DNB Working Paper

No. 391 / September 2013

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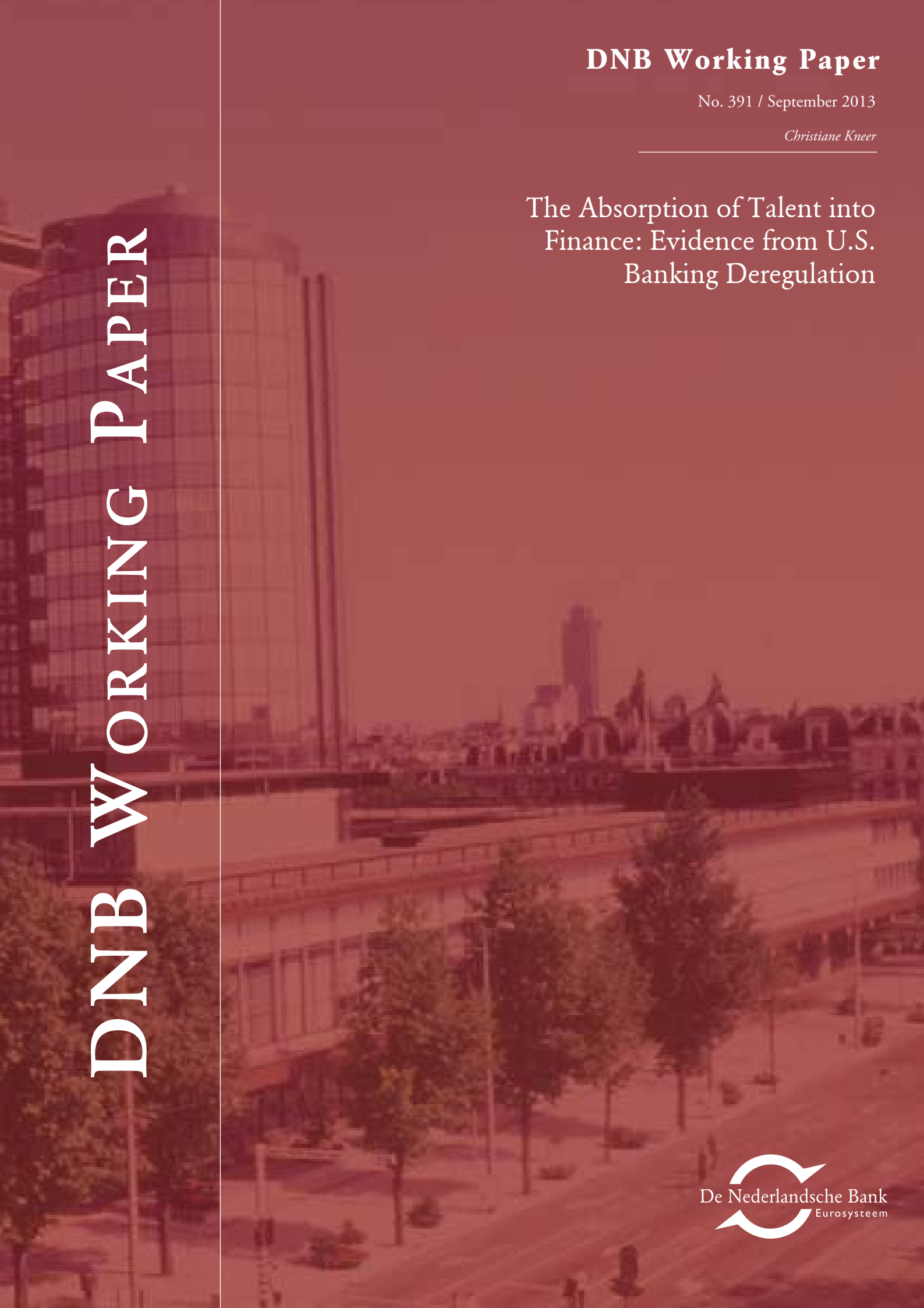

De Nederlandsche Bank
Eurosysteem

The Absorption of Talent into Finance: Evidence from U.S. Banking Deregulation

Christiane Kneer *

* Views expressed are those of the author and do not necessarily reflect official positions of De Nederlandsche Bank.

Working Paper No. 391

September 2013

De Nederlandsche Bank NV
P.O. Box 98
1000 AB AMSTERDAM
The Netherlands

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Christiane Kneer
CentER, Tilburg University and DNB

Job Market Paper

Abstract

The U.S. banking sector has grown substantially since the 1970s and has become more skill-intensive over time. This paper exploits variation in banking deregulation across U.S. states between 1997 and 2008 to test whether the banking sector absorbs talent at the expense of the real sectors in the economy. I find that the relaxation of interstate branching restrictions disproportionately reduces the labour productivity of skill-intensive manufacturing industries. This result also holds if changes in bank lending following deregulation are controlled for. My findings suggest that banking deregulation increases the demand for skilled labour of banks. The diversion of skilled individuals into banks and away from real sectors leads to labour productivity declines especially in those industries which rely heavily on skilled labour.

*****I would like to thank Thorsten Beck, Fabio Braggion and Maria Fabiana Penas, and participants in seminars at Tilburg University, the Dutch Central Bank, the 9th Annual Corporate Finance Conference, the 3rd Emerging Scholars in Banking & Finance Conference, VU Amsterdam, the BIS, the ECB, Olin Business School, the DIW, the Banque de France, and Stockholm School of Economics for useful comments and suggestions. I am grateful to Jill Hendrickson and Mark Nichols for sharing their data with me.

1. Introduction

The Global Financial Crisis has raised concerns that financial systems in advanced economies have grown too large. Although the relationship between financial development and growth is generally found to be positive (see Levine, 2005), recent research shows that there are limits to the benefits of finance.[1] This literature documents that the effect of financial development on growth becomes weaker at high levels of financial development and may even turn negative at some point. A possible explanation for this finding is the absorption of talent into the financial sector. Already Tobin (1984) suggested that "…we are throwing more and more of our resources, including the cream of our youth, into financial services remote from the production of goods and services, into activities that generate high private rewards disproportionate to their social productivity". To date there is little empirical evidence on the relationship between financial development, the allocation of talent across the real and the financial sector, and its consequences for the real economy. My paper attempts to fill this gap. I exploit variation in U.S. banking deregulation and differences in skill-intensities across manufacturing sectors to test whether talent is absorbed into the financial sector at the cost of productivity declines in the real sector.

Tobin (1984) suggests that talent may be misallocated between the financial and the real sector. Testing this hypothesis empirically is very challenging since it requires defining a benchmark for the optimal allocation of talent. The goal of this paper is more modest. I focus on the premise that talent is drawn into finance at the cost of the real sector. Under the assumption that skilled labour is inelastically supplied, labour productivity in the real sectors should decline if the financial sector absorbs talent and deprives these sectors of the brightest minds. The diversion of talent into finance should particularly affect R&D-intensive sectors which rely heavily on a skilled labour force and compete for this input with the financial sector. Murphy, Shleifer and Vishny (1991) model this situation. In their theoretical framework, rent-seeking activities (law and trading in financial markets are given as examples) and productive entrepreneurship compete for the most able individuals in an economy. They show that productivity and growth are inefficiently low if rent seeking rewards talent more than entrepreneurship and the most talented people are drawn into the rent-seeking sector.

[1] A large body of literature highlights that financial development fosters growth by mobilizing savings, allocating resources, diversifying risk, monitoring firms and exerting corporate control.

