, given the political economy of the Indian banking industry, this was a radical proposal.

It is evident from the above discussion that all banks in India, both domestic and foreign, are subject to prudential norms that make it costly for a bank to extend a risky loan. In the short run, the bank has to bear the cost of capital whose stock rises proportionally with the risk associated with the loan portfolio. In the longer run, the bank has to make provisions on the balance sheet if the loan becomes doubtful or non-performing. Both these have negative implications for the bank's profitability, and, with even the public sector banks being subjected to hard budget constraints,[20] a bank taking too many risks may eventually be forced to reduce the size of operations and lay off employees. In other words, domestic banks in India have as much incentive to shy away from risky loans as the foreign banks. Further, while domestic banks may face pressure to honour existing lending relationships even if they

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[18] However, a generous voluntary retirement scheme (VRS) offered by the State Bank of India and some other banks in the recent past was successful in the sense that more people opted for VRS than was originally envisaged.

[19] In harmony with the proposal to reduce operating cost and staff strength, the Varma Committee proposed that the branch network of the weak banks be rationalised.

[20] The extent of government support to public sector banks declined steadily over time. In 1996-97, 1997-98, 1998-99 and 1999-00, for example, government support to public sector banks stood at Rupees 15,090 million, Rupees 27,000 million, Rupees 4,000 million and Rupees 2,970 million respectively. In 1999-00 and 2000-01, there was no government support for these banks. To put this in context, the asset base of an average public sector bank stood at Rupees 178,440 million and Rupees 373,750 million in 1995-96 and 2000-01 respectively. (Source: *Trends and Progress of Banking in India*, Reserve Bank of India, various issues.)

are risky, this pressure may well be offset by the fact that many of them, especially the public sector banks, have large volumes of NPAs on their balance sheets that is likely to make them significantly risk averse. In other words, there can be no priors about the lending behaviour of foreign banks relative to the domestic banks.

3. Empirical Methodology: Measuring Efficiency and Technical Change

The measurement of firm level technical efficiency has become commonplace with the development of frontier production functions. The approach can be deterministic, where all deviations from the frontier are attributed to inefficiency, or stochastic, which is a considerable improvement, since it is possible to discriminate between random errors and differences in inefficiency. This paper uses a stochastic frontier model, of the type originally proposed by Aigner, Lovell and Schmidt (1977)[21], extended to include the characteristics of the firm that explain the inefficiency, following the work of Battese and Coelli (1995). Whereas ordinary least squares (OLS) estimation takes the average line of best fit through the observations (a mean response function) and tacitly assumes that all the banks are efficient, this can be misleading if there are considerable differences in efficiency levels. Tests associated with stochastic frontier analysis indicate whether a production frontier is the appropriate model for a given sample, and efficiency levels are estimated for all banks and for every year.

First, the frontier model determines the efficiency levels of the sample banks, with respect to those that represent best practice, and then the inefficiencies are explained. The method of maximum likelihood is used to estimate the unknown parameters, with the stochastic frontier and the inefficiency effects estimated simultaneously. The theory is not recounted in detail here as it is fully documented in Coelli (1995), Coelli, Rao and Battese (1998).

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[21] See Fried, Lovell and Schmidt (1993) for a comprehensive survey of methods and applications.

The estimating equation is

$$y_{it} = f(x_{j,it}, t, \beta) + \varepsilon_{it} \quad where \; \varepsilon_i = V_{it} - U_{it}$$
$$with \quad U_{it} \sim |N(\mu_{it}, \sigma_U^2)| \quad and \quad V_{it} \sim N(0, \sigma_V^2) \tag{1}$$

where $f(.)$ is a suitable functional form, y_{it} is the output of bank i at time t, $x_{j,\,it}$ is the corresponding level of input j and β is a vector of parameters to be estimated. The V_{it}'s are independently and identically distributed random error terms and uncorrelated with the regressors, and the U_{it}'s are non-negative random variables associated with the technical inefficiency of the bank.[22] In the second part of the model, this inefficiency term, U_{it}, is made an explicit function of k explanatory variables, $z_{k,it}$, that represent the characteristics of the banks. The U_{it} are independently (but not identically) distributed as non-negative truncations of the normal distribution of the form

$$U_{it} \sim N\left[\delta_0 + \sum_{k=1}^{M} \delta_k z_{k,it}, \sigma^2\right] \tag{2}$$

The technical efficiency of an individual bank is defined in terms of the ratio of the observed output to the corresponding frontier output, conditional on the levels of inputs used by that bank. Thus, the technical efficiency of bank i at time t in the context of the stochastic frontier production function can be expressed in terms of the errors as

$$TE_{it} = E[\exp(-U_{it})|(V_{it} - U_{it})] \tag{3}$$

which is the expectation of the exponentiated technical inefficiencies, conditional on the error, ε_{it}. Since U_{it} is a non-negative random variable these technical efficiencies lie between zero and unity, where unity indicates that this firm is technically efficient.

