Increased Access to Financing and Firm Productivity

Abstract

We analyze how increased access to financing affects firm productivity using a large sample of manufacturing firms from the U.S. Census Bureau's Longitudinal Research Database (LRD). We exploit a natural experiment following the interstate bank branching deregulations that increased access to bank financing and relate these deregulations to firm level total factor productivity (TFP). Our results indicate that firms' productivity increased subsequent to their states implementing the bank branching deregulations. The increased productivity following the deregulation is long lived. Further, TFP increases after the bank branching deregulations are greater for financially constrained firms. In particular, firms that are close to but not eligible for financial support from the U.S. Small Business Administration (and thus more financially constrained) have higher TFP increases after the deregulation than firms that just satisfy eligibility criteria (and are hence less financially constrained). Our results support the idea that greater access to financing can increase financially constrained firms' access to productive projects (i.e., positive NPV projects) that they may otherwise not be able to take up. Our results emphasize that availability of financing is important not only for startup activity (as prior research suggests), but also for increased productivity and the continued success of existing entrepreneurial and small firms.

The research presented in this paper was conducted while the authors were Special Sworn Status Researchers at the Boston Research Data Center (RDC) of the U.S. Census Bureau. The research results and conclusions expressed are those of the authors and do not necessarily indicate concurrence of the U.S. Census Bureau. All results in this paper have been reviewed to ensure that no confidential information is disclosed. Any errors and omissions are the responsibility of the authors.

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1 Introduction

Access to financing is an important issue for firms, particularly for younger and smaller entrepreneurial firms. The recent credit crisis of 2008 clearly demonstrated how critical access to bank financing is, at both the firm and economy-wide levels. Prior studies have analyzed how financing availability can affect entrepreneurial starts and closures (e.g., Black and Strahan (2002), Kerr and Nanda (2009)). In a recent paper, Robb and Robinson (2012) show that most start-ups rely heavily on bank financing. Yet, no study has directly analyzed how increased access to bank financing affects firm level performance and productivity, particularly for young firms.

There are two important limitations that studies on the effect of bank financing on firm productivity and performance need to overcome. First, bank financing is considerably more important for private firms, and data on the performance of such firms is not easily accessible. Second, reverse causality and endogeneity issues hinder proper interpretation of regression coefficients relating bank financing availability to firm productivity. A positive relation between bank financing availability and productivity can be interpreted in different ways. One interpretation is that firms seek bank financing because they more productive. Another interpretation is that bank financing can enhance productivity of these firms. Yet another interpretation can be that there are potentially unobservable factors can affect both access to finance and productivity. Disentangling these effects requires a natural experiment setting where one can consider an exogenous shift in the availability of bank financing.

In this paper, we exploit such a natural experiment and contribute by analyzing how an increase in bank financing availability following bank branching deregulations affects the productivity of firms in the United States. We overcome the data availability issue described above by using data on private and public manufacturing firms from the U.S. Census Bureau's Longitudinal Research Database (LRD). This database contains detailed data for small and large manufacturing firms in the U.S. over a long time-series from 1976 to 2005, which allows us to calculate productivity and performance measures at the firm level. We deal with the reverse causality concern by exploiting exogenous shifts in firms' access to financing as a result of deregulation of interstate bank branching

restrictions by states. In particular, over the 1990s, U.S. states began allowing out-of-state banks to set up local branches. This shift led to an increase in interstate banking and thus allowed greater access to financing for firms. Prior literature (e.g., Rice and Strahan (2010) argues that these deregulations were exogenous and we also show that these deregulations were unrelated to the productivity of firms.

Prior literature suggests that increased access to financing due to interstate banking deregulations in the U.S. reduced the cost of financing (Rice and Strahan (2010)). A natural question is whether increased access to affordable financing increases firms' access to productive projects (i.e., positive NPV projects) that they may otherwise not be able to take up.[1] We use total factor productivity (TFP) of firms as our metric of analysis to address this question. Since our measure of total factor productivity reflects the difference between expected output, given the technology in place, and the actual output produced by the firm (i.e., the component of output that is orthogonal to inputs), gains in productivity as a result of increase in financing is not simply a result of increase in the scale of operations, but rather the result of access to positive NPV projects that allows a firm to become more productive and efficient. Further, greater access to financing should lead to the highest increase in productivity for those firms that are the most financially constrained.

We start by investigating whether firms in states that implement the Interstate Banking and Branching Efficiency Act of 1994 (IBBEA) have higher productivity following the deregulation, than firms in states that do not. Similar to several other papers that have used the LRD database to study various corporate events (see, e.g., Schoar (2002), Maksimovich, Philips, and Prabhala (2011), Chemmanur, Krishnan, and Nandy (2011)), we use total factor productivity (TFP) as our measure of firm efficiency. TFP growth measures the residual growth in a firm's output after accounting for the growth in output attributable to the various factors of production and the production technology in place. In other words, an increase in TFP is an increase in the overall productivity (efficiency) of the firm, since more output can now be produced than earlier, with each of the factors of production remaining the same.As a robustness test, we also conduct our analysis using alternative measures of performance such as labor productivity and return on assets (ROA) and find qualitatively similar results to the ones we find using the TFP measure.

[1] Note that throught this paper, increased access to financing refers to both access to greater volume of bank loans as well as bank financing at more favorable terms.

We find that productivity of firms in a state increases after the state allows interstate bank branching within its borders. This result is robust to controlling for various state, firm, and industry level control variables. This increase in TFP subsequent to the deregulation of interstate bank branching is economically significant and is long lived. In falsification tests, we do not find that the TFP of firms increase due to a trend effect, i.e., TFP is flat in the period immediately prior to the interstate bank branching deregulations. Further, our main results disappear in placebo tests where we check whether TFP increases when we incorrectly assume the deregulation to start one, two, and three years prior to the actual deregulation year. We also control for various state level characteristics as well as state, county, and firm fixed effects in our analyses, and find that our results are robust to these controls. Thus, we do not find evidence that interstate bank branching deregulations were implemented earlier by states that had more productive firms or that our TFP results are driven by secular trends in TFP over time. Moreover, our results are robust to using alternative measures of firm performance such as labor productivity and ROA.

We then investigate the channel through which increased access to financing leads to greater TFP. We find that our TFP results are driven largely by financially constrained firms. Such firms experience the greatest increase in TFP after interstate bank branching deregulations, where financial constraint proxied by firm size is measured immediately prior to the deregulation. We use various size measures for this analysis, including sales (total value of shipments), assets (capital stock), and total employment. We also find that young firms, defined as firms that are 1 to 3 years old at the time of the interstate bank branching deregulations in their state, have the greatest increase in TFP after their state deregulates interstate bank branching. These results suggest that financially constrained firms primarily drive the relation between increased financing, following bank branching deregulations, and TFP.[2]

To dig deeper into whether financial constraints are indeed driving our results, we perform two additional analyses. First, we test whether our TFP results are stronger for firms in industries that are more financially constrained. We measure industry financial constraint based on the measure suggested by Rajan and Zingales (1998). This measure is based on a free cash flow measure calculated using Compustat at the industry level. We find that industries classified as more de-

[2] These results are consistent with those in Rice and Strahan (2010), who find that deregulation of interstate bank branching restrictions is associated with a higher probability that small firms borrow from banks.

pendent on external finance experience substantially greater increases in TFP following interstate bank branching deregulations than industries classified as less dependent on external finance.

Second, we employ a "Quasi-Regression discontinuity" methodology, where we test whether firms that are close to but do not satisfy the eligibility criteria for alternative funding sources, such as support from the Small Business Administration (SBA), have higher TFP increases after the bank branching deregulations than firms that just satisfy the eligibility criteria. The U.S. Small Business Administration (SBA) provides a number of financial assistance programs for small businesses. We exploit the fact that the SBA provides financial support to firms up to a certain size cutoff as a way to distinguish firms that are more financially constrained from those that are less financially constrained. For manufacturing firms, the size cutoff is a prespecified level of employment that varies with the firm's North American Industry Classification System (NAICS) industry affiliation. We restrict our attention to the set of firms that have employment within 10% of this cutoff level (where employment is measured immediately prior to the interstate bank branching deregulation in the firm's state). The advantage of this restriction is that firms just above and just below the SBA threshold are unlikely to differ substantially in terms of other characteristics and factors but differ in terms of their access to SBA financing. In particular, firms just above the SBA employment threshold are ineligible for SBA funding and are thus more financially constrained than firms just below the SBA employment threshold. It follows that, if productivity increases following bank branching deregulations are primarily driven by firms that are financially constrained, then TFP increases for firms above the SBA threshold should be higher than TFP increases for firms below the SBA threshold after the deregulation (thus we call this method "Quasi-Regression discontinuity").

Our results are consistent with this expectation. That is, firms ineligible for SBA support indeed experience greater increases in TFP when they have access to increased financing following the interstate bank branching deregulations compared to otherwise similar firms that are eligible for SBA support. Thus, this test provides additional support for the argument that financially constrained firms benefit the most from increased access to financing. Further, since the control firms (SBA eligible firms) are similar to the set of firms that we expect to be financially constrained, this methodology provides additional assurance that our results are not driven by other, potentially unobservable, differences between firms. We also conduct this analysis with the set of firms whose employment is within 30% of the SBA employment threshold as well as our entire sample and

obtain similar results to those described here.

We are one of the first studies in the literature to analyze firm-level productivity changes following increased access to financing.[3] Existing literature in this area has utilized banking regulations to analyze entrepreneurship and startup activity (Black and Strahan (2002), Kerr and Nanda (2009)), growth within a country (Jayaratne and Strahan (1996), Guiso, Sapienza, and Zingales (2004)), access to credit (Cetorelli and Strahan (2006)), loan pricing (Rice and Strahan (2010)), and allocation of credit between poor and better performing firms (Bertrand, Schoar, and Thesmar (2007)).[4] Our results add to these studies by showing that greater access to affordable financing leads to higher productivity of firms in the U.S. Thus, we provide direct evidence that enhancing the availability of cheaper finance can impact firms' real performance and productivity. Our results also show how financial constraints of firms can depress their performance, and how alleviating such constraints lead to an increase in their productivity.

A related strand of literature has documented how access to particular types of financing such as venture capital and angel financing can impact the survival and productivity of small and entrepreneurial firms (e.g., Puri and Zarutskie (2010), Chemmanur, Krishnan, and Nandy (2011), Kerr, Lerner, and Schoar (2012)). These papers show that for young startup firms access to VC or angel financing can affect productivity and the lifecycle of these firms but it is very selective - only a small proportion of startups get VC or angel financing. Our paper shows that increased access to bank financing is important in affecting the productivity of small, young, firms. This is crucial from a policy perspective if the objective is to promote the growth of startups especially given that most young firms rely heavily on bank financing.