Testing for a causal effect of skilled labour in finance on real sector outcomes is complicated by endogeneity concerns. I circumvent this problem by exploiting variation in the relaxation of interstate branching restrictions across U.S. states. The Interstate Banking and Branching Efficiency Act (IBBEA) was completed in 1997. The watershed event of IBBEA was the relaxation of restrictions on interstate branching. IBBEA granted states the right to determine the extent to which they permitted entry by out-of state banks. States could forbid out-of-state banks from opening new branches or acquiring existing ones, impose age restrictions on bank branches that could be acquired, limit the share of statewide deposits any one bank could hold or impose reciprocity conditions. Hence in 1997, which marks the beginning of my sample period, states differed in the regulatory barriers they imposed on interstate branching. Some states changed their legislation again after 1997.

It has been shown that financial liberalization led to increased demand for skilled employees in the financial sector (Philippon and Reshef, forthcoming). In the context of branching deregulation, the geographical expansion for banks and intensified competition associated with entry of out-of-state banks were probably the main drivers of skill upgrading by banks. Thus, I use variation in regulatory barriers to interstate branching to test whether the absorption of skilled labour by banks affects labour productivity in manufacturing sectors.

Kroszner and Strahan (1999, 2007) find that U.S. branching deregulation was driven by the relative strength of winners (large banks and small, bank-dependent firms) and losers of deregulation (small banks and insurance companies), and by the proportion of Democrats in government. I show that the extent of branching deregulation is not related to the relative strength of losers and winners of deregulation in manufacturing. This suggests that deregulation is exogenous to productivity in manufacturing sectors and therefore suitable for identifying the effect of a diversion of talent into banks.

To identify the diversion of talent into banks as a channel through which deregulation affects productivity in manufacturing, I exploit differences in the dependence on skilled labour across industries. Industries which rely heavily on skilled labour should be relatively more affected by the absorption of talent into finance than industries which employ mostly unskilled labour. Previous research has shown that branching deregulation is associated with an expansion of credit supply, and improvements in bank efficiency and lending quality (e.g. Rice and Strahan, 2010; Cetorelli and Strahan, 2006, and Jayaratne and Strahan, 1996 and 1998). These improvements in bank performance could affect labour productivity in non-financial sectors as funds might be allocated to more productive firms, capital constraints might be relaxed or firms might be monitored more closely by banks. To single out the effect

of changes in bank lending, I control for differential effects of deregulation across industries with differing dependencies on external funding**.**

My difference-in-differences estimates show that branching deregulation disproportionately reduces labour productivity in skill- and R&D-intensive industries. This lends support to the hypothesis that the banking sector absorbs talent at the cost of productivity declines in the non-financial industries. Specifically, I find that if a state moves from no interstate branching to maximum branching deregulation then the labour productivity of R&D-intensive sectors (75^{th} percentile of the R&D-intensity distribution) relative to less R&D-intensive sectors (25^{th} percentile) falls by an amount equal to 17% of the total variation in labour productivity. However, my results also suggest that the real sector benefits from branching deregulation through improved intermediation services. This effect might partially be attributable to the employment of more highly skilled labour by banks. If improved intermediation services are partly due to skill upgrading by banks, then the overall effect of the reallocation of talent on the labour productivity of individual real sectors depends on the combination of a sector's reliance on skilled labour and external funds. R&D-intensive sectors with little use of external funds suffer, whereas sectors which use a lot of external funds but little skilled labour benefit from the diversion of talent into banks.

Similar to the absorption of talent into the financial sector, migration of skilled labour affects the supply of talent to the manufacturing sectors in a state and year. Controlling for the differential effect of net inflows of skilled labour across industries with different R&D-intensities reinforces my original results. Furthermore, I show that my results are robust to the use of alternative measures of banking deregulation and alternative measures of the R&D- or skill-intensity of industries.

To date, direct evidence on the relationship between financial development, the diversion of human resources into finance, and productivity in the real sectors is missing. However, consistent with the idea that the financial sector diverts talent away from real sectors, a number of studies show that the relationship between financial development and economic growth is nonlinear. They find that the positive effect of finance on growth gets weaker (Masten et al., 2007; Shen and Lee, 2006; Rioja and Valev, 2004) or that the effect turns negative (Arcand et al., 2011; Cecchetti and Kharroubi, 2012) at higher levels of financial development. This suggests that there is a dark side to finance which may outweigh the benefits when the financial system becomes too large. The literature on non-linearities in the finance-growth relationship does however not identify the channels through which a large financial sector hurts the real economy.

There is also some evidence suggesting that the skill mix in the financial sector changed over time. Philippon and Reshef (forthcoming) document the transformation of the U.S. financial sector into high-skill high-wage industry and the emergence of rents in this sector in the 1980s. They find that changes in the skill demand and wages in the financial sector were mainly driven by financial regulation. Finally, the attractiveness of a career in finance to the educational elite seems to have increased substantially over time (Goldin and Katz, 2008; Kedrosky and Stangler, 2011).

The remainder of the paper is structured as follows. The next section gives an overview of the related literature. Section 3 explains U.S. bank branching reforms during the 1990s and discusses the estimation methodology. The dataset is introduced in section 4 and the results are presented in section 5. In section 6 several robustness checks are discussed. Section 7 concludes.

2. Related Literature

This paper relates to a number of theoretical models which explain the allocation of talent between the financial and the real sector, and show that the financial sector may attract too much skilled labour in equilibrium. In the model of Bolton et al. (2011), dealers with superiour asset valuation skills cherry-pick good assets in over-the-counter markets and thereby worsen the pool of assets and lower prices in the official exchange. Due to the negative externality that cream-skimming by dealers imposes on trades in the official exchange, dealers can extract informational rents when buying assets. These rents attract too much talent into finance relative to the social optimum. Alternative models of the choice between a career in finance and the real sector are provided by Philippon (2008), Cahuc and Challe (2009) and Würgler (2009). In the model of Murphy et al. (1991) rent-seeking activities (law and trading in financial markets are given as examples) and productive entrepreneurship both exhibit increasing returns to ability and therefore compete for the most able individuals in an economy. Talented individuals are attracted to sectors with large markets, weak diminishing returns to scale and compensation contracts that allow them to capture the largest returns to their ability. Productivity and growth in this model are determined by the ability of entrepreneurs. If rent seeking rewards talent more than

entrepreneurship and the most talented people are drawn into this sector then productivity and growth are inefficiently low and the level of income is reduced.

Despite these theoretical advances, empirical evidence on the effect of a diversion of human resources into finance on real sector outcomes is scarce. The findings of recent research on the finance-growth nexus are however consistent with the idea that a large financial sector absorbs resources at the cost of the real sector. A number of studies show that the impact of financial development on growth is smaller at higher levels of financial development (Masten et al., 2007; Shen and Lee, 2006; Rioja and Valev, 2004). Arcand et al. (2011) find that credit to the private sector starts having a negative effect on growth when it reaches 110% of GDP. Similarly, Cecchetti and Kharroubi (2012) show that financial development only fosters GDP-per-worker growth up to some point. Beyond this point a larger financial system is associated with lower productivity growth. They also find that faster financial sector growth unambiguously reduces the growth rate of GDP-per-worker. Thus, these studies suggest that there is a dark side to finance but they do not identify the channel through which finance hurts the economy.

This paper also relates to research on changes in the skill mix in the financial sector over time. Philippon and Reshef (forthcoming) document that until the 1930s the financial sector was a high-skill and high-wage industry. The industry subsequently lost its human capital. This trend was reversed again in the 1980s. Philippon and Reshef show that the changes in the skill demand and wages of the financial sector over time were mainly driven by financial regulation.[2] The authors estimate that from the mid-1980s onwards rents accounted for 20 to 50% of the wage differential between the financial sector and the rest of the private sector. This rise in the attractiveness of careers in finance to the educational elite is also reflected in the career choices of Harvard graduates (Goldin and Katz, 2008) and MIT graduates (Kedrosky and Stangler, 2011). By contrast, Black and Strahan (2001) find that the removal of barriers to bank expansion *within* US states led to a decrease in the compensation of bank employees. However, they do not find a significant effect of *interstate* deregulation, the type of reform this paper focuses on.[3]

[2] They use a measure of financial deregulation which takes into account intrastate branching deregulation, the removal of interest rate ceilings and the relaxation of restrictions on bank activities (the separation of commercial and investment banks, and the separation of banks and insurance companies).