The efficiency change is the index $EC_{i(t+1)}$, which is the ratio of the two distance

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[22] If the residuals are negatively skewed, the maximum likelihood estimator for the stochastic frontier production function model is simply OLS (See Waldman (1992)). In this case, either the model is mis-specified or the data are not consistent with the functional form.

functions, for time $t+1$ and t, can be calculated as

$$EC_{i(t+1)} = \frac{TE_{i(t+1)}}{TE_{it}} \tag{4}$$

4. Determinants of Credit Disbursal and Technical Efficiency

The functional form of the stochastic frontier is determined by testing the adequacy of the Cobb Douglas relative to the translog. These frontier models are defined as

$$y_{it} = \beta_0 + \sum_{j=1}^{7} \beta_j x_{jit} + V_{it} - U_{it} \tag{5}$$

and

$$y_{it} = \beta_0 + \sum_{j=1}^{7} \beta_j x_{jit} + \sum_{j=1}^{7}\sum_{k=1}^{7} \beta_{jk} x_{jit} x_{kit} + V_{it} - U_{it} \tag{6}$$

respectively, where y is advances (that is, disbursed credit) as a percentage of deposits. The proportion of deposits disbursed as credit depends on both the risk appetite of a bank and the risk that is associated with the potential pool of borrowers. In the context of the Indian banking sector, therefore, given the considerable heterogeneity in the risk-assessment capability of the banks, the expertise of the banks in assessing risk associated with loans are also likely to influence their credit disbursal behaviour. In our context, therefore, the determinants of y (i.e., x_i) are as follows:

a) <u>Labour quality</u>: Since evaluation of risks and, more importantly, risk adjusted returns, are a key pre-condition for disbursal of credit, we have to include in the specification the measure of a bank's ability to make such an evaluation. In the absence of detailed data about the skills of the labour force associated with each bank, we make the

assumption – stylised in empirical research on firm-performance – that labour quality for a bank can be measured by the proportion of employees who are skilled.[23]

b) Average quality of potential borrowers: The microeconomics of a profit maximising firm's behaviour suggests that a bank will be more reluctant to lend if the risk associated with a potential borrower with whom it can develop a business relationship is high. While it is difficult to develop a precise risk index for the borrowers, in the Indian context, it would be reasonable to assume that, by and large, lending to borrowers who reside in rural areas is associated with higher risk than lending to borrowers who reside in urban areas.[24] This is largely because of the relatively higher risk associated with the agricultural sector and the relatively higher liquidity of non-agricultural assets, especially in view of the political economy of foreclosing collateral that exists in the form of agricultural land. Hence, we proxy the risk associated with a bank's potential pool of borrowers using the proportion of its branches that are in rural areas. In other words, a bank that has a relatively high proportion of its branches in rural areas can also be expected to have a relatively high level of risk associated with a potential borrower.

c) Risk averseness of a bank: *Ceteris paribus*, the volume of credit disbursed by a bank is inversely related to its degree of risk averseness. If a bank has two alternative uses of the deposits at its disposal – disbursal of credit by way of loans or investment in corporate debentures, and investment in risk free government securities – the share of the bank's deposits invested in the risk free asset will increase with its degree of risk averseness. In India, regulations require banks to hold government or "approved"

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[23] The data provides information about the total number of officers, clerks and support staff per bank, for each of the years under consideration. We have assumed that officers are skilled labour, while the others are not.

[24] A high ratio of rural to urban branches was found to be inversely related to performance by both Sarkar, Sarkar and Bhaumik (1998) and Bhaumik and Dimova (2004).

quasi-government securities to the extent of 25 percent of their deposit base. However, since the mid 1990s, many banks have voluntarily invested much more than 25 percent of their deposits in government securities, while avoiding the market for private securities like equity and corporate bonds, despite significant liberalisation of the regulations governing banks' portfolios and an increase in the width and depth of the Indian capital market. We therefore make the reasonable assumption that the proportion of government securities in total investment reflects the risk averseness of the banks.

d) <u>Extent of mandatory risky lending</u>: All banks operating in India have to offer a stipulated minimum proportion of their loans to economic agents in the priority sectors.[25] Since these economic agents are largely farmers or small firms, the risk associated with priority sector credit is high, on average (see, e.g., Banerjee, Cole and Duflo, 2003). Therefore, since credit extended to the priority sector increases proportionately with the overall credit disbursal, this regulation with respect to priority sector lending acts as a deterrent to credit disbursal. Not surprisingly, despite the existence of a floor on priority sector exposure, banks are often in violation of this regulation, i.e., it is a *soft* regulatory constraint. However, this softness of the constraint also provides for inter-bank variation in priority sector exposure, as measured by the proportion of loans extended to the priority sector.[26] Our prior is that a bank with a relatively low exposure to the priority sector faces a softer regulatory

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[25] The priority sector comprises of agriculture and related activities, as well as designated small scale industries. Under current regulations, a domestic bank has to compulsorily extend at least 40 percent of its loans to the priority sector (33 percent for foreign banks).