Another strand of literature uses international data to assess the role of finance in development and growth. Rajan and Zingales (1998) use cross-country data and find evidence consistent with the idea that financial development promotes economic growth for industries that are more dependent on external finance. Levine, Loayza, and Beck (2000) find that a greater extent of financial

[3] A notable exception is Bertrand, Schoar, and Thesmar (2007) who show that improvements in performance of French firms followed after the government reduced state intervention in banking and reduced subsidized loans for poorly performing firms. However, our results are primarily driven by a positive shock to credit availability which led to increased competition in banking as a result of the interstate bank branching deregulation in the U.S. (Rice and Strahan (2010)) than due to the abolition of subsidized credit availability to poor quality borrowers as in Bertrand et. al..

[4] Also related to this literature, Butler and Cornaggia (2011) find a large shift in corn productivity of farmers in response to the ethanol-induced shift in demand, and that this productivity improvement was most pronounced in counties with high levels of bank deposits.

intermediation in a country has a positive effect on economic growth. Guiso, Sapienza, and Zingales (2004) use Italian data to show that better developed financial markets in a geographic region in Italy leads to greater startup activity by younger entrepreneurs and leads to greater economic growth in that region. We add to the findings of this literature by showing real firm-level productivity improvements following increased access to financing in the U.S. Finally, this paper is related to the broader literature on financing constraints of firms (e.g., Fazzari, Hubbard, and Petersen (1988), Kaplan and Zingales (1997, 2000), Moyen (2004)).

2 Interstate Banking Regulations in the U.S.

Various regulations in the US restricted intra as well as interstate banking dating back to the 19th century. The McFadden Act of 1927 restricted cross-state banking and state level regulations prevented banks from intra-state expansions. Although banks tried to get around these regulations by forming multi-bank holding companies (MBHCs), the Douglas Amendment to the 1956 Bank Holding Company (BHC) Act effectively prevented banks' expansion across state borders, unless states explicitly permitted such expansion. However, states gradually dismantled these restrictions and many states had laws in place allowing interstate banking by 1992, which primarily took the form of allowing out-of-state banks to buy in-state banks. However, interstate bank branching was still not allowed until the passage of the Interstate Banking and Branching Efficiency Act of 1994 (IBBEA).[5]

The passage of IBBEA effectively permitted bank holding companies to operate branches across state lines. However, states were given the ability to erect roadblocks to branch expansion, effectively allowing states to dissuade interstate branching based on the following four dimensions.

1. Age restriction: States could require that a bank seeking to enter its boundaries should have existed for a minimum number of years, subject to a maximum restriction of 5 years.

2. De novo interstate branching restriction: States could disallow de novo interstate bank branching.

[5] See Kerr and Nanda (2009) and Rice and Strahan (2010) for detailed descriptions of banking regulations in the U.S. over this period.

3. Individual branch acquisition restriction: States could make interstate acquisition of banks more difficult by requiring that all branches of an in-state target bank be acquired by an out-of-state bidder bank.

4. Statewide cap on deposits restriction: States could restrict the fraction of deposits an out-of-state bank could acquire in that state. The IBBEA originally set this restriction on deposit concentration at 30%, but states have the discretion to increase or decrease the cap.

These provisions provided states with tools to effectively constrain interstate bank branching. Many states succesfully utilized these provisions to bar out-of-state banks from setting up branches within their borders. The IBBEA was passed in 1994, but states had the discretion to set up their interstate bank branching regulations under the IBBEA anytime before 1997. As a result, these deregulations were implemented in a staggered manner, thereby allowing us to exploit them to analyze how an increase in access to financing as a result of these deregulations affect the productivity and performance of firms. Our primary measure of deregulation is a dummy variable called *After*, which is one for all years on and after the interstate banking deregulation is implemented in a state. Table 1 reports the state level interstate bank branching laws and the dates on which they were implemented. The data for this table is obtained from Rice and Strahan (2010). Similar to Rice and Strahan (2010), we also create a *Deregulation Index*, which is a measure of the extent of deregulation of interstate bank branching in a state. The index can take values between one to five, one being the least deregulated, i.e., where all four restrictions described above were placed to prevent interstate branching; and five is the least restricted, where none of the restrictions were placed. This index increases by one if the restriction decreases by one (of the four described above). This index takes the value zero for all years before the state implements interstate bank branching deregulation.

3 Data, Sample Selection, and Construction of Variables

The primary data used in this study is obtained from the LRD, which maintained by the Center of Economic Studies at the U.S. Census Bureau.[6] The LRD is a large micro database that provides

[6] See McGuckin and Pascoe (1988), who provide a detailed description of the Longitudinal Research Database (LRD) and the method of data collection.

plant-level information for firms in the manufacturing sector. In the census years (1972, 1977, 1982, 1987, 1992, 1997, and 2002), the LRD covers the entire universe of manufacturing plants in the Census of Manufacturers (CM). In non–census years, the LRD tracks approximately 50,000 manufacturing plants every year in the Annual Survey of Manufacturers (ASM), which covers all plants with more than 250 employees with probability one. In addition, it also includes smaller plants that are randomly selected every fifth year to complete a rotating five-year panel. Therefore, all U.S. manufacturing plants with more than 250 employees are included in the LRD database on a yearly basis from 1972 to 2005, and smaller plants with fewer than 250 employees are included in the LRD database every census year and are also randomly included in the non–census years, continuously for five years, as a rotating five year panel.[7] Most of the data items reported in the LRD (e.g., the number of employees, employee compensation, and total value of shipments) represent items that are also reported to the IRS, increasing the accuracy of the data.

To verify longitudinal links of firms and for name and address matching of firms to the Census data, we also use two alternate data source maintained by the U.S. Census Bureau, namely the Standard Statistical Establishment List (SSEL), and the Longitudinal Business Database (LBD).[8] The major advantage of using the LRD relative to the LBD for this study is the following: assets, sales, operating costs, investments, and other such firm-level information are mostly not covered in the LBD. Thus, our overall metric of firm efficiency–i.e., total factor productivity (TFP)–can only be constructed for the LRD panel.

Since the objective of our paper is to analyze the how interstate bank branching deregulations affect private entrepreneurial firms, we identify all public firms (as defined by CRSP) for every year in our sample and remove them from the LRD by using either the Compustat-SSEL bridge or a name address matching methodology as outlined in previous studies.[9] Thus, in any given year within our sample, we are left with only private firms, representing 570,596 firm-years of data for

[7] Given that a random sample of smaller plants is continuously present in our sample, our data is not substantially skewed toward larger firms; smaller firms are well represented in the data. The rotating sample of smaller plants is sampled by the Census Bureau each year in the non-census years in order to minimize such a bias in the data.

[8] The SSEL, is the Business register of the US Census Bureau, which records the name, address, and some other details of every single establishment in the US. Similar to the LRD, the LBD is created from the SSEL and is also a panel data set that tracks the set of U.S. business establishments from 1975 to the present. While the LRD is limited to the manufacturing sector, the LBD encompasses all industry sectors.

[9] We also conduct our analysis after including publicly traded firms, and our results remain qualitatively similar to those reported in this paper.

137,009 firms.[10]

3.1 Measurement of Total Factor Productivity (TFP)

The primary measure of firm efficiency used in our analysis is total factor productivity (TFP), which is calculated from the LRD for each individual establishment at the annual three-digit North American Industrial Classification System (NAICS) industry level. Firm-level TFP is then calculated as a weighted sum of plant TFP for each year. Increasingly, several articles in the finance and economics literature have used TFP to measure firm efficiency; see, e.g., Lichtenberg and Siegel (1990), McGuckin and Nguyen (1995), Maksimovic, Philips, and Prabhala (2011), and Chemmanur, He, and Nandy (2010), among others. We obtain measures of TFP at the establishment level, by estimating a log-linear Cobb-Douglas production function for each industry and year. Industry is defined at the level of three-digit NAICS codes.[11] Individual plants are indexed i, industries j, for each year t in the sample:

$$\ln(Y_{ijt}) = \alpha_{jt} + \beta_{jt} \ln(K_{ijt}) + \gamma_{jt} \ln(L_{ijt}) + \delta_{jt} \ln(M_{ijt}) + \varepsilon_{ijt}. \quad (1)$$

We use the LRD data to construct as closely as possible the variables in the production function. Output (Y) is constructed as plant sales (total value of shipments in the LRD) plus changes in the value of inventories for finished goods and work-in-progress.[12] Since we appropriately deflate plant sales by the annual industry-specific price deflator, our measure should be proportional to the actual quantity of output.[13]

Labor input (L) is defined as production-worker-equivalent man-hours–that is, the product

[10] It should be noted that both the SSEL and the LRD provide establishment-level (i.e., plant-level) data. For the purpose of our analysis we aggregate this data to the firm level using standard techiniques used in the literature previously (for example, see Chemmanur, He, and Nandy (2010), Chemmanur, Krishnan, and Nandy (2011)) and numerical identifiers for plants and firms provided in the LBD and LRD, which we discuss further below.

[11] As a robustness check, we reestimate the production function in several different ways. First, we use two- and three-digit SIC industry classifications. Second, we estimate TFP with value-added production function specifications and separate white- and blue-collar labor inputs. Third, we divide each annual four-digit SIC industry into two groups based on capital intensity–i.e., establishments with capital intensity greater than the median capital intensity for that annual industry group are put in one category, while those with capital intensity less than the median are put in another category. We then estimate the production function for each category separately. In all cases we find qualitatively equivalent results.

[12] More accurately, we use log of one plus revenue and cost measures so as not to exclude firms that have zero values for these variables.

[13] Thus, the dispersion of TFP for firms in our sample should almost entirely reflect dispersions in efficiency. For the purposes of this study, however, it does not matter even if a portion of the change in TFP arises from changes in prices for private firms.

of production-worker man-hours, and the ratio of total wages and salaries to production-worker wages. We also reestimate the TFP regression by specifying labor input to separately include non-production workers, which yields qualitatively similar results. Values for capital stock (K) are generated by the recursive perpetual inventory formula. We use the earliest available book value of capital as the initial value of net stock of plant capital (this is either the value in 1972, or the first year a plant appears in the LRD sample). These values are written forward annually with nominal capital expenditure (appropriately deflated at the industry level) and depreciated by the economic depreciation rate at the industry level obtained from the Bureau of Economic Analysis. Since values of all these variables are available separately for buildings and machinery, we perform this procedure separately for each category of assets. The resulting series are then added together to yield our capital stock measure.