[3] Besides, Black and Strahan (2001) examine the effect of interstate *banking* deregulation rather than interstate branching deregulation.

My paper also contributes to a burgeoning literature on the relationship between finance and labour market outcomes. This research highlights the role of financial constraints rather than the absorption of talent. Pagano and Pica (2012) find that financial development is associated with faster employment growth in non-OECD countries only, and does not have an effect on labour productivity or real wage growth. Bertrand, Schoar and Thesmar (2007) show that French banking reforms in the 1980s led to faster employment growth in relatively bank-dependent sectors. Evidence by Benmelech, Bergman and Seru (2011) suggests that firms' employment decisions and aggregate unemployment are sensitive to credit availability. Larrain (2012), Jerzmanowski and Nabar (2011) and Beck et al. (2010) study the effect of financial liberalization on wage inequality. In line with the idea that increased demand for skilled labour in the financial sector puts upward pressure on the wages of high skilled labour, the former find that financial liberalization increases inequality. The evidence presented by Beck et al. (2010) by contrast suggests that financial liberalization decreases inequality.

Finally, there is some contradictory evidence on the impact of banking deregulation on innovation. While Ng (2012) finds that patenting increases following the relaxation of restrictions on bank expansion within states, Hombert and Matray (2012) come to the opposite conclusion.

3. U.S. Banking Deregulation and Identification Strategy

Throughout history, US regulation has prohibited or restricted bank expansion both within and between states. Prior to the 1970s intrastate branching was forbidden in most states. Until the early 1990s however, all but one state had relaxed restrictions on branching within states (Kroszner and Strahan, 1999).[4] The passage of the Riegel-Neal Interstate Banking and Branching Efficiency Act (IBBEA) in 1994 loosened federal restrictions on geographical expansion across states. By 1994 most states already permitted interstate banking, i.e. they allowed out-of-state bank holding companies to acquire in-state banks. The real significance of IBBEA was therefore the removal of barriers to interstate branching. Between the passage of the act in 1994 and June 1997 states had to decide whether to opt-in or to opt-out of the IBBEA branching provisions. Only Texas and Montana initially opted-out

[4] Up until 1970 only 12 states allowed unrestricted branching within their state. Between 1970 and 1993 another 27 states eliminated barriers to intrastate branching. In the remaining states restrictions remained partially in place (Kroszner and Strahan, 1999).

but both states decided to opt-in later on (interstate branching reforms went into effect in 1999 in Texas and 2001 in Montana).

Once states opted-in to interstate branching they could specify the exact rules for out-of-state bank entry. States could embrace interstate branching completely or erect barriers to entry in any of the following ways: Firstly, states could determine a minimum age of target institutions to be acquired, although state law could not impose an age requirement exceeding 5 years. Secondly, states could prohibit de novo interstate branching.[5] Thirdly, acquisitions of individual branches (without the acquisition of the entire bank) were only possible if the state in which the branch was located permitted this transaction. Furthermore, states could discourage out-of-state entry by imposing state-wide deposit caps. IBBEA mandated that an interstate merger should not result in a post-merger bank holding more than 30% of state-wide deposits but states had the authority to raise or lower this limit. Finally, states could apply reciprocity conditions on those wanting to branch into the state. Under reciprocity, a state would for instance allow de novo branching of a bank chartered in another state only if that state also permitted de novo entry.

I use data on interstate branching restrictions from Hendrickson and Nichols (2011) to construct an index of states' openness to out-of-state bank entry for the period 1992-2008. There are a maximum of 5 barriers to interstate branching a state can erect. To construct an index of branching deregulation I take the value 5 and deduce one if a state erects barriers to entry in any of the following ways: (i) a state imposes a minimum age requirement of 3 years or more for target institutions to be acquired (ii) a state prohibits de novo interstate branching (iii) a state prohibits the acquisition of individual branches by an out-of-state bank (iv) a state imposes a deposit concentration limit (v) a state offers de novo branching, acquisition of a branch or portion of a bank, a set age requirement or deposit cap with reciprocity only.[6] Since none of the states imposes zero barriers to entry, my branching deregulation index ranges from 0 to 4 with 4 indicating maximum openness to out-of-state bank entry.

Table 1 lists the effective dates of interstate branching regulation changes and the index of branching restrictions for each state between 1992 and 2008. States such as Maryland, Michigan or North Carolina opened up to out-of-state entry at a very early stage.

[5] Under IBBEA, interstate branching through bank mergers was however allowed in all states.

[6] This index is similar to the one constructed by Johnson and Rice (2008). However, there is a slight difference in the criterion attached to the deposit cap and their index only covers the period 1994-2005.

Many others, such as Arizona, Arkansas or Colorado retained tight interstate branching restrictions until the late 2000s. Since my industry-level data are only available as from 1997, I cannot exploit changes in legislation prior to this date. However, there are 14 states that changed their legislation again after 1997 in such a way that their branching regulation index was affected. Except for Indiana, Kentucky, Maryland and Washington all these states gradually reduced barriers to entry over time. Indiana, Kentucky, New Hampshire, Tennessee and Washington relaxed branching restrictions more than once after 1997. Thus, I can effectively exploit 16 regulatory changes between 1997 and 2008.

In my analysis the variation in regulatory restrictions on interstate branching serves to test whether increased employment of highly skilled individuals in the banking sector influenced labour productivity in the manufacturing sector. Table 2 shows that between 1992 and 2008 the share of skilled individuals working in banks was significantly higher in states with less interstate branching restrictions. I compare the ratios of skilled bankers over the total number of skilled individuals averaged over state-years with a branching deregulation index smaller than three (relatively restrictive interstate banking laws in place) to the skill ratios averaged over state-years with an index greater than or equal to three (relatively open to interstate banking). Skilled individuals are defined as individuals with a master degree or more. The skill ratios for states and years were constructed on the basis of individual-level data from the March Demographic Supplement to the Current Population Survey (CPS). My sample includes civilians aged 16 to 64 who work at least part-time. The evidence in table 2 is in line with the finding of Philippon and Reshef (forthcoming) that financial sector deregulation in the U.S. had a large positive effect on the education and wages of financial sector employees.

Why might branching deregulation lead to increased employment of skilled individuals in banking? Firstly, competition in the banking market intensifies as a result of entry of out-of-state banks (see e.g. Rice and Strahan, 2010). Tighter competition provides incentives for banks to become more productive, i.e. to exploit economies of scale and scope, to use more efficient input combinations, to adopt new technologies, and to increase their product quality and range. Johnson and Rice (2008) show that the relaxation of interstate branching restrictions is associated with a significant increase in the number of out-of-state branches to total branches. There is also evidence that operating costs, loan losses and loan rates of banks fall sharply after branching deregulation (Rice and Strahan, 2010; Jayaratne and Strahan, 1998) and that service quality improves (Dick, 2006). Furthermore, the structure of the banking market changes with deregulation as banks expand geographically,

less efficient banks exit and large banks with a significant scale of operations emerge (Jayaratne and Strahan, 1998; Stiroh and Strahan, 2003). To the extent that these changes related to competition and market structure are complementary to skilled labour, deregulation should entail skill upgrading by banks.[7]

I exploit the exogenous cross-state cross-year variation in the timing and degree of branch deregulation and differential effects of deregulation across industries with different R&D-intensities to shed light on the causal impact of increased use of skilled labour in finance on labour productivity manufacturing industries. Using the variation in branching deregulation, I address concerns about reverse causality and common factors driving both employment of highly skilled labour in finance and productivity in other industries. Reverse causality could for instance arise because skilled employees might switch from employment in manufacturing to employment in the financial industry in response to a productivity slowdown in manufacturing. Furthermore, a common factor such as technology adoption might drive both employment of highly skilled labour in finance and productivity in other industries. These challenges make it impossible to test directly for the effect of skilled labour in finance. Exploiting differences in skill- or R&D-intensities across industries allows attributing the effect of deregulation to the absorption of skilled labour into finance. The productivity of industries which depend more on highly skilled research employees should be more affected by the absorption of skilled labour into banking following deregulation.