[26] It is easy to see that if this were not a soft constraint, the priority sector exposure of all rational banks would have equalled the floor mandated by regulation, thereby precluding any inter-bank variation in the proportion of credit provided to the priority sector.

constraint than a bank with a relatively high priority sector exposure, and hence the former is more willing to disburse credit than the latter.

e) Legacy: The prudential norms enforced by the RBI require banks to identify and classify doubtful and bad loans, make provisions for them according to prescribed norms that are consistent with the Basle recommendations, and write them off if they remain non performing beyond a maximum waiting period. Non performing assets (NPAs) not only affect the banks' balance sheets directly, they also increase the cost of capital by way of the capital adequacy ratio and the perceived risk associated with the banks by the capital market.[27] Hence, a high volume of NPAs on a bank's balance sheet will reduce its appetite for risk, and thus deter it from extending credit. In the extreme situation, a bank might also be persuaded to limit its operations by way of "narrow" banking until its balance sheet returns to health. In other words, legacy from the past is likely to affect a bank's credit disbursal behaviour in the current period. We measure this legacy by the extent of its balance sheet exposure to NPAs.[28] Specifically, we use the (one-period) lagged value of the stock of NPAs as an explanatory variable.

Finally, we use a time trend to capture the increasing level of macroeconomic and structural reforms, as well as banking sector reforms, in the Indian economy. All the variables are in logarithms, and all are mean differenced to allow direct estimation of the elasticities.[29]

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[27] There is evidence to suggest that implementation of capital adequacy requirements reduces risk appetite of banks (e.g., Konishi and Yasuda, 2004).

[28] We use two measures of NPAs, namely, gross NPA as a percentage of total advances, and net NPA as a percentage of total advances.

[29] Where the translog is: $\ln y = b_0 + b_1 \ln x_1 + b_2 \ln x_2 + (1/2)[b_{11}(\ln x_1)^2 + b_{22}(\ln x_2)^2] + b_{12} \ln x_1 \ln x_2$, the advantage of deflating by the mean is that the mean of each variable is now equal to 1. Then, calculate the partial derivatives and evaluate them at the sample means. Since, the log of 1 is 0, the elasticity is simply equal to the

As mentioned above, our empirical methodology simultaneously estimates the frontier and the determinants of the efficiency (or inefficiency) as measured by the *distance* of a bank from the frontier. Since we are estimating a production function, as opposed to a cost function, distance from the frontier would measure the extent of inefficiency. Although our analysis involves identification of the covariates of *degrees* of inefficiency, it would be instructive to reiterate, at this stage, the interpretation of (technical) inefficiency. A bank is deemed to be inefficient if its output is less than what would be consistent with its input endowment, i.e., if it uses its inputs less efficiently than the banks that lie on the frontier. For example, if Bank A has a greater proportion of skilled employees than Bank B, *ceteris paribus*, Bank A would be expected to have a higher credit-deposit ratio. However, this clearly does not preclude the possibility that Bank A uses the human capital of its employees less efficiently than does Bank B. In other words, Bank A may have a higher credit-deposit ratio than Bank B, but Bank B's technical efficiency may be higher than that of Bank A.

Given this notion of technical efficiency, we use the following specification to explain inter-bank variation in this inefficiency:

i) <u>Ownership</u>: We use dummy variables to capture the different types of ownership among Indian banks, namely, public sector banks, domestic private sector banks and foreign banks. Our prior is that foreign banks are likely to be less efficient than the domestic banks. This can be on account of the greater learning requirement of the foreign banks regarding the Indian credit market, and/or on account of the alleged preference of foreign banks to cherry pick only the blue chip borrowers such that they do not lend to the extent that is consistent with the resources at their disposal and the extent of regulations with which they *de facto* have to cope. Note that, as highlighted

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first order coefficient, b_1. In other words, in a mean differenced model, we can obtain a measure of the elasticities directly from the coefficients associated with the linear form of *ln x_i*.

by our example, a relatively low technical efficiency of foreign banks would not be inconsistent with a relatively high average level of credit-deposit ratio.

ii) <u>Compliance with risk-augmenting regulations</u>: As mentioned above, banks in India are required to extend a significant proportion of their credit to the priority sector. We have also seen that not all banks meet this criterion even though over the years there has been a move towards greater compliance. We hypothesise that a bank's *inefficiency* relative to the frontier would be inversely related to the *softness* of this regulatory constraint. This is identified by a dummy variable that takes the value 1 if a bank is found to have complied with the priority sector regulations during a given year, and zero otherwise.

iii) <u>Alternative sources of revenue</u>: If a bank has the expertise to earn a significant amount of fee-based income, it might find it more profitable to utilise its resources more (or better) towards high value added fee-based activities than in more risky credit market activities that are relatively low value-added activities from the bank's point of view. Hence, the extent of inefficiency of a bank relative to the frontier should increase if the proportion of non-interest income in its revenue is high. However, this relationship, through plausible, is by no means definitive. Fee-based activities of a bank are usually tied to interest earning activities, and hence a bank may have the incentive to use its resources efficiently in the credit market to identify and attract customers with high growth potential, the present value of whose future demand for fee-based services is high. A high proportion of non-interest income in a bank's

revenue might therefore be an indication of efficient use of a bank's resources in the credit market.

iv) <u>Learning</u>: Learning plays an important role in a market that is marked by informational asymmetry. Learning in the context of the credit market not only takes place over time but is also an increasing function of the number of interactions between a bank and the potential borrowers.[31] If a bank has a large number of interactions with potential borrowers per unit of time, its learning is likely to be more rapid and, therefore, the extent of its inefficiency with respect to the frontier will decrease. We measure the (potential) extent of interactions between a bank and the potential borrowers by the total number of branches the bank has across India.