Finally, material input (M) is defined as expenses for the cost of materials and parts purchased, resales, contract work, and fuel and energy purchased, adjusted for the change in the value of material inventories. All the variables are deflated using annual price deflators for output, materials, and investment at the three-digit NAICs level from the Bartelsman and Gray National Bureau of Economic Research (NBER) Productivity Database.[14] Deflators for capital stock are available from the Bureau of Economic Analysis.[15] Plant-level TFP is then computed as the residuals of regression (1), estimated separately for each year and each three-digit NAICs industry. Therefore, the average TFP (i.e., the average of the residuals) in any three-digit NAICs industry-year is zero by construction. Plant-level TFP measures are then aggregated to the firm level by a value-weighted approach, where the weight on a plant is the ratio of its output (total value of shipments) to the total output of the firm.[16] The firm-level TFP is then winsorized at the first and 99th percentiles.

3.2 Other Variables Used in the Analysis

In this subsection we discuss the construction and measurement of the different firm-specific variables as well as other proxies used in our analysis. The LRD contains detailed information at the plant level on the various production function parameters, such as total value of shipment, employ-

[14] See Bartelsman and Gray (1996) for details.

[15] See Lichtenberg (1992) for a detailed description of the construction of TFP measures from LRD variables.

[16] As a robustness check, we also used the ratio of its capital stock to the total capital stock of the firm and the ratio of plant employment to firm employment as weights. In all cases, our results remain qualitatively unchanged.

ment, labor costs, material costs, new capital investment for the purchase of buildings, machinery, equipment, etc. Using this detailed information, we first construct the variables of interest at the plant-level, and then aggregate the plant level information to firm-level measures.

Capital Stock is constructed via the perpetual inventory method, discussed in Section 3.1. *Capital Expenditure* is the dollar value the firm spends on the purchase and maintenance of plant, machinery, and equipment, etc. *Material Cost* is the expense for the cost of materials and parts purchased, resales, contract work, and fuel and energy purchased. *Salaries and Wages* is the total production-worker wages plus total non-production-worker wages plus total supplemental labor costs, which include both legally required supplemental labor costs as well as voluntary supplemental labor costs of the firms. *Total Production Cost* is calculated as the sum of materials cost plus rental and administrative expenditures. All values in the LRD are in thousands of dollars (in 1998 real terms), and all plant-level measures are winsorized at the 1st and 99th percentile.

We define *Firm Size* as the natural logarithm of capital stock of the firm. *Market Share* is defined as the firm's market share in terms of sales at the annual three-digit NAICS level. We use the market share of the firm to proxy for the firm's industry leader position. We construct the industry *Herfindahl Index* based on the market share measure of each firm in the LRD. The *Herfindahl Index* is calculated by summing up the square of each firm's market share (in sales) at the annual three-digit NAICS level. A higher *Herfindahl Index* means that the industry is more concentrated. *Firm age* is is calculated as the time from the birth to current year of the oldest plant of a firm. We use the LBD to calculate the firm age, since it is derived from the U.S. Business Register files that has data on the universe of U.S. establishments for all years.

We also define *External Financial Dependence* of a firm's industry based on the measure of external financial dependence proposed by Rajan and Zingales (1998) and used in Cetorelli and Strahan (2006). To construct this measure, we take all firms on Compustat between 1978 and 2005. We exclude "young" Compustat firms, that is, firms that had gone public only recently. A measure of external financial dependence for such firms is likely to be nonrepresentative of the typical needs of a firm in a given sector. We define firms as young if they appear in Compustat for 10 years or less. We then sum across all years each firm's total capital expenditures (Pre-Xpressfeed Compustat item # 128) minus cash flow from operations. Cash flow from operations equals revenues minus nondepreciation costs (Pre-Xpressfeed Compustat item # 110) plus decreases in inventories and

accounts receivable plus increases in accounts payable.[17]This sum equals the total external funds needed to finance investments. A negative value for this sum means that the firm had free cash flow available for disbursement to shareholders or to pay down debt. A positive value for this sum means that the firm needed to raise additional capital to finance its investment. We then divide this free cash flow figure by total capital expenditure. After constructing this ratio for each firm, we use the median value for all firms in each three-digit NAICS category and define a dummy called *External Financial Dependence* as one if this value is positive for the industry and zero otherwise.

In addition to the firm-specific and industry-wide controls mentioned above, we also use seperate variables for our "Quasi-Regression discontinuity" analysis. The U.S. SBA provides a number of financial assistance programs for small businesses.[18] To analyze the effect of the deregulation on financially constrained firms, we exploit the fact that the SBA provides financial support to firms up to a certain size cutoff. For manufacturing firms, this size cutoff is a prespecified level of employment that varies with the North American Industry Classification System (NAICS) industry affiliation of the firm.[19] For a firm, the variable *SBA Eligible* is one if, in the closest year prior to the year of the interstate bank branching deregulation, the number of employees in the firm is smaller than the required SBA threshold level to be eligible for SBA financing, and zero otherwise. Firms immediately above the threshold will not be eligible for SBA financing, and thus will be more financially constrained compared to firms immediately below the threshold. The variable *SBA Ineligible* is thus defined as one minus *SBA Eligible*. We also create a *Normalized Employment* variable which is defined as the firm's total employment in the closest year to the year of the deregulation (used to create the *SBA Eligible* variable) divided by the SBA employment threshold value for the three-digit NAICS industry of the firm. Note that, by construction,*SBA Eligible*=1 iff *Normalized Employment*<=1.

[17]Thus, we subtract investments in net working capital from cash flow. The numerator of external financial dependence equals the negative of "free cash flow." Note also that the Compustat items mentioned in the text are only defined for cash flow statements with codes 1, 2, or 3. For format code 7, we use the sum of items #123, 125,126, 106, 213, and 217.

[18]In 2006, the total value of financial support provided by the SBA to small businesses was $78.1 billion, which grew to $90.45 billion in 2009, indicating that the SBA represents a significant source of financial support for smaller firms.See http://www.sba.gov.

[19]Size eligibility standards to receive SBA financial support are listed at the SBA Web site: http://www.sba.gov/

4 How Does Increased Access to Financing Affect Productivity?

4.1 Descriptive Statistics

Table 2 reports the summary statistics using the pooled LRD data in our sample. Note that, due to U.S. Census Bureau disclosure requirements, we cannot report median values for our data. We thus report a quasi-median which is the average value of all observations between the 45th and 55th percentile and is very close to the actual median values of each variable. Our sample of LRD firms have mean asset value of $10.5 million and a quasi-median value of $1.4 million. Mean sales in our sample is around $31 milion, whereas median sales is around $6 million. Mean and quasi-median capital expenditure in the sample are around $801,600 and $93,000 respectively. This capital expenditure reflects both new purchases of capital equipment as well as expenditures incurred for maintenance of existing facilities. These figures, particularly the quasi-median values suggest that our sample includes many small firms, which would potentially be affected more by banking deregulations. In addition, we report in Table 2, summary statistics for production costs, materials cost, age, salaries and wages, and herfindahl index of the pooled sample of our LRD firms.

4.2 Bank Branches and County-level productivity

The passing of the IBBEA led to an increase in the number of bank branches in states that deregulated the IBBEA clauses related to de-novo branching. In particular, it allowed out of state banks to open set up branches in deregulated states without any restrictions. An increase in bank branches post deregulation therefore led to an increase in the availablity of financing in those states that implemented IBBEA. We motivate our analysis by first looking at whether a positive correlation exists between increases in bank branches in a county and the aggregate TFP for that county. To calculate aggregate county level TFP, we use a county-level weighted-average of plant productivity, weighted by total value of shipments of plants in that county. We then relate this productivity variable to the county-level number of bank branches in Table 3. In these regressions, we control for *Log of County Size*, which is the one year lagged value of total capital stock all plants in a county; the *County Market Share*, which is the one year lagged value of market share of the total value of shipments for the county, calculated as the total value of shipments for all plants in the county divided by total value of shipments for all plants in the whole of the U.S. for a given

year; *County Herfindahl Index*, which is the one year lagged within-county concentration measure calculated using total value of shipments; and year and county fixed effects.

The result in Column (1) of Table 3 indicates that the total number of bank branches in a county is positively related to the county-level productivity. Further, we also find, in Column (2) of Table 3, that this increase in county-level productivity is driven by the increase in the number of out-of-state branches in the county and not by the increase in branches by in-state banks. Moreover, the coefficient estimate on out-of-state bank branches variable is statistically different from that on the in-state bank branches variable at the 1 percent level. Economically, a one standard deviation in the number of out-of-state bank branches in a county is related to a 4.23 percent increase in the county-level productivity.

These results therefore suggest that there is a positive association between an increase in out–of-state-bank branching (an intended consequence of the IBBEA), leading to an increase in the availability of financing in a county and that county's TFP. However, these results are not conclusive in showing that the availability of financing has a causal effect on productivity and performance. In particular, there may be potentially unobservable factors that may drive both the demand for financing and productivity. Another possibility is that financing availability increases in response to greater productivity. We address these concerns in the remainder of this paper by analyzing how firm-level productivity responds to exogenous changes in the availability of financing as a result of the interstate bank branching deregulations in the 1990s.

4.3 Productivity Changes After Interstate Bank Branching Deregulation

We use firm-level TFP as a comprehensive measure of productivity from here on and analyze how the TFP of a firm changes after the state in which the firm is located adopts the banking deregulation brought about by the IBBEA.[20] We employ a firm fixed effects regression framework to analyze these effects. In these regressions, we control for time-varying observable characteristics of the firm and industry as well as year fixed effects. The methodology adopted in our regression framework throughout this article is consistent with that suggested by Petersen (2009), who advocates using

[20] We conservatively estimate a state to have adopted the IBBEA as long as the state deregulates any one of the four main clauses in the IBBEA as outlined before. All our results reported below become much stronger (both in magnitude and significance) if we define a state to have adopted the IBBEA, when they have explicitly deregulated the restrictions related to bank branching.

fixed effects and adjusting the standard errors for correlations within clusters. In all regressions, we report standard errors clustered at the firm level. We implement this approach through the following regression specifications:

$$Y_{it} = \alpha_t + \beta_i + \gamma X_{it} + \delta After_{it} + \varepsilon_{it} \tag{2}$$

$$Y_{it} = \alpha_t + \beta_i + \gamma X_{it} + \delta_1 Before_{it}(4,1) + \delta_2 After_{it}(0,3) + \delta_3 After_{it}(>=4) + \varepsilon_{it} \tag{3}$$

where Y_{it} is our variable of interest (i.e., firm TFP); X_{it} is a control for log of firm size (where size is measured as total capital stock), log of firm size squared, log of firm age, and the industry Herfindahl index, which are time varying; $After_{it}$ in (2) is a dummy variable, which equals one for a firm if the observation is in the year of or after interstate bank branching deregulation in the state of the firm and zero otherwise.[21] In (3), we introduce $Before_{it}(4,1)$, which is a dummy variable that equals one if the year is within four years prior to the interstate bank branching deregulation in the state of the firm and zero otherwise. Conceptually, this variable is similar to the $After_{it}$ variable and captures the difference in the TFP for firms between the four years prior to financing deregulation in a state of a firm and the years *prior* to the four years before the deregulation.[22] We also decompose the $After_{it}$ variable into two parts: $After_{it}(0,3)$ captures the changes from years 0 to 3 subsequent to the interstate bank branching deregulation, and $After_{it}(>=4)$ captures the effect on TFP from the fourth year after the deregulation. This allows us to address how the changes brought about by the financing deregulation are distributed over time. The dynamic pattern of the effect of interstate bank branching deregulation on TFP is captured by the coefficients $\delta's$ in all three equations. In all specifications, i indexes firms, t indexes years, β_i are firm fixed effects, and α_t are year fixed effects. The above specifications are estimated on the entire panel of private firms in the LRD. We drop variable subscripts i and t in the discussion that follows for parsimony.