This identification strategy rests on the assumption that the timing and the extent of branching deregulation are exogenous to productivity in manufacturing sectors. A negative relationship between productivity and my branching deregulation index could for example result from policymakers expanding the financial sector in response to a productivity slump in manufacturing. Furthermore, weak manufacturing sectors might lack the power to successfully lobby against the liberalization of the financial sector. Previous evidence suggests that regulatory change in the U.S. banking sector was shaped by the relative power of private interest groups and by ideological factors. Kroszner and Strahan (1999) find that the timing of intrastate branching deregulation across U.S. states is explained by the relative strength of winners (large banks and small, bank-dependent firms) and losers of deregulation (small banks and insurance companies). They also show that a higher proportion of

[7] For the financial industry only Philippon and Reshef (forthcoming) document the positive relationship between deregulation and skill upgrading. For other industries, there is a large body of literature on the link between skill upgrading and increased competition associated with deregulation or external sector reforms (see e.g. Chamarbagwala and Sharma (2011), Cragg and Epelbaum (1996), Feenstra and Hanson (1997), Guadalupe (2007), Hanson (2003)).

Democrats in the government delays deregulation. Similar factors explain votes on interstate banking and branching deregulation (Kroszner and Strahan, 2007). Unfortunately, there are no studies on the role of industrialists in shaping the regulatory process. Nevertheless, the findings of Kroszner and Strahan rule out that branching deregulation was exclusively a response to productivity developments in the manufacturing sector.

Thus, I estimate the following equation to determine whether the absorption of talent by the financial industry hurts productivity in other sectors by depriving these sectors of the brightest minds:

$$Y_{ist} = \alpha\ \text{vashare}_{ist} + \beta\ \text{R\&D-intensity}_i * \text{reg}_{st} + \gamma\ \text{external finance dependence}_i * \text{reg}_{st} + \rho_{st} + \sigma_{it} + \varepsilon_{ist} \quad (1)$$

where i indexes manufacturing industries, s indexes the 50 states and t indexes time. I drop state-year observations in which a regulatory change occurred. Y is an indicator of labour productivity. Since fixed effects that vary with both industry and state are not included in the regression model, I add the variable *vashare* which is defined as industry i's share of total value added in manufacturing in state s and year t. This variable measures the relative importance of a given sector in a market and controls for the possibility that sectors with different sizes differ systematically in their labour productivity. ρ_{st} are vectors of state-year indicator variables which control for any state and time-varying effect on industry productivity. By the same token, σ_{it} are industry-year indicator variables which capture industry-specific time-varying effects. Standard errors are clustered at the state level. Years in which deregulation went into effect were dropped from the analysis.

The primary variable of interest is the interaction term of *R&D-intensity* and *reg*. *R&D-intensity* proxies a sector's intrinsic dependence on R&D and should be closely related to its skill needs. *Reg* is the branching deregulation index ranging from 0 (most restrictive regulation) to 4 (most permissive regulation). The β-coefficient captures the brain-drain effect. A negative β-coefficient in this model is consistent with the idea that the absorption of skilled labour by the banking industry reduces labour productivity in the real sectors.

Deregulation could also affect real sector productivity through an improvement of the performance of the banking sector (see Rice and Strahan(2010), Cetorelli and Strahan (2006) and Jayaratne and Strahan (1996, 1998) for evidence on the effect of deregulation on bank performance). Improved bank performance could affect labour productivity in manufacturing because funds might be allocated to more productive firms, financial constraints might be

relaxed and firms might be monitored more closely by banks. These changes in bank performance might partially be driven by the absorption of skilled labour into banks. I control for this effect by including the variable *external finance dependence*$_i$*reg_{st}, an interaction between the deregulation index and an indicator of an industries' dependence on external sources of funds. This control variable captures the differential effect of improved bank performance across sectors. A positive γ-coefficient would suggest that improved bank performance following branching reform benefits especially those sectors that depend strongly on external sources of finance. Note that my specification does not allow decomposing the effect of improved bank performance into a part which is due more skilled labour working in banks, and a part which is due to other changes associated with deregulation. I only distinguish between a brain-drain effect and a bank performance effect more generally.

4. Data

I construct a panel dataset of manufacturing industries for the 50 states over the period 1997 to 2008 using data from the Annual Survey of Manufactures (ASM) which are available at the U.S. state and industry level.[8] The ASM is conducted on an establishment basis and comprises manufacturing establishments with one or more paid employees. The Census Bureau only conducts the survey in the four years between economic censuses. For the years 1997, 2002 and 2007 the ASM data are supplemented by data from the Economic Census. The manufacturing sectors are broken down into 3-digit NAICS industries.

As a measure of labour productivity I use the ratio of real value added generated by an industry and the total number of employees working in that industry. Real value added was obtained by deflating value added with producer prices from the Bureau of Labor Statistics. The total number of employees consists of production and non-production workers. This includes employees who work part-time. As a second indicator of labour productivity I use

[8] The sample period was chosen on the basis of data availability. ASM data prior to 1997 are classified by SIC-codes. Since a one-to-one correspondence between these industry codes is often missing the earlier ASM data based on SICs cannot readily be added to the later ASM data based on NAICS. My sample period ends in 2008 because the branching regulation data are only available for the period 1992-2008.

value added of an industry divided by the hours worked by its production workers. Production workers are essentially workers in blue-collar occupations. This is nevertheless a relevant measure of labour productivity for my purposes because a reduction of skilled labour should also lead to a decline in the labour productivity of unskilled labour.

Data from Compustat are used to construct measures of R&D-intensities and external finance dependence of industries at the 3-digit NAICS level. The industry characteristics are calculated for the 1980s for the U.S. as a whole. This particular period was chosen because in the 1980s the financial system in the U.S. was already very well developed without being "overgrown" or "bloated" (Krugman, 2009). I therefore assume that during that period non-financial industries could still satisfy their demand for high-skilled labour without suffering too much from competition for talent from the financial sector. This is consistent with the findings of Philippon and Reshef (forthcoming) that "financial jobs were relatively skill-intensive, complex and highly paid until the 1930s and after the 1980s, but not in the interim period". An R&D-intensity measure based on data from the 1980s should therefore be a good proxy for an industry's intrinsic dependence on highly skilled labour. Rajan and Zingales (1998) argue capital markets in the U.S. during the 1980s were relatively frictionless and hence the amount of external finance used by firms at the time is a good measure of their intrinsic demand for external finance. They point out that industries differ in their dependence on external sources of finance due to industry-specific technological factors determining initial project scale, gestation period, cash-harvest period and the need for investments.

Like Rajan and Zingales (1998), I define external finance as the amount of desired investment that cannot be financed through internal cash flows. More specifically, my measure of dependence on external finance is the industry-level median of the ratio of capital expenditures minus cash flows from operations divided by capital expenditures. The numerator and denominator for each firm are summed over all years before dividing. Cash flow is calculated using Compustat item 110, if available, and otherwise by the sum of Compustat items 123, 125, 126, 106, 213, and 217, plus the change in working capital (the sum of Compustat items 302, 303, and 304). Capital expenditure is calculated as the sum of Compustat items 128 (capital expenditure) and 129 (net acquisitions). The R&D-intensity of an industry is measured as the industry-level median of either the ratio of research and development expenses to sales or of the ratio of research and development expenses to total assets.