5. Data and Choice of Model

The model has been estimated using data obtained from the *Indian Banks' Association*. The empirical analysis involves the use of data from six financial years: 1995-96 through 2000-01. The data suggests that although there were 36 foreign banks registered in India during the period, the 10 largest foreign banks accounted for more than 85 percent of the deposit and asset base of this group. Further, all the others had a maximum of 2 branches in India, suggesting that their main line of business was not providing credit to Indian borrowers. Rather, most of these banks provided trade credit and services related to cross-border transactions. Hence, we included in our sample only the 10 largest foreign banks. For similar reasons, and for the sake of consistency, we also dropped from our sample all domestic banks that had two or fewer branches during the time period in question. Eventually, we were left

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[31] Note that learning can take two forms. For foreign banks, learning is likely to involve updating information about potential borrowers and the institutional aspects of the credit market. Domestic banks, on the other hand, might learn more about the most efficient way to use their resources in the context of business practices associated with the credit market.

with 27 public sector banks, 23 incumbent domestic private sector banks which had been in operation prior to the initiation of liberalisation of the banking sector, 8 *de novo* domestic private sector banks which started operation after the initiation of liberalisation, and 10 foreign banks. Together, they account for about 98 percent of the deposits and assets of the Indian banking industry.

The summary statistics for the data are reported in Table 1. The descriptive statistics indicate that, as mentioned above, the foreign banks have significantly higher credit-deposit ratios than the domestic banks. Anecdotal evidence and communications with personnel at the Reserve Bank of India suggest that the most likely explanation for the remarkably high credit-deposit ratios for the foreign banks is that these wholly-owned subsidiaries of multinational banks use deposits raised overseas, that is not subject to CRR and SLR in India, to make advances in the Indian credit market. In other words, there is *prima facie* evidence that, on average, foreign banks are active in the Indian credit market. The extent of their participation in credit market activities follows a predictable pattern: the credit-deposit ratio is very high in the mid 1990s when the growth of India's real sector is high at between 6 and 7 percent per annum; it declines towards the end of the decade as India's growth slows down and political and economic instability surfaces in the form of changing governments, crisis in the neighbouring South East Asian countries, and the international sanctions following the nuclear tests of 1998; and rises once again in the new millennium with greater political stability, greater economic reforms and an upswing in economic indicators. Interestingly, while the credit-deposit ratio of the domestic banks also follows this pattern, their exposure to the credit market is far less volatile than that of the foreign banks.

Predictably, the foreign banks have higher levels of skilled labour, fewer branches, lower exposure to the rural sector, and a smaller burden of NPAs on their balance sheets than the domestic banks. As expected, the former also earn a greater share of their revenues in the

form of non-interest income than the latter. However, the foreign banks have a comparable level of exposure to government securities in their investment portfolio. In the mid 1990s, the high level of exposure of foreign banks to government securities is explained by the paucity of high quality corporate securities in India at that time. The exposure of foreign banks to government paper has decreased steadily over time and by 2000-01, in conformity with our priors, their exposure to such securities was below that of the domestic banks. Importantly, while the exposure of both domestic and foreign banks to the priority sector were similar in the mid 1990s and while both declined over time, the decline in the exposure of the foreign banks is much sharper than that of the domestic banks. Anecdotal evidence suggests that this is on account of the rising share of foreign currency loans that are not affected by priority sector regulations.

<center>INSERT Table 1 about here.</center>

We now turn to the estimation of the model itself. To begin with, we have tested for the appropriate model specification, given the data. Model selection is based on a series of hypothesis tests using generalized likelihood ratio (LR) tests.[32] The first null hypothesis that the restrictive Cobb Douglas function is an adequate representation for the data (H_0: $\beta_{ij} = 0$, i,j, = 1, … 7) is rejected, indicating that the translog function, with interaction and squared terms is the preferred model. The second null hypothesis, that there is no time effect over the sample period (H_0: $\beta_7 = \beta_{77} = \ldots \beta_{7i} = 0$) is also strongly rejected by the data, where β_7 is the estimated coefficient on the time trend, β_{77} is for time-square and the β_{7i} are the time related cross product terms.

In the third test, the parameter γ ($\gamma = \sigma^2_u/(\sigma^2_v + \sigma^2_u)$ is the ratio of the error variances from (1), where γ is defined between zero and unity. If $\gamma = 0$, technical inefficiency is not

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[32] The likelihood-ratio test statistic, $\lambda = -2\{\log(\text{Likelihood } (H_0)) - \log(\text{Likelihood } (H_1))\}$ has approximately χ^2_v distribution with v equal to the number of parameters assumed to be zero in the null hypothesis.

present, and where $\gamma = 1$, there is no random noise. The null hypothesis of no inefficiencies in the model (H_0: $\gamma = \delta_k = 0$) is rejected, indicating that the frontier is a significant improvement over a mean response function.