Table 4 reports the results of our TFP fixed effects regressions. Column (1) reports the results

[21] Our results remain qualitatively similar if we replace capital stock with total employment as the control variable for size.

[22] This also serves an important part of validating our identification strategy. As noted by Roberts and Whited (2011), this helps in serving as a test for the key assumption in difference-in-differece regressions, namely, that of parallel trends. In this test, the coefficient on the $Before_{it}(4,1)$ variable should be insignificant from zero and smaller in magnitude than that of the treatment effect $After_{it}$.

of the basic specification in equation (2) above. We find that the coefficient estimate on the *After* variable is positive and statistically significant at the 5 percent level. Specifically, the results indicate that the TFP of a firm increases by 0.8 percent after the deregulation of interstate bank branching in the U.S. As in Schoar (2002), we interpret the economic effect of this coefficient estimate as follows: holding input costs constant, a certain percentage increase in productivity translates to an equal percentage increase in revenues, ceteris paribus. An increase in revenues leads to a more than proportional increase in profits, since the elasticity of profits to productivity is greater than one. Intuitively, an increase in productivity holding all else constant leads to higher revenues without changing costs. For our case, a 0.8 percent increase in TFP corresponds to to a 4.8 percent increase in profits, assuming a 20 percent profit margin. Further, since profits are revenues minus costs, the smaller the profit margin, the higher the elasticity of profits to productivity. Thus, a lower profit margin will actually predict a higher percent increase in profits for a given percent increase in TFP. For instance, reducing the profit margin to 10 percent increases the effect of interstate bank branching deregulation on profits to 8.8 percent. Thus, financial deregulation of interstate bank branching has an economically meaningful impact on firm productivity and performance. Moreover, as we document in later sections, this relation is even stronger for smaller and financialy constrained firms.

Column (2) of Table 4 reports the results of the fixed effects regressions by spliiting up the *After* variable into two parts, based on the specification in equation (3). In this specification, *After(0,3)* and *After(>=4)* represent the short and long term effects of the interstate bank branching deregulation, respectively. Column (2) results are similar to those in Column (1). Both *After(0,3)* and *After(>=4)* have coefficient estimates that are positive and statistically significant at least at the 5 percent level. The economic magnitudes of the coefficient estimates indicate that the TFP improvements after interstate bank branching deregulations are between 0.8 percent in the first three years and 1.2 percent after year 4. These numbers indicate that the profitability gains as a result of the financial deregulations are between 4.8 percent and 7.2 percent. However, the coefficient estimates for *After(0,3)* and *After(>=4)* are not statistically different from each other. Broadly, this result indicates that the effects of increased financing availability is long-lived and durable.

One critique of our methodology is that perhaps our results are driven by states that time their interstate bank branching deregulations to coincide with higher productivity gains. Further, the

coefficient estimates on *After* in Columns (1) and (2) may simply reflect an increasing TFP trend across all firms. Thus, our argument that these deregulations present an exogenous shift in financing availability needs to be tested. One way that we rule out such timing and trend explanations is by introducing the *Before(4,1)* dummy variable in Columns (3) and (4) of Table 4 (see, e.g., Bertrand and Mullainathan (2003)). If the deregulations are due to states trying to time productivity or if our results above represent secular trend in productivity, then the coefficient estimate on *Before(4,1)* should be positive and statistically significant. In Columns (3) and (4), we find that the coefficient estimate of the *Before(4,1)* dummy is not statistically significant. Moreover, the difference between the *After* dummies and *Before(4,1)* is positive and statistically significant at the 5 percent level. This result alleviates concerns regarding our prior results being driven by reverse causality or trends in TFP.

As described above, states could limit the extent of interstate bank branching possible by regulating on four different dimensions of interstate banking. We use the *Deregulation Index* to denote the level of interstate bank branching deregulation in a given state. In Column (5) of Table 4, we add a specification where the *Deregulation Index* replaces the *After* variable. Recall that, the higher this variable is, the more deregulated the state is. We find that, consistent with expectation, the *Deregulation Index* variable is positive and statistically significant at the 1 percent level. Thus, consistent with previous results, we find that greater financial deregulation is associated with higher productivity.

4.4 Robustness Checks

We also conduct additional tests in this section to ensure that our results are not driven by potential biases in the sample or due to alternative explanations. Black and Strahan (2002) find that greater access to financing leads to more incorporations and Kerr and Nanda (2009) find that increase in financing availability increases new startup activity as well as closures of these newer firms. To rule out the possibility that our results are driven by new firm births after the deregulation of interstate bank branching in various states, we exclude firms born after interstate bank branching deregulations in our first robustness test. The results are reported in Column (1) of Table 5 and are qualitatively similar to our base results. Thus, our TFP results are not driven by new firm births and deaths after financial deregulation.

One possibility is that survivorship bias can affect our results. In particular, if many firms die after the financial deregulation, then the set of firms that survive after deregulation would seem to perform better than the set of firms before deregulation. We can mitigate such a bias by restricting our attention to the sample of firms that survive after deregulation. In Column (2), we report the results after excluding all firms that die within our sample period which should mitigate any potential survivorship biases in the sample. The results in Column (2) indicate that in this survivorship bias mitigated sample, the effect of *After* on TFP is positive and statistically significant. Further, in Column (3) of Table 5, we restrict our sample for the TFP regression to the time period within 4 years of the deregulation and find similar results.[23]

Another concern is whether interstate bank branching deregulations itself can be related to state level factors (Kroszner and Strahan (1999)). We follow Rice and Strahan (2010) and control for various state-level characteristics to alleviate this concern. In particular, we control for the one year lagged state-level TFP, log assets, log employment, and log sales in the TFP regressions. State-level TFP is defined as the weighted average TFP of all plants in a state, weighted by total sales. State-level assets, employment, and sales are the sum of capital stock, employment, and total value of shipments of all plants in a state. We also control for state fixed effects in our TFP regressions.[24] The results of the TFP regressions after controlling for various state-level characteristics are reported in Table 6. We find that our main result holds inthese tests. That

[23] In unreported tests, we also estimate our base regressions after restricting our sample period to 3 years and 7 years around the deregulation and find qualitatively similar results.

[24] In unreported tests, we conduct our regressions using controls similar to those in Rice and Strahan (2010) in our paper. In particular, we control for the size of the insurance industry relative to that of the banking industry in a state. We calculate this variable as the ratio of the value added from insurance to value added from insurance plus banking. The data for value added by these industries are obtained from the Bureau of Economic Analysis. Since banks can also sell insurance products in many states, there may be opposition from insurance industry lobby in these against the expansion of the banking industry. The timing of the deregulation may be related to the relative power of the insurance industry in the state. Next, smaller banks in a state can lobby against greater competition due to interstate bank branching deregulations, and thus may impact the timing of the deregulation. As a result, the power of small banks in a state can affect the timing of the deregulation. We control for small bank share in a state, calculated as fraction of total assets in a state held by banks with assets below the state median, and the size-weighted average difference in capital-to-asset ratio of small banks minus large banks. Here, banks with assets smaller than the state median are defined as small banks. The latter two variables are calculated using data from Call Reports. Greater extent of interstate bank branching deregulations can also help small, more bank-dependent borrowers. Thus, we control for the fraction of total establishments in a state with less than 20 employees. We compute this variable using the U.S. Census Bureau's Longitudinal Business Database (LBD), which has data on all employer firms in the U.S. We also control for the political ideology by using a dummy variable that is one if the governer is a Democrat, and zero otherwise; and the fraction of state legislators who register as Democrats. These variables are obtained from the U.S. Book of the States. All these control variables are calculated as of 1993, the year before the passage of the IBBEA. All basic TFP results hold even after controlling for these state-level characteristics. It should be noted however, that our state fixed effects regression in Column (6), subsumes alll these control variables as they are invariant over time for a particular state.

is, the coefficient estimate on the *After* variable is positive and statistically significant holds in all specifications in the table.

Since TFP is not an accounting measure, and we cannot directly link the TFP of a given firm to its profitability without additional assumptions. Thus, one may question whether changes in TFP indeed translate into changes in profitability or changes in output. As a robustness check for our main results, we use alternative measures of performance. We use value added per worker or *Labor Productivity*, which is defined as total sales divided by the number of workers. In addition, we use *ROA*, defined as total sales minus total production costs and total salaries and wages divided by firm capital stock, as another alternative measure of performance to check our results. These measures do not have the desirable theoretical properties of TFP, but they do have familiar statistical properties, since they are not computed from a regression. We report the results of the regressions with *Labor Productivity* and *ROA* as dependent variables in Table 7 and find similar results to those using TFP. In particular, we find that both *Labor Productivity* and *ROA* of firms increase after interstate bank branching deregulations.

Overall, we find that our results are robust to a variety of control variables, subsample choices, and output measures. Our results are robust to controlling for potential survivorship biases as well as to controlling for various state-level characteristics. Our TFP results are also robust to using alternative measures of firm performance.

4.5 Placebo Tests on Bank Branching Deregulation

We further address potential reverse causality concerns regarding the passage of interstate bank branching deregulations in the U.S. in this section. We controlled for such potential reverse causality in previous sections by controlling for the *Before(4,1)* dummy in the TFP regressions in Table 4, following Bertrand and Mullainathan (2003). The coefficient estimate on the *Before(4,1)* dummy is insignificant and therefore provides reassurance that these laws were not implemented to coincide with other unobservable state characteristics that would have also boosted firm productivity. Moreover, including specific state-level variables and state fixed effects in Table 6 also does not alter our main results. In this section, we provide further evidence that reverse causality does not drive our results.

If our results reflect a treatment effect of interstate bank branching deregulations by states, then

our results should disappear if we falsely assume that our treatment (i.e., interstate bank branching deregulation) occurs one, two, or three years prior to the actual deregulation year (see, e.g., Roberts and Whited (2011)). Thus, we repeat our TFP regressions under such false definitions of the *After* variable. Columns (1), (2), and (3) in Table 8 report the results of this placebo analysis where the *After* variable is one for one, two, or three years prior to the actual deregulation, respectively, and zero otherwise. Our results indicate that the coefficient estimate on the falsified *After* variable is insignificant and not different from zero. Overall, the various tests and robustness checks described above support the idea that interstate bank branching deregulations have a causal effect on the productivity of firms.