Table 3 shows the external finance dependences and the R&D-intensities of each of the 21 manufacturing industries. Chemicals and computer and electronic products are the industries which are both most R&D-intensive and most dependent on external finance. The apparel and accessories sector is least R&D-intensive. The leather industry is least dependent on external finance. My two measures of R&D-intensity are highly correlated ($\rho>0.9$). Furthermore, both measures of R&D-intensity are correlated with the dependence on external finance ($\rho>0.6$). Given this high correlation, I also present results from estimations which do not include the interaction between external finance dependence and the deregulation index.

5. Results

A. Comparing Mean Labour Productivity in Deregulated and Regulated Banking Markets

A simple comparison of means in table 4 illustrates the identification strategy underlying my regressions. My sample is broken down into four groups: a control group in deregulated banking markets, a control group in regulated banking markets, a treatment group in deregulated banking markets and a treatment group in regulated banking markets. Industries with above median R&D-intensity form the treatment group and industries with below median R&D-intensity represent the control group. State-years for which the branching deregulation index takes a value greater than two are considered deregulated banking markets. Those with an index value between zero and two are considered regulated markets.

Panel A shows mean labour productivities for each of the four groups as measured by the ratio of real value added over employees, and panel B shows mean labour productivities as measured by the ratio of real value added over hours worked. For all different combinations of labour productivity and R&D-intensity measures used the same pattern emerges: Average labour productivity in the treatment group is higher in regulated banking markets than in deregulated markets. The opposite is true for the control group. Labour productivity in industries with relatively low R&D-intensity is higher in deregulated banking markets. Furthermore, in deregulated markets the mean labour productivity in the control group is always higher than in the treatment group. Conversely, in regulated markets the mean labour productivity is always higher in the treatment group. For all specifications,

deregulation is associated with a decline in labour productivity on average. If for example R&D-intensity is captured by R&D expenses over sales, deregulation is associated with an average decline in value added over employees of 0.19.

The regression results that will be presented next are based on continuous measures of R&D-intensity and branching deregulation rather than the indicator variables used to assign observations to the four groups in table 4. In the regressions I also control for a potential positive effect of deregulation stemming from improved bank performance. This effect is not singled out in table 4 and might partly explain why deregulation improves labour productivity in the control group. These industries have low R&D-intensities and are therefore less affected by a potential drag of skilled labour into finance. They might however benefit from increased loan supply and lower interest rates in more competitive banking markets. More capital and investment in turn is likely to boost productivity. Moreover, it is possible that an increase in the labour productivity of sectors with low R&D-intensities reflects improved bank performance due to skill upgrading of banks.

B. Regression Results

The results from estimating equation (1) are presented in table 5. The dependent variable is real value added over employees in columns (1) to (4) and real value added over hours worked in columns (5) to (8). Consistent with the idea that banking absorbs talent at the expense of productivity in manufacturing sectors, the coefficient on the interaction between the branching deregulation index and R&D-intensity on labour productivity is negative. The coefficients are significant for all specifications. The positive coefficient on the interaction of the branching index and external finance dependence is in line with the hypothesis that skilled bank employees have a positive effect on labour productivity in manufacturing by improving bank performance. The coefficients on the interaction between deregulation and R&D-intensity are more negative if the positive effect of improved bank performance is singled out.

The row with the differential effects in table 5 sheds light on the economic significance of the coefficients on the interaction between deregulation and R&D-intensity. It shows the differential in labour productivity between very R&D-intensive industries versus less R&D-intensive industries if a state moves from no interstate branching to full interstate branching, i.e. if its index value changes from 0 to 4. Labour productivity in very R&D-intensive industries such as transportation equipment (75^{th} percentile in the R&D-intensity

distribution) relative to less R&D-intensive industries such as wood products (25th percentile in the R&D-intensity distribution) as measured by value added over employees falls on average by 0.14 if a state which had no interstate banking fully embraces interstate branching.[9] This is a large effect given that the sample mean of labour productivity as measured by value added over employees is 1.19 and the standard deviation is 1.17. The reduction in labour productivity measure based on hours worked is 0.11 which is also a very large compared with a sample mean of 0.87 and a standard deviation of 0.95.

It is also possible to deduce the effect of deregulation for individual industries from the results in table 5. The estimates in table 5 column (2) suggest that a change from no interstate banking (index value of 0) to maximum branching deregulation (index value of 4) results in a decline of labour productivity of 0.18 for the chemical industry. The chemical industry is both very R&D-intensive and very dependent on external finance and should therefore experience the bright and the dark sides of a move of talent into banks. It is interesting to compare this estimate to an industry which is not very R&D-intensive but very dependent on external finance such as wood products. A move from no interstate banking to full branching deregulation in this industry results in an increase in labour productivity of 0.01. Thus some industries gain and others suffer from interstate branching deregulation.

C. Labour Mobility

A factor which could potentially distort my results is migration of skilled labour between states. This is the case independently of whether migration occurs in response to branching deregulation or not. It is however likely that skilled labour flows out of heavily regulated states, and flows into deregulated state to meet the increased demand for talent there. A net outflow of skilled labour (or equivalently, a negative net inflow of skilled labour) has a similar effect on labour productivity as the absorption of talent into the financial sector does: The reduction in labour supply should disproportionally hurt R&D-intensive industries which rely heavily on skilled labour. Thus, a net outflow of skilled labour should reinforce the brain-drain effect. Conversely, a net inflow of skilled labour into a state should benefit

[9] The R&D-intensity of transportation equipment is 0.0189 if R&D-intensity is measured by the ratio of R&D expenses over sales. This comes closest to the 75th percentile of the industry distribution of R&D expenses over sales. If R&D-intensity is measured by the ratio of R&D expenses over assets, plastic and rubber products constitute the 75th percentile of the distribution. For both measures of R&D-intensity, wood products are closest to the 25th percentile of the distribution.

especially the labour productivity of R&D-intensive sectors. Hence, net inflows of skilled labour should counteract the effect of talent absorption into finance.

To single out the effect of migration, I add an interaction between R&D-intensity and net inflows of skilled labour to equation (1). Since a net inflow of skilled labour benefits especially R&D-intensive sectors, the coefficient on this control variable should be positive. The magnitude of the coefficient on the interaction term of R&D-intensity and the branching deregulation index should increase if this positive effect of net inflows of skilled labour is controlled for. Thus, in the presence of migration the coefficients in table 5 underestimate the true effect of the absorption of skilled individuals into the financial sector.

I obtain data on migration flows from the CPS. Net inflows are measured by the number of skilled individuals moving into a state minus the number of skilled individuals leaving a state in a given year. Only those individuals who moved between states and who work at least part time are included in my sample. As in table 2, I define skilled labour as individuals with a master degree or more. The results from estimations including the interaction term of net inflows of skilled labour and R&D intensity are shown in table 6. The coefficients on this interaction term are close to zero and never significant. However, the magnitude of the main coefficients of interest is larger than in the regressions in table 5 which do not control for migration. This suggests that my previous results underestimate the true effect of the absorption of talent into the financial sector. Since net inflows of skilled labour are endogenous in this regression framework, this evidence is however no more than indicative.[10]

6. Robustness Checks

This section presents several sensitivity analyses to show that my main results are robust to the use of alternative measures of R&D-intensity and alternative indices of banking deregulation.

[10] Instruments that are commonly used for migration between countries are not suitable for migration between US states.

A. Alternatives to the R&D-intensity Indicator

My measures of R&D-intensities indicate to which extent an industry is affected by a brain-drain induced by the banking sector. As outlined in section 3, I calculated the R&D-intensities based on data from the 1980s. This period was chosen for two reasons: Firstly, the evidence suggests that the financial sector in the US worked well at the time without having reached a size which might be considered excessive. Secondly, this decade precedes my sample period by more than seven years and thus endogeneity problems are mitigated. A potential drawback of using R&D-intensities from the 1980s is that these might not be representative of the intrinsic skill-needs of industries in the late 1990s or 2000s because technologies and skill-needs of industries might have changed over time.