6. Results

We note two things at the outset. First, earlier research (Bhaumik and Dimova, 2004) had indicated that the Indian banking sector had experienced a structural break during the 1995-96 to 2000-01 period. To test whether this was the case with these data we first estimated the whole sample as the restricted model and then the two periods separately, namely, 1996-97 and 1997-98, and 1998-99 to 2000-01.[33] Tests of when it is appropriate to pool subsets in panel data models are discussed extensively in Baltagi (1995).[34] The models show this to be the case as the coefficient estimates were clearly different, and consistent with the finding of Bhaumik and Dimova (2004). Hence, we estimated the frontier and coefficients of the associated translog specification for the two sub-time periods. Second, $\gamma \approx 1$ for both the regressions associated with both the time periods. In other words, given the data and the specification, we have a frontier for each of the two sub-time periods.

The coefficient estimates for the translog specification are reported in the appendix. The elasticities associated with the explanatory variables, estimated at the mean values of these variables, are reported in Table 2. The upper part of the Table 2 reports the elasticies associated with the translog function that defines our frontier. Columns 1 and 2 report the

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[33] Note that we lose the observations for 1995-96 because we use the lagged value of NPA in the specification that explains inter-bank variation in the credit-deposit ratio.

[34] This is a Chow test distributed as F((r,(n-k-1)). Another test of stability is based on unequal error variances, again an F test (Toyoda, 1974). This too, confirmed the structural break, supporting the need to construct two frontiers from these data.

elasticity estimates for the 1996-98 period, while columns 3 and 4 report the elasticity estimates for the 1998-2001 period. The measure of NPA reported in columns 1 and 3 is the *gross* NPA as a percentage of total advances while the measure reported in columns 2 and 4 is the *net* NPA as a percentage of total advances. Since the translog specification involves the use of both linear and quadratic forms of the explanatory variables, as well as the interaction terms, we present the overall elasticity for each variable, evaluated at the mean. The coefficients of the translog model underlying these elasticities are reported in the appendix.

INSERT Table 2 about here.

The elasticity estimates capturing the impact of the explanatory variables on the credit-deposit ratio of the banks are partly counter-intuitive. Consistent with our priors, the ratio is inversely related to both exposure to the rural sector and to the priority sector. However, skill level of employees does not seem to have any impact on the ability to make advances. This result can perhaps be explained by the inability of our measure of labour quality to capture the heterogeneity of skills among "officers" employed by the different banks.

More importantly, exposure to government securities is positively correlated with the extent of credit disbursal by banks. This result has possibly been driven by two sets of banks. At one end of the spectrum, we have large public sector banks that have a high proportion of government securities in their investment portfolio, due to historical precedent and the political economy of public sector banks in India. These banks also had high credit-deposit ratios. At the other end of the spectrum, foreign banks rarely invest in non-sovereign securities in India because of rating risks and lack of liquidity in the market for corporate bonds. Hence, these banks have a high proportion of government securities in their investment portfolios. However, at the same time many of these foreign banks had adopted a bullish strategy on India, especially during the latter part of the 1990s. The positive

correlation between the proportion of government securities in the investment portfolio, and the advance to deposit ratio for some large public sector and foreign banks has resulted in a positive coefficient on the government securities variable.

More importantly, contrary to expectations, credit disbursal by banks is *positively* correlated with the legacy of NPAs, with the exception of foreign banks during the 1998-99 to 2000-01 period. This suggests that the dynamics of the impact of NPAs on the lending behaviour of banks is perhaps driven largely by perverse behaviour characterised by ever-greening of existing doubtful loans, and attempts by the banks' management to reduce the exposure to NPAs as a percentage of total advances by expanding overall credit rapidly. This inference about greater risk-taking by banks facing low profit streams and/or having low net worth, evidence of which has been found elsewhere (e.g., Salas and Saurina, 2003; Horiuchi and Shimizu, 1998; Galloway, Lee and Roden, 1997), is consistent both with the theoretical literature (e.g., Blum, 1999) and with the available anecdotal evidence about domestic Indian banks.

While the results are largely robust across the two sub-periods, the model is clearly a better fit for the data for the 1996-98 sub-period – as indicated by the greater number of significant coefficients, a result that is consistent with that of Bhaumik and Dimova (2004). The greater noise in the data for the 1998-2001 period can be attributed to shocks like the nuclear test in 1998 and the subsequent sanctions imposed on India by a large number of industrialised countries and the border war with Pakistan in 1999. The impact of the shocks is captured in part by the trend variable, which has a negative coefficient for the 1998-2001 period.[35]

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[35] India's GDP growth rate, which averaged 7.5% during 1995-97 period, declined sharply to 4.8% during 1997-98, recovered to an average of 6.3% during 1998-2000 and declined again to 4.4% during 2000-01. The growth rate of the manufacturing, construction and energy sectors during the corresponding periods were 10% (1995-

The lower part of Table 2 reports the determinants of technical inefficiency, and the results here are more consistent with our priors. As expected, inefficiency is a decreasing function of the bank-specific *softness* of the regulatory constraint with respect to priority sector exposure. Further, while the proportion of non-interest income in a bank's revenue did not affect its technical efficiency in the 1996-98 period, inefficiency (efficiency) was a decreasing (increasing) function of non-interest income in the 1998-2001 period. Finally, as expected, the inefficiency of the banks decreased with the extent of branch network in the former period, even though marginal gains from learning seem to have been exhausted by 1998-99.