5 Financial Constraint and the Effect of Increased Access to Financing on Productivity

We now consider the channel through which increased access to financing leads to greater productivity. We hypothesize that our results are primarily driven by firms that are financially constrained. Such firms are unable to grow or improve their performance as they are unable to access more productive (i.e., positive NPV) projects in the absence of availability of adequate financing. However, since the interstate bank branching deregulations should lead to an exogenous increase in the availability of financing, firms that are financially constrained will benefit the most following the deregulation, as it would then allow them to take on additional positive NPV projects, improving their performance and productivity. In the following sections, we use various proxies for financial constraints and show that our results are indeed driven by firms that are more financially constrained.

5.1 Firm Size and Financial Constraint

We start by analyzing whether our results documenting TFP gains vary based on firm size. Firm size has typically been used as a proxy for financial constraint, as smaller firms typically face a greater number of constraints in sourcing capital.[25] We use various proxies for firm size including

[25] For example, smaller firms are typically private and therefore do not have access to public capital markets. They also lack a viable internal capital market to source funds from.

sales (i.e., total value of shipments), assets (capital stock), and employment. We divide our sample by size quintile bins based on these measures and report our regression results in Table 9. The size variable used to classify firms in the size quintile bins is measured as of the closest year prior to the interstate bank branching deregulation in the state of the firm.[26] Thus, we only use the set of firms that exist in the sample prior to deregulation for these tests. We then run our TFP regressions with *After* interacted with a *Small* dummy, which is one for firms in the smallest quintile bin, and *After* interacted with a *Large* dummy, which is one for firms in all other quintiles. In addition, we run another specification where we interact the *After* variable with a dummy variable for each of the five size quintiles.

Columns (1) and (2) in Panel A of Table 9 report the regression results for size bins based on sales. In Column (1) in Panel A of Table 9 reports the result for *After* interacted with *Small* and *Large* firm dummies. the coefficient estimate on *After*Small* is economically large and statistically significant at the 1 percent level. The economic magnitude suggests that the TFP for small firms increases by 9.7 percent after interstate bank branching deregulations. Using the methodology for interpreting changes in productivity as changes in profitability, this change in TFP corresponds to a 58 percent increase in profits. Moreover, this value is statistically different and substantially larger than the coefficient estimate for *After*Large.*

Our results are even starker when we interact *After* with dummies for the five size quintile bins. Column (2) in Panel A of Table 9 reports the results of this regression. The economic magnitude and statistical significance of the *After*Size Quintile 1* is identical to that of *After*Small* found in Column (1), by definition. The effect of financial deregulation is also positive for the second and third size quintiles, although the economic magnitude of the *After*Size Quintile 2* and *After*Size Quintile 3* variables are smaller and statistically different than that for *After*Size Quintile 1* (2.4 percent and 1.2 percent vs. 9.7 percent, respectively). The coefficient estimates for all the remaining size quintiles interacted with *After* are statistically insignificant. The difference between the coefficient estimates on *After*Size Quintile 1* and *After*Size Quintile 5* is also statistically significant at the 1 percent level. Our results are similar when we repeat these tests with size split bins based on assets. In Columns (3) and (4) of Panel A of Table 9, using size bins defined using total assets, we find that the TFP of smaller firms increases substantially more than that of larger

[26] We also use a five year cutoff and find qualitatively similar results to the ones reported in this paper.

firms after the deregulation of interstate bank branching.

Kerr and Nanda (2009) use employment based splits to segment their analysis based on size. We ralso conduct our size-based interaction tests based on employment bins using the following cutoffs: 1 to 10 employees, 11 to 20 employees, 21 to 50 employees, 51 to 100 employees, and greater than 100 employees. We interact *After* with each of these employment bins as well as with a dummy for the smallest bin (which we define as *Small* as before) and a dummy for all other bins (which we define as *Large*). Panel B of Table 9 reports the results with the size employment bins. We find that our results mirror the results using total value of shipments and capital stock. Smaller firms by employment experience a greater increase in TFP after the deregulation of interstate bank branching. In particular, Column (1) indicates that the coefficient estimate on *After*Small* is positive and significant at the 1 percent level, whereas that on *After*Large* is statistically significant at the 10 percent level. Economically, smaller firms (i.e., those with 10 employees or less) experience a 2.2 percent increase in productivity which corresponds to a 13.2 percent increase in profits, whereas large firms (i.e., those with greater than 10 employees experience a 0.6 percent increase in productivity which corresponds to a 3.6 percent increase in profits. The difference between the coefficient estimate of *After*Small* with that of and *After*Large* is statistically significant at the 5 percent level. Further, as reported in Column (2), our results are similar when we interact *After* with each employment bin dummy. In particular, smaller firms by employment have a greater increase in TFP compared to larger firms.

The results in this section suggest that smaller (and thus more financially constrained) firms gain substantially more from greater access to financing as a result of interstate bank branching deregulations than larger (and less financially constrained) firms. We use three different proxies for size, i.e., sales, assets, and employment, and find that our results hold for all three size proxies.

5.2 Firm Age and Financial Constraint

In a recent paper, Haltiwanger, Jarmin, and Miranda (2010) find that newly born and young firms are the ones that contribute significantly to job creation. They argue that since such firms are also typically small, higher growth rates are usually attributed to small firms. Their result therefore suggests that younger firms may be the ones with the greatest need for financing. They might also be more financially constrained because of a shorter track record and lower cash flows. Thus,

similar to the size bins used in the previous section, we repeat our interaction tests using age bins. Thus, we create age bins (where firm age is measured as of one year prior to the law change) based on the following age cutoffs: 1 to 3 years, 4 to 10 years, 11 to 24 years, and greater than or equal to 25 years. We interact *After* with each of these age bins as well as with *Young,* which is a dummy variable that is one for firms in the youngest age bin, and *Old*, which is a dummy variable that is one for firms in all other bins. The results of these TFP regressions are reported in Table 10. The result in Column (1) indicates that TFP increase after the deregulation is positive and statistically significant for younger and older firms, but is more pronounced, both statistically and economically, for younger firms. Economically, the coefficient estimate on *After*Young* indicates that TFP for young firms increasing by 3.4 percent after the deregulation of interstate bank branching (consistent with an increase in profits of 20.4 percent). On the other hand, the coefficient estimate on *After*Old* is less than one-quarter the economic value of the *After*Young* coefficient estimate. Moreover, the coefficient estimate on *After*Young* is statistically different from that on *After*Old* at the 5 percent level. The results are similar in Column (2) where we interact *After* with a dummy for each of the age bins. The coefficient estimate on *After* interacted with the smallest age bin dummy (i.e., between 1 to 3 years) is economically and statistically much larger than the coefficient estimate on After interacted with the largest age bin dummy (i.e., greater than or equal to 25 years) at the 5 percent level.

The results in this section indicate that younger firms benefit the most from an increase in availability of financing as a result of deregulation of interstate bank branching. This result is consistent with the idea that TFP increases after financial deregulation are driven by more financially constrained firms (such as young firms) getting greater access to capital.

5.3 External Financial Dependence of Industry and Financial Constraint

We use the measure of external financial dependence based on industry accounting variables used in Rajan and Zingales (1998) and Cetorelli and Strahan (2006) to further analyze how the effect of greater access to financing on firm TFP varies with financial constraints. Thus, we interact the *After* variable in our TFP regressions with the *High External Financial Dependence* dummy for the firm's industry. We also include *After* interacted with a *Low External Financial Dependence* dummy variable. The *Low External Financial Dependence* dummy is defined as one minus the *High*

External Financial Dependence dummy.

The results of the interaction tests are reported in Table 11 and support the inference from the results in the previous two subsections. In particular, while both interaction terms have positive and significant coefficient estimates, the estimate on *After*High External Financial Dependence* is economically and statistically larger than that on *After*Low External Financial Dependence.* The results suggest that firms in highly financially constrained industries have a 2.7 percent increase in TFP, whereas those in less financially constrained industries have a 0.7 percent increase in TFP after the deregulation of interstate bank branching. The results here provide additional support to the idea that greater access to financing allows financially constrained firms to implement more productive and higher NPV projects.

5.4 Eligibility to Access SBA financing and Financial Constraint (Quasi-Regression Discontinuity)

Finally, we adopt a methodology of distinguishing between financially constrained and unconstrained firms, using an exogenous discontinuity in the eligibility of firms that can apply for Small Business Administration (SBA) financing. Thus, SBA support-eligible firms have access to an additional source of financing, and thus are less financially constrained than non-SBA support-eligible firms. We restrict our attention to the set of firms that have pre-deregulation level of employment that is within +10, -10 percent range of the SBA funding threshold. The important identifying assumption here is that firms just above and just below the SBA financing threshold are similar in most respects other than being eligible for SBA financing. This allows us to compare firms that are unlikely to differ significantly on characteristics other than access to an additional source of financing (SBA financing). Thus, those firms that are SBA ineligible (i.e., immediately above the SBA threshold) are more financially constrained relative to firms that are SBA eligible (i.e., immediately below the SBA threshold). Thus, if financial constraints are indeed driving our results, we should find that SBA ineligible firms experience a greater increase in productivity as a result of increased access to financing after the deregulation of interstate bank branching than SBA eligible firms.

Since the methodology here uses a discrete jump at a predefined threshold and a narrow band around the jump point, we refer to this as "Quasi-Regression discontinuity" approach. Chemmanur,

Krishnan, and Nandy (2011) use the SBA funding threshold as an exogenous discontinuity in the propensity of firms to seek venture capital financing. In our context, however, this is not a strict regression discontinuity (RD) approach in the sense that the discontinuity does not identify the treatment. Rather, we use the discontinuity to identify cross-sectional variation in the effect of the treatment (i.e., interstate bank branching deregulations) on the outcome variable (TFP).

We start by showing how TFP varies across firms that have various values for *Normalized Employment* separately for the *After=0* and the *After=1* regimes. Figure 1 reports the results of local polynomial smoothing estimations of TFP on the *Normalized Employment* variable around the SBA eligibility threshold point. Recall that *Normalized Employment* is defined as the employment prior to the interstate bank branching deregulation divided by the SBA employment threshold value for the firm's industry. The figure illustrates our main result in this section. For the *After=1* regime, there is a large increase (i.e., a large "jump") in the TFP of firms at the SBA threshold. Relative to this, the increase or "jump" in the TFP of firms around the SBA threshold point for the *After*=0 regime is much smaller. Thus, we see that firms that have fewer alternative financing options experience greater increases in TFP relative to firms that have more financing options after the deregulation of interstate bank branching. Our differences-in-differences estimator described below essentially statistically estimates the difference between the two "jumps" depicted in the figure.