To address this concern I re-estimate equation (1) using R&D-intensities calculated for the period 1986-1996, i.e. the decade preceding my dataset. Results are qualitatively unchanged.[11] Furthermore, I divide industries into those which displayed a high R&D-intensity from the 1980s onwards and those which did not. I create a dummy variable which takes a value of one if an industry ranks among the top third most R&D-intensive industries of the distribution in every single year between 1980 and 2008 and zero otherwise. The industries which exhibit a high R&D-intensity throughout this period are chemicals, non-electrical machinery, computer and electronic products, miscellaneous products, and electrical equipment.[12] Table 7 shows the results from estimations using this indicator variable rather than the continuous R&D-intensity measure as before. The results confirm my previous findings.

Another potential problem with my original industry characteristic is that R&D-expenses might not fully capture the skill requirements of an industry. A more direct indicator of an industry's skill requirement is the human capital of its workforce. I therefore replace the R&D-intensity in equation (1) with industries' share of workers with a master degree or more. The shares were calculated for the year 1993 using CPS-data on civilians aged 16 to 64 who worked at least part-time. The year 1993 was chosen because it is the last year before interbank branching laws started to change (Alaska was the first state to deregulate in 1994). Thus this skill indicator is not affected by a potential intensification of competition for talent due to branching deregulation. A measure of skill-shares based on earlier years might be

[11] The results are not shown here but are available on request.

[12] This applies irrespective of the specific R&D-intensity measure used.

preferable but unfortunately the use of earlier data is complicated by the industry coding of the CPS. Industries in the CPS are classified according to the Census system which changed over time. A concordance between Census industry classifications and NAICS codes was not available for data prior to the 1990s. Even for the early 1990s the matching of industry codes is imperfect and results in the loss of one of the NAICS industries (code 323). Nevertheless the estimates in table 8 which are based on the share of highly educated individuals rather than R&D-intensities provide a useful robustness check.

B. Alternative Banking Deregulation Indices

In this subsection I repeat my analysis with two alternative deregulation indices: the interstate branching index of Rice and Strahan (2010) and the interstate *banking* deregulation indicator of Kroszner and Strahan (1999).[13] The index of Rice and Strahan is very similar to the index used in section 3. One important difference is that it only covers regulatory reforms until 2005. The recent financial crisis is therefore excluded from the sample. Furthermore, the index ignores reciprocity conditions and accounts for deposit caps in a slightly different way: To construct my original index I subtract one if a state imposes a deposit concentration limit greater than zero. For the Rice and Strahan index, one is subtracted if the deposit cap is less than 30%.

The results from estimations using the Rice and Strahan index are reported in table 9. They lend support to my previous conclusions. For the regressions with value added over employees as the dependent variable the coefficients imply a fall in productivity of skill-intensive relative to less skill-intensive industries of 0.1 if a state moves from no interstate branching to full interstate branching. This can be compared to the sample mean of 1.12. For the regressions with value added over hours worked as the dependent variable the coefficients imply a decline in productivity of 0.05 which is also large compared to the sample mean of 0.81.

States relaxed their restrictions to interstate *banking* at different times during the 1980s and early 1990s.[14] With interstate banking, mergers and acquisitions of banks across state lines were permitted. I create a dummy variable taking a value of one in the years following

[13] Both, the Rice and Strahan index and information on interstate banking reform are available for the 50 states and the District of Columbia. The latter has not been included in the sample used before.

[14] Hawaii which had not deregulated interstate banking by the mid-1990s is an exception.

interstate banking reform. Since the regulatory changes occurred before the mid-1990s I use labour productivity data and value added shares from historical ASM data. These data are available for the period 1987-1995 with manufacturing sectors broken down into 2-digit SIC industries. In accordance with the historical ASM data, the R&D-intensities from Compustat are also calculated for 2-digit SIC industries. I can effectively exploit 13 regulatory changes over the period 1987-1995. The results from estimating equation (1) using interstate banking deregulation shown in table 10 are in line with my previous findings.[15]

C. A Note on Endogeneity

Following the reasoning of Kroszner and Strahan (1999), those industries which benefit most and those industries which suffer most from the absorption of talent should be active lobbyists in the deregulation process. To test whether deregulation is indeed exogenous in my setting, I therefore examine the relationship between the degree of deregulation in a state and the relative strength of losers and winners from the diversion of talent into finance. I consider manufacturing industries with above median external finance dependence and below median R&D-intensity the winners of deregulation. Conversely, industries with below median external finance dependence and above median R&D-intensity are defined as the losers of deregulation. To test whether deregulation occurred in response to lobbying by industries, it would be ideal to analyse the relationship between the extent of branching deregulation and the relative strength of winners and losers in the years before deregulation took place. Since my sample period only starts in 1997 and many states deregulated before or during that year, I examine the relationship between the relative strength of industries and my deregulation index only for the actual years of deregulation. States which deregulated before 1997 are therefore not included in this analysis[16].

I find that my deregulation index is not correlated with either the sum of the value added generated by winners divided by the sum of the value added generated by losers, or the sum of the value added per employee (or value added over hours worked) generated by winners divided by the sum of value added per employee (or value added over hours worked)

[15] As before, I drop the year of deregulation. Furthermore, Delaware and South Dakota were dropped from the analysis because these state witnessed dramatic expansions of their banking sectors over the 1980s as credit card operations were moved there to exploit liberal usury laws.

[16] Results are however unchanged if these states are included in the sample and it is assumed that they deregulated in 1997.

generated by losers. The absence of a (positive) relationship between these variables suggests that the deregulation process was not driven by private interest groups in manufacturing. I also investigate the link between my deregulation index and the relative growth rates of winners and losers between the year of deregulation and the year following deregulation to see whether deregulation reflects policymakers' support of growth sectors, as public-interest theory would suggest. There is no correlation between my deregulation index and the ratio of mean value added growth of winners over that of losers, and between my deregulation index and the ratio of mean labour productivity growth of winners over that of losers.

The evidence presented by Kroszner and Stahan (1999, 2007) and the findings presented in this section suggest that variation in deregulation is indeed exogenous in my setting.

7. Conclusion

This paper exploits variation in US branching deregulation to assess the impact of the absorption of talent into the banking sector on labour productivity in the real sectors of the economy. I find that interstate branching deregulation disproportionally reduces labour productivity in R&D-intensive manufacturing sectors. This suggests that the absorption of skilled labour into banks hurts the real sector, and might be one of the factors behind the non-linearities in the finance-growth relationship documented by recent studies. I also show that branching deregulation disproportionally benefits those sectors which rely heavily on external finance. To the extent that this effect can be attributed to skill upgrading by banks, non-financial sectors also gain from the diversion of talent into banks. Whether the negative brain-drain effect or the positive bank performance effect dominates ultimately depends on the specific skill- and funding requirements of an industry.

My evidence does however not allow drawing conclusions about the overall efficiency of the reallocation of skilled labour following deregulation. Firstly, it is difficult to assess to which extent the bank performance effect is attributable to skill upgrading by banks. Furthermore, the absorption of highly skilled individuals into banks could affect non-financial industries through channels other than labour productivity which are not explored in this paper.

It is likely that the shrinkage of the financial sector during the recent financial crisis and tighter regulations designed in response to this event led to a release of human capital. An analysis of this episode could improve our understanding of the resource drain from the financial sector - an aspect which should definitely be taken into account in our quest for the optimal financial system.