During the 1996-98 period, the domestic private banks were clearly more efficient than the foreign banks, the omitted category, even though, *ceteris paribus*, there was no perceptible difference between the extent of inefficiency of the foreign banks and public sector banks. However, the results indicate that, during the 1998-2001 period, both the public and private sector domestic banks were less inefficient than the foreign banks. This trend is also highlighted in Figure 1.[36] It indicates that all but a handful of domestic banks experienced improvement in technical efficiency between 1996-97 and 2000-01. On the other hand, at least 50 percent of the foreign banks experienced a decline in their technical efficiency over the same time period. Indeed, while the average efficiency of incumbent domestic banks increased from 0.76 in 1996-97 to 0.87 in 2000-01, and the average efficiency of *de novo* domestic banks increased from 0.71 to 0.87 over the same period, the average efficiency of the foreign banks remained unaltered at 0.80.

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97), 3.8% (1997-98), 4.4% (1998-2000) and 7% (2000-01), respectively (*Economic Survey*, Government of India, 2002-3, p S-10).

[36] We generated the graph for both specifications, the one in which NPA is measured in *gross* terms, and the alternative specification in which it is measured in *net* terms. The graphs look alike and therefore we present only that for the specification that includes *gross* NPA.

INSERT Figure 1 about here.

There are several possible explanations for this observed phenomenon. It can be argued that, over time, the learning of the domestic banks with respect to best practice in the credit market was possibly greater than the learning of the foreign banks with respect to the borrower pool and institutional factors. Hence, the domestic banks, which were not as efficient as the foreign banks, on average, in 1996-97, caught up with, and indeed outperformed, the foreign banks in terms of technical efficiency by 2000-01. This explanation is consistent with the existing literature on the Indian banking sector (e.g., Bhaumik and Dimova, 2004). It is equally possible, however, that the ability of the foreign banks to augment their technical efficiency was affected not by their slower rate of learning but by a paucity of high quality borrowers. This line of argument is appealing on account of the fact that, as observed earlier, domestic deposit bases do not seem to impose constraints on the ability of the foreign banks to offer credit to (presumably) the blue chip borrowers.

5. Concluding Remarks

This paper is a perfect supplement to the existing literature on Indian banking which indicates that, starting from little competition in the immediate aftermath of the reforms in the early 1990s (Sarkar and Bhaumik, 1998), competition in the Indian industry grew steadily (Shirai and Rajsekaran, 2001) such that there was a convergence between the operational performance of public sector and other types of banks over time (Bhaumik and Dimova, 2004). In this paper, we show that a noticeable presence of foreign banks in the Indian credit market has coincided with a steady improvement in the technical efficiency of the domestic banks with respect to credit disbursal such that, by the turn of the century, the domestic banks were more efficient, on average, than the foreign banks which had an initial advantage with

respect to technical efficiency. The impact of liberalisation of the banking industry and the resultant competition are palpable. However, the results also indicate that there is at least some possibility that while foreign banks are willing to take significant exposures to the Indian borrowers, they are likely to restrict their exposure to blue chip borrowers and not exploit the full potential of the resources, including softness of regulatory constraints, at their disposal. Importantly, the results of both this paper and Bhaumik and Dimova (2004) indicate that the domestic *de novo* banks outperform the others with respect to both profitability and technical efficiency with respect to credit disbursal. In other words, if policymaking for the banking sector in an emerging market involves both an improvement in the profitability/viability of banks and the best possible use of banking resources to disburse credit that is important for economic growth, the emphasis of policymaking should be more on liberalisation that encourages entry of *de novo* domestic banks into the industry than on foreign direct investment (FDI) related reforms that reduce the barriers to entry of the foreign banks. Competition, rather than foreign ownership *per se*, is more likely to be a panacea to banking sectors in these countries.

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Table 1: Descriptive Statistics – Mean (Standard Deviation)

|	1996-97		1998-99		2000-01	
	Domestic	**Foreign**	**Domestic**	**Foreign**	**Domestic**	**Foreign**
Credit-deposit ratio	0.69 1.21)	0.91 0.36)	0.49 0.09)	0.71 0.20)	0.48 0.09)	0.78 0.31)
Priority % total advances	31.49 9.37)	31.20 4.30)	33.27 6.66)	34.86 5.58)	29.68 13.75)	13.94 5.89)
Govt. security % total investment	71.37 9.80)	83.83 10.69)	67.62 9.12)	77.16 12.01)	68.10 9.87)	64.20 14.09)
Non-interest income % total income	12.69 4.10)	19.01 4.79)	13.92 4.99)	21.66 7.04)	13.86 4.00)	22.74 5.53)
Gross NPA % advances	12.34 8.88)	2.15 2.14)	13.23 7.59)	6.75 13.18)	12.22 6.38)	5.85 3.92)
Net NPA % advances	6.65 5.32)	0.60 1.11)	7.46 4.48)	2.39 4.57)	7.45 4.29)	1.85 1.79)
Officer-non officer ratio	0.43 0.57)	0.99 0.62)	0.45 0.68)	2.34 3.51)	0.37 0.17)	3.36 3.34)
Rural branches % total branches	56.76 23.12)	0.00 0.00)	61.51 32.43)	0.54 1.69)	56.48 16.01)	0.49 1.54)
Total branches	835.62 1362.49)	14.00 17.85)	857.88 1370.86)	13.60 16.62)	885.50 1394.15)	12.90 12.09)