We conduct our TFP regression using the sample of firms that is within the 10% employment band around the SBA threshold. We include interaction terms between *After* and *SBA eligible* as well as between *After* and *SBA ineligible*. In addition, we include interaction terms between the *Normalized Employment* and *After* as well as between *Normalized Employment* squared and *After*. The size controls include one year lagged value of log employment, one year lagged value of log employment squared, and one year lagged value of log assets. The results, reported in Column (1) of Table 12, are consistent with those in Figure 1. SBA ineligible firms experience a greater increase in TFP after interstate bank branching deregulations than non-SBA eligible firms. In particular, the coefficient estimate on *After*SBA ineligible* is positive and significant at the 5 percent level while the coefficient estimate on *After*SBA eligible* is insignificant. Economically, SBA eligible firms experience a 5 percent increase in TFP. Moreover, the difference in the coefficient estimates of *After*SBA ineligible* and *After*SBA eligible* are statistically different at the 1 percent level.

We repeat this analysis after restricting the sample to a band of 30 percent around the SBA threshold restriction and find similar results in Column (2) of Table 12.[27] Finally, we use the entire sample and find the our main result from Column (1) holds here as well. Thus, our results point to greater financial constraints driving the positive relation between increased availability of financing as a result of interstate bank branching deregulations and firm TFP. Moreover, to the extent that firms within a 10 percent band around the SBA threshold are similar in all respects other than the eligibility for SBA funding, our results are unlikely to come from potentially unobservable differences between firms in states that allow earlier interstate bank branching deregulation and firms in states that deregulate interstate bank branching later.

6 Conclusion

We analyze how increased access to financing affects firm productivity using a large sample of manufacturing firms obtained from the U.S. Census Bureau's Longitudinal Research Database (LRD). We exploit the exogenous shift in access to financing due to interstate bank branching deregulations that took place in the 1990s and relate these deregulations to firm level total factor productivity (TFP). Our results indicate that firms' productivity increased subsequent to their states allowing out-of-state banks to establish local bank branches. The increased productivity after deregulation is long lived and is not driven by states timing the implementation of their interstate bank branching deregulation or by secular trends in TFP. TFP increases after financial deregulation is greater for firms that are financially constrained, such as smaller firms, younger firms, and firms that are in more financially constrained industries. We find that firms that are close to but do not satisfy eligibility criteria for financial support from the U.S. Small Business Administration (and thus more financially constrained) have higher TFP increases after financial deregulation than firms that just satisfy eligibility criteria (less financially constrained). Our results support the idea that greater access to affordable financing can increase financially constrained firms' access to productive projects (i.e., positive NPV projects) that they may otherwise not be able to take up. Our results emphasize that availability of financing is important not only for startup activity (as prior research

[27] Note that widening the band around the SBA threshold for selecting the sample for the quasi-RD analysis will not bias our results, since we also control for employment as well as for *After* interacted with *Normalized Employment* and *After* interacted with *Normalized Employment squared*.

suggests), but also for the success of existing entrepreneurial and small firms.

This study contributes to the existing literature by analyzing the real performance effects of increased access to financing. Our analysis of the intensive margin of firm-level outcomes (i.e., productivity) is useful to understand the economic consequences of both increasing access to financing as well as financial deregulation on existing firms. Our results suggest that increased access to bank financing allows small, young, and financially constrained firms to take up real investment opportunities that they may not otherwise be able to have access to. We show that such increased access to financing increases their productivity. This is crucial from a policy perspective if the objective is to promote the growth of startups especially given that most young firms rely heavily on bank financing.

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Table 1: Interstate Bank Branching Laws by States

This table reports the changes in interstate bank branching laws in the U.S. from 1994 to 2005. This data is from Johnson and Rice (2008). The effective date of the state's setting of interstate bank branching restrictions allowed under the Interstate Banking and Branching Efficiency Act (IBBEA) is in the first column, with some states having multiple effective dates as they imposed or removed restrictions gradually. The next four columns then report the actual restrictions set by each state as of each effective date.

State	Effective Date	Age restriction	De novo interstate branching restriction (Yes = State restricts de novo interstate branching)	Individual branch acquisition restriction (Yes = State does not allow acquisition of branches)	Statewide cap on deposits restriction
Alabama	5/31/1997	5	Yes	Yes	30%
Alaska	1/1/1994	3	Yes	No	50%
Arizona	8/31/2001	5	Yes	No	30%
Arizona	9/1/1996	5	Yes	Yes	30%
Arkansas	6/1/1997	5	Yes	Yes	25%
California	9/28/1995	5	Yes	Yes	30%
Colorado	6/1/1997	5	Yes	Yes	25%
Connecticut	6/27/1995	5	No	No	30%
Delaware	9/29/1995	5	Yes	Yes	30%
DC	6/13/1996	No	No	No	30%
Florida	6/1/1997	3	Yes	Yes	30%
Georgia	5/10/2002	3	Yes	Yes	30%
Georgia	6/1/1997	5	Yes	Yes	30%
Hawaii	1/1/2001	No	No	No	30%
Hawaii	6/1/1997	5	Yes	Yes	30%
Idaho	9/29/1995	5	Yes	Yes	No
Illinois	8/20/2004	No	No	No	30%
Illinois	6/1/1997	5	Yes	Yes	30%
Indiana	7/1/1998	5	No	No	30%
Indiana	6/1/1997	No	No	No	30%
Iowa	4/4/1996	5	Yes	Yes	15%
Kansas	9/29/1995	5	Yes	Yes	15%
Kentucky	3/22/2004	No	Yes	Yes	15%
Kentucky	3/17/2000	No	Yes	Yes	15%
Kentucky	6/1/1997	5	Yes	Yes	15%
Louisiana	6/1/1997	5	Yes	Yes	30%
Maine	1/1/1997	No	No	No	30%
Maryland	9/29/1995	No	No	No	30%
Massachusetts	8/2/1996	3	No	No	30%
Michigan	11/29/1995	No	No	No	No
Minnesota	6/1/1997	5	Yes	Yes	30%

Mississippi	6/1/1997	5	Yes	Yes	25%
Missouri	9/29/1995	5	Yes	Yes	13%
Montana	10/1/2001	5	Yes	Yes	22%
Montana	9/29/1995	N/A			Increases 1% per year from 18% to 22%
Nebraska	5/31/1997	5	Yes	Yes	14%
Nevada	9/29/1995	5	Limited	Limited	30%
New Hampshire	1/1/2002	No	No	No	30%
New Hampshire	8/1/2000	5	No	No	30%
New Hampshire	6/1/1997	5	Yes	Yes	20%
New Jersey	4/17/1996	No	Yes	No	30%
New Mexico	6/1/1996	5	Yes	Yes	40%
New York	6/1/1997	5	Yes	No	30%
North Carolina	7/1/1995	No	No	No	30%
North Dakota	8/1/2003	No	No	No	25%
North Dakota	5/31/1997	No	Yes	Yes	25%
Ohio	5/21/1997	No	No	No	30%
Oklahoma	5/17/2000	No	No	No	20%
Oklahoma	5/31/1997	5	Yes	Yes	15%
Oregon	7/1/1997	3	Yes	Yes	30%
Pennsylvania	7/6/1995	No	No	No	30%
Rhode Island	6/20/1995	No	No	No	30%
South Carolina	7/1/1996	5	Yes	Yes	30%
South Dakota	3/9/1996	5	Yes	Yes	30%
Tennessee	3/17/2003	3	No	No	30%
Tennessee	7/1/2001	5	No	No	30%
Tennessee	5/1/1998	5	Yes	No	30%
Tennessee	6/1/1997	5	Yes	Yes	30%
Texas	9/1/1999	No	No	No	20%
Texas	8/28/1995	N/A	N/A	N/A	20%
Utah	4/30/2001	5	No	No	30%
Utah	6/1/1995	5	Yes	No	30%
Vermont	1/1/2001	No	No	No	30%
Vermont	5/30/1996	5	Yes	No	30%
Virginia	9/29/1995	No	No	No	30%
Washington	5/9/2005	5	No	No	30%
Washington	6/6/1996	5	Yes	Yes	30%
West Virginia	5/31/1997	No	No	No	25%
Wisconsin	5/1/1996	5	Yes	Yes	30%
Wyoming	5/31/1997	3	Yes	Yes	30%

Table 2: Summary Statistics

This table reports summary statistics for firms in the manufacturing sector in the LRD between 1976 and 2005. *Assets* is constructed via the perpetual inventory method and is the sum of building assets *plus* machinery assets. *Sales* is the total value of shipments. *Production Cost* sum of materials cost plus rental and administrative expenditures. *Total capital expenditure* is the dollar value the firm spends on the purchase and maintenance of plant, machinery, and equipment, etc. *Materials Cost* is the expenses for the cost of materials and parts purchased, resales, contract work, and fuel and energy purchased. *Age* is the number of years since the firm first appeared in the LRD sample. *Salaries and Wages* is the total production-worker wages plus total non-production-worker wages plus total supplemental labor costs, which include both legally required supplemental labor costs as well as voluntary supplemental labor costs of the firms. *Herfindahl Index* is the extent of industry concentration measured by summing up the square of each firm's market share (in sales) at the annual three-digit NAICS level. To comply with the U.S. Census Bureau confidentiality requirements we report Quasi-Medians which are the average of all observations between the 45^{th} and the 55^{th} percentile for each variable. All observations are at the firm-year level. Where relevant, figures are in thousands of dollars.