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Appendix

Table 1 Interstate branching laws: 1992-2008

This table shows for every state the year in which interstate branching reforms came into effect and gives the branching deregulation index resulting from these changes. The index ranges from 0 to 4 with 4 indicating maximum openness to entry of out-of-state banks. Alabama for instance adopted interstate branching regulations in 1997 corresponding to an index value of 1. These regulations were in place until 2006 when branching regulations were relaxed slightly. In Arizona all 5 restrictions to interstate branching were implemented in 1996. This is captured by an index value of 0.

State	Effective Date	Index	State	Effective Date	Index
Alabama	1997	1	Nevada	1995	1
Alabama	2006	2	Nevada	2007	2
Alaska	1994	2	New Hampshire	1997	1
Arizona	1996	0	New Hampshire	2000	2
Arizona	2001	1	New Hampshire	2002	3
Arkansas	1997	1	New Jersey	1996	3
California	1995	1	New Mexico	1996	1
Colorado	1997	1	New York	1997	2
Connecticut	1995	2	North Carolina	1995	3
Delaware	1995	1	North Dakota	1997	1
Florida	1997	1	North Dakota	2003	3
Georgia	1997	1	Ohio	1997	4
Hawaii	1997	1	Oklahoma	1997	1
Hawaii	2001	4	Oklahoma	2000	3
Idaho	1995	1	Oregon	1995	2
Illinois	1997	1	Oregon	1997	1
Illinois	2004	3	Pennsylvania	1995	3
Indiana	1997	3	Rhode Island	1995	3
Indiana	1998	2	South Carolina	1996	1
Iowa	1996	1	South Dakota	1996	1
Kansas	1995	1	Tennessee	1996	0
Kentucky	1997	1	Tennessee	1998	1
Kentucky	2000	2	Tennessee	2001	2
Kentucky	2004	1	Texas	<1999	n/a
Louisiana	1997	1	Texas	1999	3
Maine	1997	3	Utah	1995	2
Maryland	1995	4	Vermont	1996	2
Maryland	2008	3	Vermont	2001	3
Massachusetts	1996	2	Virginia	1995	3
Michigan	1995	4	Washington	1996	1
Minnesota	1997	1	Washington	2005	2
Mississippi	1997	1	Washington	2007	1
Missouri	1995	1	West Virginia	1997	3
Montana	<2001	n/a	Wisconsin	1996	1
Montana	2001	1	Wyoming	1997	1
Nebraska	1997	1			

Table 2 Comparison of the share of skilled bankers across deregulated and regulated banking markets

This table reports ratios of the number of skilled bankers over the total number of skilled individuals in a state and year averaged across regulated and deregulated banking markets over the period 1992-2008. The means are significantly different at the 2% level based on a simple t-test. Skilled individuals are defined as those individuals with a master degree or more. Data on skills were obtained from the CPS.

State-year	Observations	Mean skill share
Regulated banking markets (index<3)	647	1.6%
Deregulated banking markets (index>=3)	203	1.9%
Difference		-0.2%**

Table 3 Industry characteristics: R&D-intensities and external finance dependence

Industry characteristics were calculated from Compustat using data from 1980-1989. Industry R&D-intensities are defined as median R&D-expenses divided by sales or total assets. External finance dependence is the median ratio of capital expenditures minus cash flows from operations divided by capital expenditures.

Naics-Code	**Industries**	**R&D-intensity (R&D/sales)**	**R&D-intensity (R&D/assets)**	**External finance dependence**
311	Food Products	0.0057	0.0103	0.101
312	Beverages & Tobacco	0.0066	0.0081	0.099
313	Textiles & Fabrics	0.0112	0.0201	-0.079
314	Textile Mill Products	0.0079	0.0178	-0.068
315	Apparel & Accessories	0.0034	0.0038	0.089
316	Leather Products	0.0079	0.0140	-0.671
321	Wood Products	0.0068	0.0082	0.308
322	Paper	0.0129	0.0122	-0.013
323	Printed Matter & Related Products	0.0060	0.0079	-0.127
324	Petroleum & Coal Products	0.0068	0.0063	0.081
325	Chemicals	0.0632	0.0585	0.657
326	Plastic & Rubber Products	0.0163	0.0257	0.087
327	Nonmetallic Mineral Products	0.0106	0.0114	0.090
331	Primary Metal Manufacturing	0.0063	0.0074	0.051
332	Fabricated Metal Products	0.0114	0.0133	0.076
333	Machinery, except Electrical	0.0250	0.0321	0.323
334	Computer & Electronic Products	0.0741	0.0834	0.518
335	Electrical Equipment, Appliances, Component	0.0268	0.0366	0.159
336	Transportation Equipment	0.0189	0.0234	0.120
337	Furniture & Fixtures	0.0084	0.0153	-0.108
339	Miscellaneous	0.0389	0.0389	0.622

Table 4 Mean productivity by R&D intensity and deregulation of banking markets

This table shows mean labour productivities of R&D-intensive and less R&D-intensive industries in regulated and deregulated banking markets between 1997 and 2008. Industries are broken down by 3-digit NAICS-codes. Industries with above median R&D-intensity form the treatment group and industries with below median R&D-intensity the control group. "Deregulated banking markets" are state-year observations for which my deregulation index takes a value greater than or equal to 3 and "regulated banking markets" are those with an index value below three. ** and *** indicate statistical significant at the 5% and the 1%-level, respectively, based on simple t-tests.

Panel A: Mean labour productivity as measured by value added over employees

	Deregulated banking markets (index>=3)	Regulated banking markets (index<3)	Difference
Treatment group (above median R&D/sales)	1.12	1.18	-0.06
Control group (below median R&D/sales)	1.26	1.14	0.13
Difference-in-Differences	-0.15	0.04	-0.19***
Treatment group (above median R&D/assets)	1.11	1.16	-0.06
Control group (below median R&D/assets)	1.25	1.16	0.09
Difference-in-Differences	-0.14	0.00	-0.15**

Panel B: Mean labour productivity as measured by value added over hours worked

	Deregulated banking markets (index>=3)	Regulated banking markets (index<3)	Difference
Treatment group (above median R&D/sales)	0.84	0.89	-0.05
Control group (below median R&D/sales)	0.90	0.78	0.11
Difference-in-Differences	-0.06	0.11	-0.17***
Treatment group (above median R&D/assets)	0.86	0.92	-0.06
Control group (below median R&D/assets)	0.87	0.78	0.09
Difference-in-Differences	-0.01	0.13	-0.14***

Table 5 Regression of productivity on interactions of R&D-intensity and deregulation

This table reports results from estimating equation (1) for 1997-2008. Industries are classified according to 3-digit NAICS codes. In columns (1) to (4) value added over employees is the dependent variable and in columns (5) to (8) value added over hours worked is the dependent variable. The standard errors in parentheses are clustered at the state-level. *, **, and *** indicate statistical significance at the 10, 5 and 1 % level. The differential effect is the differential in labour productivity between very R&D-intensive industries (75th percentile of the respective R&D-intensity distribution) relative to less R&D-intensive industries (25th percentile) if a state moves from no interstate branching to maximum branching deregulation.

	Labour productivity							
	Value added over employees				Value added over hours worked			
value added share	7.395***	7.396***	7.383***	7.381***	5.828***	5.830***	5.820***	5.817***
	(1.432)	(1.431)	(1.436)	(1.435)	(1.058)	(1.056)	(1.059)	(1.057)
ext.fin.dependence*reg		0.136*		0.0596		0.132*		0.0779
		(0.0770)		(0.0705)		(0.0709)		(0.0639)
R&D-intensity*reg	-2.820**	-4.288**			-2.249**	-3.665**		
(R&D/sales)	(1.323)	(1.845)			(1.114)	(1.684)		
R&D-intensity*reg			-2.680*	-3.271*			-2.274*	-3.047*
(R&D/assets)			(1.335)	(1.663)			(1.184)	(1.602)
Differential effect	-0.14	-0.21	-0.19	-0.23	-0.11	-0.18	-0.16	-0.21
Industry x Year FE	yes	yes	yes	yes	yes	yes	yes	yes
State x Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Observations	5,977	5,977	5,977	5,977	5,992	5,992	5,992	5,992
R-squared	0.819	0.819	0.819	0.819	0.821	0.821	0.821	0.821

Table 6 Regression controlling for migration

This table reports results from estimating equation (1) including an interaction term between R&D-intensity and net inflows of skilled labour for the period 1997-2008. Skilled individuals are defined as those with a master degree or more. Industries are classified according to 3-digit NAICS codes. In columns (1) to (4) value added over employees is the dependent variable and in columns (5) to (8) value added over hours worked is the dependent variable. The standard errors in parentheses are clustered at the state-level. *, **, and *** indicate statistical significance at the 10, 5 and 1 % level.