Table 2: Regression Results: Estimated Elasticities

(Dependent variable: Credit-deposit ratio)

	1996-97 and 1997-98		1998-99 to 2000-01	
Maximum Likelihood Estimates (t stats)	1	2	3	4
Constant	0.06	0.05	0.17	0.11
	(2.46)	(1.87)	(16.85)	(7.28)
Proportion of skilled labour	- 0.06	- 0.05	- 0.15	- 0.08
	(-0.22)	(-0.20)	(-0.73)	(-0.45)
Proportion of rural branches	- 0.49	- 0.47	- 0.75	- 0.35
	(-2.12)	(-2.19)	(9-3.05)	(-1.69)
Proportion of government securities in total investment	2.52	2.67	0.28	- 0.001
	(1.44)	(2.17)	(0.26)	(0.00)
Proportion of priority sector advances in total credit disbursal	- 0.89	- 0.78	- 0.35	- 0.87
	(-1.14)	(-1.01)	(-0.48)	(-1.89)
Non performing assets as percentage of loans	0.03	0.07	0.03	- 0.59
	(0.77)	(1.28)	(1.05)	(-3.88)
Time			- 0.18	- 0.24
			(-0.95)	(-1.32)
γ	0.64	0.50	0.99	0.96
	(4.32)	(2.64)	(127.27)	(49.39)
σ^2	0.02	0.01	0.04	0.14
	(3.41)	(3.74)	(5.63)	(1.50)
Log Likelihood	105.85	110.62	166.49	153.34
Inefficiency Effects				
Constant	0.10	0.04	1.51	1.77
	(0.45)	(0.20)	(6.67)	(2.11)
Dummy for public sector banks	0.10	0.08	- 0.48	- 0.52
	(0.49)	(0.44)	(-2.24)	(-0.52)
Dummy for private sector banks	0.53	0.48	- 0.38	0.17
	(2.53)	(2.22)	(-2.84)	(0.24)
Dummy for non-compliance with priority sector lending regulations	- 0.14	- 0.14	- 0.07	- 0.34
	(-1.78)	(-1.80)	(-0.93)	(-1.08)
Proportion of non-interest income in total revenue	0.01	0.01	- 0.49	- 1.01
	(0.24)	(90.22)	(-7.35)	(-1.82)
Total number of branches	- 0.12	- 0.08	0.03	0.01
	(-2.21)	(-2.06)	(0.95)	(0.15)
Efficiencies				
Mean	0.93	0.94	0.84	0.89
Standard deviation	(0.06)	(0.06)	(0.11)	(0.09)

Note: *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively.

Figure 1: Changes in Technical Efficiency over Time.
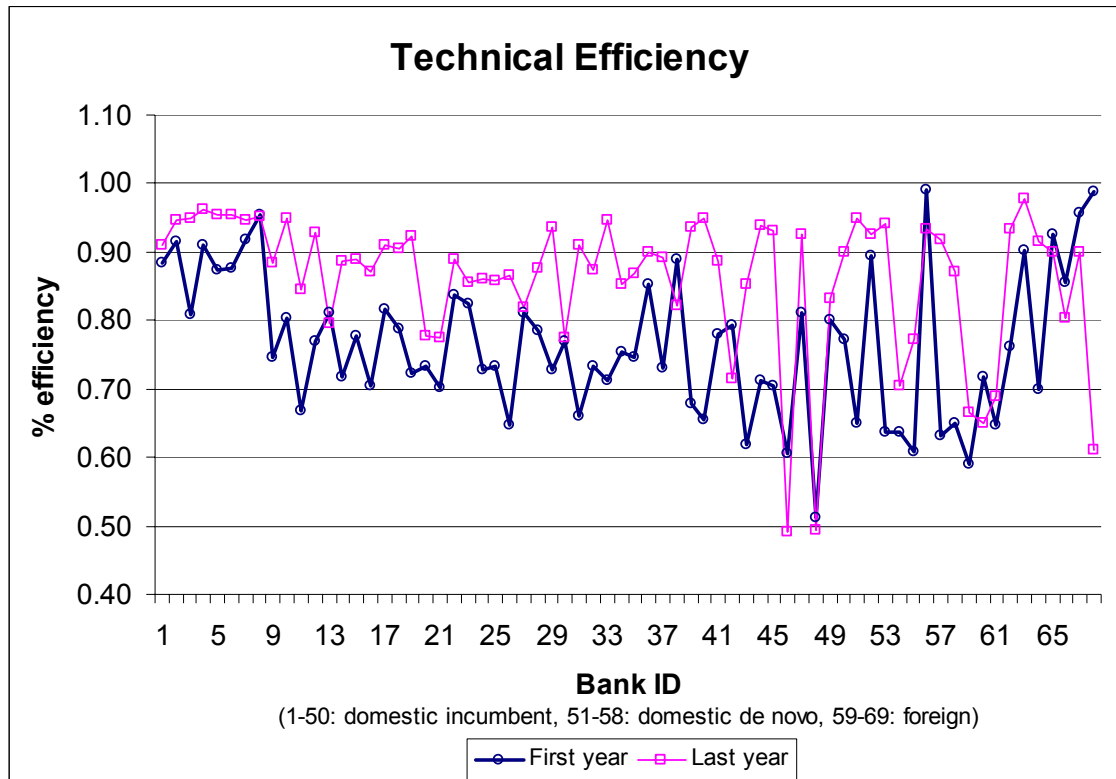
Note: First year = 1996-97, Last year = 2000-01