Pooled sample statistics			
	Mean	Quasi-Median	Count
Assets	10458.69	1421.938	570596
Sales	31054.17	6029.849	570596
Production cost	15623.6	2687.164	570596
Total capital expenditure	801.6138	93.00072	570596
Materials cost	19915.64	2321.423	570596
Age	17.56307	16.31364	570596
Salaries and Wages	4659.628	1339.898	570596
Herfindahl Index	0.018446	0.01249	570596

Table 3: County Level TFP changes Across Census Years

This table reports results for fixed effects regressions where the dependent variable is the aggregated TFP of all plants in a county for Census years ending in 2 or 7 (for years between and including 1987 and 2002), winsorized at the one percent level. The independent variables are: *Total number of bank branches*, which the total number of bank branches recorded in the U.S. Census Bureau's Census of Finance, Insurance, and Real Estate (FIRE) database; *In-state bank branches*, which the number of in-state bank branches recorded in the U.S. Census Bureau FIRE database; *Out-of-state bank branches*, which the number of out-of-state bank branches recorded in the U.S. Census Bureau FIRE database; *Log assets*, which is the natural log of the value of the one year lagged county's capital stock; *Log assets*^{2}; *Market share*, which market share or the sales in the county relative to sales in all other counties in the same year; *Herfindahl Index*, which is the concentration of the sales at the county level for a given year (winsorized at the one percent level); and county and year fixed effects. Heteroskedasticity corrected robust standard errors, which are clustered on firms, are in brackets. All regressions are estimated with an intercept term. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)
Total number of bank branches	.0002***	
	[0.0000]	
In-state bank branches		-0.0001
		[0.0001]
Out-of-state bank branches		0.0003***
		[0.0001]
Log assets	0.019	0.017
	[0.019]	[0.020]
Log assets squared	-0.001	-0.001
	[0.001]	[0.001]
Market share	96.388***	96.215***
	[29.605]	[29.779]
Herfindahl index	0.042*	0.042*
	[0.023]	[0.023]
County FE	Y	Y
Year FE	Y	Y
Observations	10369	10369
Number of counties	2852	2852
Adj. R-sq	0.355	0.355
Out-of-state banks – In-state banks		0.0004***

Table 4: TFP changes Around Interstate Bank Branching Deregulations

This table reports results for panel data regressions where the dependent variable is the TFP of a firm for a given year (winsorized at the one percent level). The independent variables are: *After*, which is a dummy variable that equals one for a firm in a state which has deregulated bank branching by out-of-state banks, and zero otherwise; *Before(4,1)*, which is a dummy variable that equals one for years -4 to -1 relative to the deregulation of interstate bank branching in the firm's state, and zero otherwise; *After(0,3)*, which is a dummy variable that equals one for years 0 to 3 relative to the deregulation of interstate bank branching in the firm's state, and zero otherwise; After(>=4), which is a dummy variable that equals one for years 4 or greater relative to the deregulation of interstate bank branching in the firm's state, and zero otherwise; *Deregulation Index* is an index that is one for the state that has the most restrictive interstate bank branching regulations as of the effective date of the state's setting of interstate bank branching restrictions, and increases by one for each restriction that is relaxed by a state (this index takes the value zero in all years prior to the effective date); *Log assets*, which is the natural log of the one year lagged value of the firm's capital stock; *Log assets*^{2}; *Log Age*, which is the natural logarithm of firm age; *Herfindahl Index*, which is the one year lagged concentration of the firm's three digit NAICS industry (winsorized at the one percent level); and firm and year fixed effects. Heteroskedasticity corrected robust standard errors, which are clustered on firms, are in brackets. All regressions are estimated with an intercept term. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Before(4,1)			0.003	0.003	
			[0.003]	[0.003]	
After	0.008**		0.011**		
	[0.003]		[0.004]		
After(0,3)		0.008**		0.011***	
		[0.003]		[0.004]	
After(>=4)		0.013***		0.017***	
		[0.005]		[0.005]	
Deregulation Index					0.003***
					[0.001]
Log assets	-0.068***	-0.068***	-0.068***	-0.068***	-0.068***
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
Log assets^2	0.003***	0.003***	0.003***	0.003***	0.003***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Log age	-0.006*	-0.006*	-0.006*	-0.006*	-0.006
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
Herfindahl index	0.290***	0.290***	0.290***	0.290***	0.292***
	[0.079]	[0.079]	[0.079]	[0.079]	[0.079]
Firm and Year FE	Y	Y	Y	Y	Y
Observations	570596	570596	570596	570596	570596
Number of firms	137009	137009	137009	137009	137009
Adj. R-sq.	0.517	0.517	0.517	0.517	0.517
After(>=4) - After(0,3)		0.005		0.005	
After - Before(4,1)			0.008**		
After(0,3) – Before(4,1)				0.008**	
After(>=4) – Before(4,1)				0.013***	

Table 5: TFP changes Around Interstate Bank Branching Deregulations: Robustness Checks

This table reports results for panel data regressions where the dependent variable is the TFP of a firm for a given year (winsorized at the one percent level). The independent variables are: *After*, which is a dummy variable that equals one for a firm in a state which has deregulated bank branching by out-of-state banks, and zero otherwise; *Log assets*, which is the natural log of the one year lagged value of the firm's capital stock; *Log assets*^{2}; *Log Age*, which is the natural logarithm of firm age; *Herfindahl Index*, which is the one year lagged concentration of the firm's three digit NAICS industry (winsorized at the one percent level); and firm and year fixed effects. Column (1) reports the regression results after excluding firms that are not observed in the LRD after the law change. Column (2) excludes firms that are categorized in the US Census Bureau Business Register as dying within our sample period. Column (3) restricts the sample to within 4 years before and after interstate bank branching deregulations are implemented in a firm's state. Column (4) excludes firms born after interstate bank branching deregulations are implemented in a firm's state. Heteroskedasticity corrected robust standard errors, which are clustered on firms, are in brackets. All regressions are estimated with an intercept term. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)
	Exclude firms born after deregulation of interstate bank branching	Exclude firms categorized as Death in LBD	Sample restricted to within 4 years of law change
After	0.008**	0.006*	0.005*
	[0.003]	[0.004]	[0.003]
Log assets	-0.072***	-0.075***	-0.044***
	[0.004]	[0.005]	[0.006]
Log assets^2	0.003***	0.004***	0.001***
	[0.000]	[0.000]	[0.000]
Log age	-0.001	0.002	0.008
	[0.004]	[0.005]	[0.006]
Herfindahl index	0.282***	0.368***	0.440**
	[0.080]	[0.101]	[0.178]
Firm and Year FE	Y	Y	Y
Observations	558881	336977	201787
Number of firms	130701	62152	67880
Adj. R-sq.	0.515	0.495	0.570

Table 6: TFP changes Around Interstate Bank Branching Deregulations: State Level TFP Controls

This table reports results for panel data regressions where the dependent variable is the TFP of a firm for a given year (winsorized at the one percent level). The independent variables are: *After*, which is a dummy variable that equals one for a firm in a state which has deregulated bank branching by out-of-state banks, and zero otherwise; *Log assets*, which is the natural log of the one year lagged value of the firm's capital stock; *Log assets*^{2}; *Log Age*, which is the natural logarithm of firm age; *Herfindahl Index*, which is the one year lagged concentration of the firm's three digit NAICS industry (winsorized at the one percent level); *Log state capital stock*, which is log of the one year lagged value of total capital stock of all manufacturing plants in the firm's state; *Log state employment*, which is the log of the one year lagged value of the total employment of all manufacturing plants in the state; *Log state sales*, which is the log of the one year lagged value of total value of shipments of all manufacturing plants in the state. State TFP is defined as the weighted average TFP of all plants in a state, weighted by total value of shipments; firm, state, and year fixed effects. Heteroskedasticity corrected robust standard errors, which are clustered on firms, are in brackets. All regressions are estimated with an intercept term. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
After	0.007**	0.008**	0.008**	0.008**	0.008**	0.01***
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.004]
Log state capital stock	0.004				-0.003	-0.003
	[0.003]				[0.009]	[0.010]
Log state employment		0.003			-0.029**	-0.008
		[0.003]			[0.012]	[0.012]
Log state sales			0.004		0.035***	0.022*
			[0.003]		[0.013]	[0.012]
State TFP				-0.001	-0.016**	-0.013*
				[0.004]	[0.007]	[0.008]
Log assets	-0.068***	-0.068***	-0.068***	-0.068***	-0.068***	-0.104***
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.002]
Log assets^2	0.003***	0.003***	0.003***	0.003***	0.003***	0.007***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Log age	-0.006*	-0.006*	-0.006*	-0.006*	-0.006*	0.013***
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.001]
Herfindahl index	0.29***	0.291***	0.291***	0.29***	0.291***	0.018
	[0.079]	[0.079]	[0.079]	[0.079]	[0.079]	[0.05]
Firm FE	Y	Y	Y	Y	Y	N
State FE	N	N	N	N	N	Y
Observations	570596	570596	570596	570596	570596	570596
Number of firms	137009	137009	137009	137009	137009	137009
Adj. R-sq.	0.517	0.517	0.517	0.517	0.517	0.025

Table 7: Changes in ROA and Labor Productivity around Interstate Bank Branching Deregulations

This table reports results for panel data regressions where the dependent variable in Column (1) is the firm's labor productivity, which is defined as total sales divided by the number of workers (winsorized at the one percent level); and in Column (2) is ROA, defined as total sales minus production costs and salaries and wages divided by firm capital stock (winsorized at the one percent level). The independent variables are: *After*, which is a dummy variable that equals one for a firm in a state which has deregulated bank branching by out-of-state banks, and zero otherwise; *Log assets*, which is the natural log of the one year lagged value of the firm's capital stock; *Log assets*^{2}; *Log Age*, which is the natural logarithm of firm age; *Herfindahl Index*, which is the one year lagged concentration of the firm's three digit NAICS industry (winsorized at the one percent level); and firm and year fixed effects. Heteroskedasticity corrected robust standard errors, which are clustered on firms, are in brackets. All regressions are estimated with an intercept term. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)
	Labor Productivity	ROA
After	3.458***	0.055*
	[1.004]	[0.030]
Log assets	-118.767***	-3.062***
	[4.648]	[0.083]
Log assets^2	10.404***	0.146***
	[0.371]	[0.005]
Log age	-6.667***	-0.084**
	[1.295]	[0.038]
Herfindahl index	-78.812	-2.996***
	[47.929]	[0.677]
Firm and Year FE	Y	Y
Observations	584817	583104
Number of firms	141325	144023
Adj. R-sq.	0.661	0.780

Table 8: TFP changes Around Interstate Bank Branching Deregulations: Placebo Tests

This table reports results for panel data regressions where the dependent variable is the TFP of a firm for a given year (winsorized at the one percent level). The independent variables are: *After*, which is a dummy variable that equals one for a firm in a state which has deregulated bank branching by out-of-state banks starting in one, two, and three years prior to the deregulation effective date in columns (1), (2), and (3) respectively, and zero otherwise; *Log assets*, which is the natural log of the one year lagged value of the firm's capital stock; *Log assets*^{2}; *Log Age*, which is the natural logarithm of firm age; *Herfindahl Index*, which is the one year lagged concentration of the firm's three digit NAICS industry (winsorized at the one percent level); and firm and year fixed effects. Heteroskedasticity corrected robust standard errors, which are clustered on firms, are in brackets. All regressions are estimated with an intercept term. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

	1 year lag	2 year lag	3 year lag
	(1)	(2)	(3)
After	0.004	-0.005	-0.001
	[0.003]	[0.003]	[0.003]
Log assets	-0.068***	-0.068***	-0.068***
	[0.004]	[0.004]	[0.004]
Log assets^2	0.003***	0.003***	0.003***
	[0.000]	[0.000]	[0.000]
Log age	-0.006*	-0.006*	-0.006*
	[0.004]	[0.004]	[0.004]
Herfindahl index	0.290***	0.290***	0.290***
	[0.079]	[0.079]	[0.079]
Firm and Year FE	Y	Y	Y
Observations	570596	570596	570596
Number of firms	137009	137009	137009
Adj. R-sq.	0.517	0.517	0.517