	Labour productivity							
	Value added over employees				Value added over hours worked			
Value added share	7.934***	7.930***	7.913***	7.906***	6.360***	6.356***	6.345***	6.336***
	(1.625)	(1.622)	(1.626)	(1.622)	(1.230)	(1.225)	(1.227)	(1.223)
Ext.fin.dependence*reg		0.143*		0.0647		0.139*		0.0836
		(0.0839)		(0.0739)		(0.0736)		(0.0638)
R&D-intensity*reg	-3.033**	-4.574**			-2.426**	-3.926**		
(R&D/sales)	(1.422)	(2.017)			(1.169)	(1.768)		
R&D-intensity*reg			-2.930**	-3.574*			-2.481*	-3.313*
(R&D/assets)			(1.447)	(1.813)			(1.240)	(1.656)
R&D-intensity*netinflows	-6.64e-05	-6.68e-05			-2.04e-05	-2.08e-05		
(R&D/sales)	(8.51e-05)	(8.50e-05)			(6.91e-05)	(6.89e-05)		
R&D-intensity*netinflows			-9.22e-05	-9.24e-05			-2.96e-05	-2.99e-05
(R&D/assets)			(8.45e-05)	(8.45e-05)			(7.10e-05)	(7.10e-05)
Industry x Year FE	yes	yes	yes	yes	yes	yes	yes	yes
State x Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Observations	5,107	5,107	5,107	5,107	5,115	5,115	5,115	5,115
R-squared	0.816	0.816	0.816	0.816	0.825	0.826	0.825	0.825

Table 7 Regression of labour productivity on interactions of deregulation and R&D-intensity indicator variables

This table reports results from estimating equation (1) for 1997-2008. Industries are classified according to 3-digit NAICS codes. In columns (1) and (2) value added over employees is the dependent variable and in columns (3) to (4) value added over hours worked is the dependent variable. In this table R&D-intensity is a dummy variable which takes a value of 1 if an industry ranked among the top third most R&D-intensive industries in every single year between 1980 and 2008. The standard errors in parentheses are clustered at the state-level. *, **, and *** indicate statistical significance at the 10, 5 and 1 % level.

	Labour productivity			
	Value added over employees		Value added over hours worked	
Value added share	7.396***	7.396***	5.827***	5.828***
	(1.440)	(1.441)	(1.064)	(1.065)
Ext.fin.dependence*reg		0.0281		0.0389
		(0.0783)		(0.0581)
R&D-intensity*reg	-0.0990**	-0.111**	-0.0780**	-0.0950**
	(0.0411)	(0.0495)	(0.0363)	(0.0453)
Industry x Year FE	yes	yes	yes	yes
State x Year FE	yes	yes	yes	yes
Observations	5977	5977	5992	5992
R-squared	0.819	0.819	0.821	0.821

Table 8 Regression of labour productivity on interactions of skill-intensity and deregulation

This table reports results from estimating equation (1) for 1997-2008. Industries are classified according to 3-digit NAICS codes. In columns (1) and (2) value added over employees is the dependent variable and in columns (3) to (4) value added over hours worked is the dependent variable. Estimations are based on industry skill-intensities instead of R&D-intensities. Skill-intensities were calculated from CPS data for the year 1993. The print industry (code 323) was dropped. The standard errors in parentheses are clustered at the state-level. *, **, and *** indicate statistical significance at the 10, 5 and 1 % level.

	Labour productivity			
	Value added over employees		Value added over hours worked	
Value added share	7.395***	7.395***	5.833***	5.833***
	(1.432)	(1.431)	(1.060)	(1.059)
Ext.fin.dependence*reg		0.0469		0.0506
		(0.0611)		(0.0438)
Skill-intensity*reg	-1.317**	-1.551**	-1.033*	-1.287**
	(0.653)	(0.744)	(0.517)	(0.593)
Industry x Year FE	yes	yes	yes	yes
State x Year FE	yes	yes	yes	yes
Observations	5774	5774	5788	5788
R-squared	0.818	0.818	0.820	0.820

Table 9 Regression using the Rice and Strahan deregulation index

This table reports results from estimating equation (1) for 1997-2005 using the deregulation index from Rice and Strahan (2010). Industries are classified according to 3-digit NAICS codes. In columns (1) to (4) value added over employees is the dependent variable and in columns (5) to (8) value added over hours worked is the dependent variable. The standard errors in parentheses are clustered at the state-level. *, **, and *** indicate statistical significance at the 10, 5 and 1 % level.

	Labour productivity							
	Value added over employees				Value added over hours worked			
Value added share	6.576***	6.596***	6.563***	6.569***	4.957***	4.972***	4.951***	4.956***
	(1.392)	(1.394)	(1.398)	(1.401)	(0.989)	(0.989)	(0.992)	(0.993)
Ext.fin.dependence*reg		0.110		0.0506		0.0875		0.0526
		(0.0698)		(0.0666)		(0.0610)		(0.0567)
R&D-intensity*reg	-2.122**	-3.364**			-1.139	-2.126*		
(R&D/sales)	(1.055)	(1.394)			(0.865)	(1.260)		
R&D-intensity*reg			-2.054*	-2.598**			-1.138	-1.704
(R&D/assets)			(1.063)	(1.275)			(0.913)	(1.210)
Industry x Year FE	yes	yes	yes	yes	yes	yes	yes	yes
State x Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Observations	3,792	3,792	3,792	3,792	3,806	3,806	3,806	3,806
R-squared	0.825	0.825	0.824	0.824	0.816	0.817	0.816	0.816

Table 10 Regression using the interstate banking deregulation indicator

This table reports results from estimating equation (1) for 1987-1995 using the interstate banking indicator from Kroszner and Strahan (1999). Industries are classified according to 2-digit SIC codes. In columns (1) to (4) value added over employees is the dependent variable and in columns (5) to (8) value added over hours worked is the dependent variable. The standard errors in the parentheses are clustered at the state-level. *,**, and *** indicate statistical significance at the 10, 5 and 1 % level.

	Labour productivity							
	Value added over employees				Value added over hours worked			
Value added share	2.856***	2.865***	2.854***	2.859***	2.182***	2.190***	2.181***	2.185***
	(0.490)	(0.489)	(0.490)	(0.490)	(0.331)	(0.329)	(0.331)	(0.330)
Ext.fin.dependence*reg		0.305*		0.173		0.254*		0.165
		(0.173)		(0.196)		(0.150)		(0.179)
R&D-intensity*reg	-2.132	-5.332***			-1.336	-3.998*		
(R&D/sales)	(1.605)	(1.852)			(1.893)	(2.002)		
R&D-intensity*reg			-1.662	-3.360**			-1.055	-2.674
(R&D/assets)			(1.376)	(1.670)			(1.622)	(1.650)
Industry x Year FE	yes	yes	yes	yes	yes	yes	yes	yes
State x Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Observations	6220	6220	6220	6220	6227	6227	6227	6227
R-squared	0.912	0.912	0.912	0.912	0.909	0.909	0.909	0.909

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