Appendix Table 1: MLE from Translog Regression Dependent variable: Credit-deposit ratio)

	1	2	3	4
Constant	0.0646	0.0529	0.1765	0.1765
	2.465)	1.869)	16.853)	16.853)
Proportion of skilled labour	-0.0635	-0.0517	-0.1575	-0.1575
	-0.222)	-0.197)	-0.731)	-0.731)
Proportion of rural branches	-0.4999	-0.4785	-0.7548	-0.7548
	-2.118)	-2.185)	-3.053)	-3.053)
Proportion of government securities in total investment	2.5249	2.6738	0.2828	0.2828
	1.442)	2.172)	0.264)	0.264)
Proportion of priority sector advances in total credit disbursal	-0.8930	-0.7871	-0.3538	-0.3538
	-1.144)	-1.015)	-0.480)	-0.480)
Lagged net non performing assets	0.0364	0.0719	0.0393	0.0393
	0.766)	1.281)	1.052)	1.052)
Time			-0.1824	-0.1824
			-0.955)	-0.955)
Proportion of skilled labour^2	0.0083	0.0108	0.0167	0.0167
	1.331)	1.760)	3.237)	3.237)
Proportion of rural branches^2	0.0205	0.0186	0.0021	0.0021
	1.781)	1.565)	0.235)	0.235)
Proportion of government securities in total investment^2	-0.6356	-0.6328	-0.2862	-0.2862
	-2.153)	-3.056)	-1.694)	-1.694)
Proportion of priority sector advances in total credit disbursal^2	0.0844	0.1101	0.0478	0.0478
	1.322)	1.812)	1.230)	1.230)
Lagged net non performing assets^2	0.0002	0.0008	-0.0005	-0.0005
	0.771)	1.830)	-3.316)	-3.316)
Time^2	0.0014	0.0035	0.0118	0.0118
	0.180)	0.476)	0.723)	0.723)
Skilled labour*rural branches	-0.0171	-0.0165	-0.0303	-0.0303
	-2.196)	-2.313)	-4.605)	-4.605)
Skilled labour*government securities	0.0501	0.0445	0.0333	0.0333
	0.536)	0.518)	0.517)	0.517)
Skilled labour*priority sector	-0.0445	-0.0458	0.0194	0.0194
	-1.489)	-1.566)	1.102)	1.102)
Skilled labour*non performing assets	-0.0056	-0.0142	-0.0038	-0.0038
	-1.555)	-2.861)	-1.485)	-1.485)
Skilled labour*time	0.0198	0.0229	0.0069	0.0069
	0.880)	1.069)	0.676)	0.676)
Rural branches*government securities	0.2059	0.2154	0.2195	0.2195
	3.059)	3.784)	3.376)	3.376)
Rural branches*priority sector	-0.0710	-0.0747	0.0314	0.0314
	-1.921)	-2.044)	1.232)	1.232)
Rural branches*non performing assets	0.0007	-0.0011	0.0039	0.0039
	0.231)	-0.253)	1.976)	1.976)
Rural branches*time	-0.0133	-0.0234	-0.0264	-0.0264
	-0.606)	-1.088)	-2.031)	-2.031)
Gov securities*priority sector	0.1422	0.0728	0.0357	0.0357
	0.670)	0.362)	0.174)	0.174)
Gov securities*non performing assets	-0.0060	-0.0107	0.0069	0.0069
	-0.382)	-0.667)	0.680)	0.680)
Gov securities*time	-0.1249	-0.1235	0.0380	0.0380
	-2.068)	-2.296)	0.663)	0.663)
Priority sector*non performing assets	-0.0026	-0.0025	-0.0165	-0.0165
	-0.433)	-0.251)	-3.326)	-3.326)
Priority sector*time	0.1012	0.0978	0.0185	0.0185
	1.4580	1.617)	0.593)	0.593)
Non performing assets*time	0.0021	0.0079	0.0023	0.0023
	0.6152	1.480)	1.091)	1.091)

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