Table 9: TFP changes Around Interstate Bank Branching Deregulations: By Firm Size Quintiles

This table reports results for panel data regressions where the dependent variable is the TFP of a firm for a given year (winsorized at the one percent level). The independent variables in Panel A are: an interaction term between *After*, which is a dummy variable that equals one for a firm in a state which has deregulated bank branching by out-of-state banks, and zero otherwise, and *Small*, which is one if the firm size immediately prior to the law change is in the smallest quintile, and zero otherwise; interaction term between *After* and *Large*, which is a dummy variable that is one if the firm size immediately prior to the law change is in the top four quintiles, and zero otherwise; interaction terms between *After* and each of the five size quintiles (i.e., *Size Quintile 1*, and so on); The independent variables in Panel B are: an interaction term between *After* and *Small*, which is one if the firm employment immediately prior to the law change is less than 10, and zero otherwise; interaction term between *After* and *Large*, which is a dummy variable that is one if the firm employment immediately prior to the law change is greater than or equal to 11, and zero otherwise; interaction terms between *After* and each of the five employment bins (i.e., for employment between 1 and 10, between 11 and 20, between 21 and 50, between 51 and 100, and greater than 100). Other independent variables common to both Panels (A) and (B) are: *Log assets*, which is the natural log of the one year lagged value of the firm's capital stock; *Log assets*^{2}; *Log Age*, which is the natural logarithm of firm age; *Herfindahl Index*, which is the one year lagged concentration of the firm's three digit NAICS industry (winsorized at the one percent level); and firm and year fixed effects. Heteroskedasticity corrected robust standard errors, which are clustered on firms, are in brackets. All regressions are estimated with an intercept term. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A: TFP Results by Size Based on Sales and Assets

	Size Bins by Sales		Size Bins by Assets	
	(1)	(2)	(3)	(4)
After*Small	0.097***		0.043**	
	[0.019]		[0.02]	
After*Large	0.006*		0.008**	
	[0.003]		[0.003]	
After*Size Quintile 1		0.097***		0.043**
		[0.019]		[0.020]
After*Size Quintile 2		0.024***		0.036***
		[0.009]		[0.008]
After*Size Quintile 3		0.012*		0.020***
		[0.006]		[0.005]
After*Size Quintile 4		-0.001		-0.002
		[0.005]		[0.004]
After*Size Quintile 5		0.005		-0.002
		[0.004]		[0.004]
Log assets	-0.08***	-0.08***	-0.08***	-0.082***
	[0.005]	[0.005]	[0.005]	[0.005]
Log assets^2	0.004***	0.004***	0.004***	0.004***
	[0.000]	[0.000]	[0.000]	[0.000]
Log age	0.006	0.004	0.007	0.002
	[0.005]	[0.005]	[0.005]	[0.005]
Herfindahl index	0.343***	0.341***	0.346***	0.333***
	[0.106]	[0.106]	[0.106]	[0.106]
Firm and Year FE	Y	Y	Y	Y
Observations	294438	294438	294438	294438
Number of firms	47745	47745	47745	47745
Adj. R-sq.	0.489	0.489	0.489	0.489
After*Small – After*Large	0.091***		0.035*	
After*Quintile 1 – After*Quintile 5		0.092***		0.045**

Panel B: TFP Results by Size Based on Employment		
	(1)	(2)
After*Small	0.022***	
	[0.008]	
After*Large	0.006*	
	[0.003]	
After*(Emp >=1 & <=10)		0.022***
		[0.008]
After*(Emp >=11 & <=20)		0.016**
		[0.007]
After*(Emp >=21 & <=50)		0.011**
		[0.005]
After*(Emp >=51 & <=100)		0.003
		[0.005]
After*(Emp >=101)		0.002
		[0.004]
Log assets	-0.080***	-0.081***
	[0.005]	[0.005]
Log assets^2	0.004***	0.003***
	[0.000]	[0.000]
Log age	0.006	0.004
	[0.005]	[0.005]
Herfindahl index	0.345***	0.342***
	[0.106]	[0.106]
Firm and Year FE	Y	Y
Observations	294438	294438
Number of firms	47745	47745
Adj. R-sq.	0.488	0.488
After*Small – After*Large	0.017**	
After*(Emp >=1 & <=10)– After*(Emp >=100)		0.021***

Table 10: TFP changes Around Interstate Bank Branching Deregulations: By Firm Age Groups

This table reports results for panel data regressions where the dependent variable is the TFP of a firm for a given year (winsorized at the one percent level). The independent are: interaction terms between *After*, which is a dummy variable that equals one for a firm in a state which has deregulated bank branching by out-of-state banks, and zero otherwise, and five age bins (i.e., firms with age immediately prior to the law change with ages between 1 and 3, between 4 and 10, between 11 and 24, and greater than or equal to 25)*; Log assets*, which is the natural log of the one year lagged value of the firm's capital stock; *Log assets*^{2}; *Log Age*, which is the natural logarithm of firm age; *Herfindahl Index*, which is the one year lagged concentration of the firm's three digit NAICS industry (winsorized at the one percent level); and firm and year fixed effects. Heteroskedasticity corrected robust standard errors, which are clustered on firms, are in brackets. All regressions are estimated with an intercept term. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

After*Young	0.034***	
	[0.013]	
After*Old	0.007**	
	[0.003]	
After*(Age >=1 & <=3)		0.035***
		[0.013]
After*(Age >=4 & <=10)		0.008
		[0.006]
After*(Age >=11 & <=24)		0.009**
		[0.004]
After*(Age >=25)		0.006
		[0.004]
Log assets	-0.074***	-0.074***
	[0.005]	[0.005]
Log assets^2	0.003***	0.003***
	[0.000]	[0.000]
Log age	-0.001	-0.003
	[0.004]	[0.004]
Herfindahl index	0.260***	0.260***
	[0.081]	[0.081]
Firm and Year FE	Y	Y
Observations	501628	501628
Number of firms	110679	110679
Adj. R-sq.	0.504	0.504
After*Young – After*Old	0.027**	
After*(Age >=1 & <=3) - After*(Age >=25)		0.026**

Table 11: TFP changes Around Interstate Bank Branching Deregulations: By External Financing Dependence of the Firm's Industry

This table reports results for panel data regressions where the dependent variable is the TFP of a firm for a given year industry (winsorized at the one percent level). The independent variables are: an interaction term between *After*, which is a dummy variable that equals one for a firm in a state which has deregulated bank branching by out-of-state banks, and zero otherwise, and *High External Financial Dependence*, which is a dummy variable that is one if the firm is in a three digit NAICS industry that is classified as highly dependent on external finance based on Rajan and Zingales' (1998) measure, and zero otherwise; an interaction term between *After* and *Low External Financial Dependence*, which is one minus the *High External Financial* dummy; *Log assets*, which is the natural log of the one year lagged value of the firm's capital stock; *Log assets*^{2}; *Log Age*, which is the natural logarithm of the firm's age; *Herfindahl Index*, which is the one year lagged concentration of the firm's three digit NAICS industry industry (winsorized at the one percent level); and firm and year fixed effects. Heteroskedasticity corrected robust standard errors, which are clustered on firms, are in brackets. All regressions are estimated with an intercept term. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

After*High External Financial Dependence	0.027***
	[0.008]
After*Low External financial Dependence	0.007**
	[0.003]
Log assets	-0.068***
	[0.004]
Log assets^2	0.003***
	[0.000]
Log age	-0.006*
	[0.004]
Herfindahl index	0.272***
	[0.079]
Firm and Year FE	Y
Observations	570550
Number of firms	137006
Adj. R-sq.	0.517
After*High External Financial Dependence – After*Low External Financial Dependence	0.021***

Table 12: TFP changes Around Interstate Bank Branching Deregulations: By SBA Financing Eligibility of Firm prior to Law Change

This table reports results for panel data regressions where the dependent variable is the TFP of a firm for a given year industry (winsorized at the one percent level). The independent variables are: an interaction term between *After*, which is a dummy variable that equals one for a firm in a state which has deregulated bank branching by out-of-state banks, and zero otherwise, and *SBA eligible*, which is a dummy variable that is one if the firm's employment immediately prior to the firm's state's interstate bank branching deregulation is lower than the SBA employment threshold for the firm's three digit NAICS industry to be classified as a small firm, and zero otherwise; an interaction term between *After* and *SBA ineligible*, which is one minus the *SBA eligible* dummy; *After* interacted with *Normalized employment*, which is the log of the firm's employment immediately prior to the firm's state's interstate bank branching deregulation divided by the SBA employment threshold for the firm's three digit NAICS industry; *After* interacted with *Normalized employment*^{2}; *Log employment*, which is the one year lagged value of the firm's employment*; Log employment squared*; *Log assets*, which is the natural log of the one year lagged value of the firm's capital stock; *Log Age*, which is the natural logarithm of the firm's age; *Herfindahl Index*, which is the one year lagged concentration of the firm's three digit NAICS industry (winsorized at the one percent level); and firm and year fixed effects. Column (1) reports the regression results with the sample of firms whose employment prior to the financial deregulation is within 10 percent of the SBA threshold. Column (2) reports the regression results with the sample of firms whose employment prior to the financial deregulation is within 30 percent of the SBA threshold. Column (3) reports the regression results with the complete sample. Heteroskedasticity corrected robust standard errors, which are clustered on firms, are in brackets. All regressions are estimated with an intercept term. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)
	10% sample	30% sample	Full sample
After*SBA ineligible	0.050**	0.038**	0.017**
	[0.023]	[0.016]	[0.008]
After*SBA eligible	-0.056	-0.003	-0.009
	[0.035]	[0.019]	[0.006]
After*Norm. employment	-0.936**	-0.043	-0.003
	[0.368]	[0.085]	[0.005]
After*Norm. employment^2	0.617	-0.076	0.001
	[3.508]	[0.233]	[0.001]
Log employment	-0.146***	-0.075*	-0.05***
	[0.048]	[0.04]	[0.007]
Log employment^2	0.014***	0.008**	0.007***
	[0.004]	[0.004]	[0.001]
Log capital stock	0.023**	-0.002	-0.029***
	[0.011]	[0.007]	[0.002]
Log age	-0.013	-0.01	0.002
	[0.029]	[0.02]	[0.006]
Herfindahl index	-0.151	0.021	0.355***
	[0.473]	[0.313]	[0.124]
Firm and Year FE	Y	Y	Y
Observations	11146	23957	220625
Number of firms	817	1754	30702
Adj. R-sq.	0.516	0.512	0.486
After* SBA ineligible – After* SBA eligible	0.106***	0.041*	0.027**