Finance and Efficiency: Do Bank Branching Regulations Matter?*

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Abstract

We use portfolio theory to quantify the efficiency of state-level sectoral patterns of production in the United States. On the basis of observed growth in sectoral value-added output, we calculate for each state the efficient frontier for investments in the real economy. We study how rapidly different states converge to this benchmark allocation, depending on access to finance. We find that convergence is faster - in terms of distance to the efficient frontier and improving Sharpe ratios - following intra- and (particularly) interstate liberalization of bank branching restrictions. This effect arises primarily from convergence in the volatility of state output growth, rather than in its average. The realized industry shares of output also converge faster to their efficient counterparts following liberalization, particularly for industries that are characterized by young, small and external finance dependent firms. Convergence is also faster for states that have a larger share of constrained industries and greater distance from the efficient frontier before liberalization. These effects are robust to industries integrating across states and to the endogeneity of liberalization dates. Overall, our results suggest that financial development has important consequences for efficiency and specialization (or diversification) of investments, in a manner that depends crucially on the variance-covariance properties of investment returns, rather than on their average only.

Key words: Financial development, Growth, Sharpe ratio, Volatility, Diversification.

JEL classification: E44, F02, F36, O16, G11, G21, G28

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1 Introduction

Over the past decade, an extensive literature in international finance has confirmed the role of financial development as an important catalyst for growth and allocative efficiency.[1] A common thread running through most of this literature is the focus on the *level* of investment returns, and rarely, on their volatility. In striking contrast, the literature in finance on mean-variance efficiency and the capital asset-pricing model suggests that the *variance-covariance* properties of returns should play an equally crucial role in the allocative efficiency of investment. What should matter are suitably risk-adjusted returns. Inspired by this literature, we introduce in this paper a measure of the portfolio efficiency of investments in the real economy. Specifically, we calculate the efficient production frontier of an economy, on the basis of *both* the mean and the variance-covariance structure of returns on investment in different industries of the economy. The method also gives rise to a measure of the efficient Sharpe ratio and the corresponding weights on investments in different industries.

Armed with this benchmark for allocative efficiency in real activity, we seek to answer the following questions that are central to understanding the real effects of financial development: Is the allocation of capital efficient? Does improved access to finance foster allocative efficiency in the real economy? In particular, does convergence to the efficient frontier accelerate following financial deregulation? If so, what are the channels through which this is achieved? Our goal is to investigate the link between financial development and the precise nature of specialization (or diversification) of investment in the real economy. In particular, we investigate to what extent this link is consistent with a portfolio theory of the allocation of output across sectors.

Our laboratory for answering these questions consists of state-level sectoral value-added output and banking deregulation in the United States. We treat each state in the U.S. as

[1]King and Levine (1993) and Levine and Zervos (1996) were the first to establish the empirical link between aggregate growth and financial development. Beck, Levine and Loayza (2000) established that this link is robust to considering measures of growth based on total factor productivity and capital accumulation. In disaggregated data, Rajan and Zingales (1998) show that financial development affects growth more for those sectors that tend to rely on external finance for technological reasons. Beck et al. (2005) extend this work to find that financial development also eases constraints within industries that are more dependent on small firms. Fisman and Love (2004) provide evidence on a finance-growth nexus by looking at co-movement in growth rates of countries at similar levels of industrial and financial development. Chari and Henry (2002) document that opening financial markets to foreign investment results in greater growth for capital-poor countries. Wurgler (2000) shows that well-developed capital markets are conducive of investment efficiency in that they tend to direct investment towards sectors that turn out to subsequently grow fast, and away from declining industries. Finally, Bekaert et al (forthcoming) find significant reallocation effects towards sectors with high growth potential, as proxied by their stock value.

an individual economy and study how relaxing state branching restrictions for banks within and between states has affected the allocative efficiency of production patterns. To account for the specificity and partial irreversibility of capital, we allow the shift to efficiency following deregulation to be gradual rather than instantaneous. In particular, we investigate the properties of convergence towards the efficient frontier, and whether it is affected by liberalization.[2]

Our analysis relies on four assumptions regarding banks' objectives, organization and financing. First, banks seek efficient levels of diversification through the allocation of loans in their portfolios. Indeed, the diversification of all idiosyncratic risk is the driving force behind the optimality of banks as delegated monitors in the model of Diamond (1984).[3]

Second, we assume that information frictions prevent individual bank branches from having unrestricted access to the entire spectrum of projects available, and, in turn, create a local bias in branch-level loan portfolios, unless they are allowed to branch freely.[4] If the assumption holds, then branching restrictions prevent banks from organizing distant lending through branch networks. This leads to bank lending patterns across sectors that are likely to be away from the efficient ones, i.e. the allocations that would obtain under free branching. In principle, such restricted access reduces the scope of efficient diversification for banks, which may feed back into the real economy and result in more volatile investment portfolios, and, possibly, lower realized return levels.

On the one hand, this suggests that the lifting of bank branching regulation should shift the allocation of investments across industries towards the efficient one. On the other hand,

[2]Of course, faster convergence to the optimum also means that the long-run distance to the frontier is affected by liberalization. Our setup thus has direct implications on the variation in distance from the frontier across states. We have also checked whether the levels of state growth, volatility and Sharpe ratio - rather than their distance from efficiency - are affected by branching deregulations. We found no significant impact.

[3]Why should banks use their loans portfolio to achieve efficient levels of diversification? Why would they need to, if their shareholders were able to achieve diversification by choosing to include other assets in their portfolio? Note that banks in the U.S. are typically heavily leveraged in deposits, not invested in equity, and generally not publicly owned. In addition, Kashyap and Stein (2000) provide robust evidence that inter-bank lending constitutes a tiny portion of the typical commercial bank's balance sheet relative to their deposit base, for time periods as recent as the 1990s. Since credit risk-transfer mechanisms such as credit derivatives became widely available only in late 90's, banks' loan portfolios were their de facto main source of diversification over our sample period of 1977 to 2000.

[4]The empirical literature in finance has asked whether information frictions can explain home bias in shareholder portfolios (see French and Poterba (1991) and Lewis (1999)). More recently, Coval and Moskowitz (1999, 2001) have documented that professional investment managers exhibit a strong preference for locally headquartered firms, particularly small, highly levered firms that produce non-traded goods. Such local bias is also evident in bank lending as shown by Petersen and Rajan (2002), though the "distance" to borrower has been falling in the 90's.

it clarifies that both intra-state and inter-state branching restrictions may be required for this shift to materialize fully. If branching across states is regulated, then banks may be limited in their ability to diversify state-level shocks, and, in turn, be limited in raising finance in the form of deposits and capital.[5] In other words, restrictions on the free flow of banking capital *across* states may limit the efficiency gains afforded by deregulation of *within*-state branching. Inter-state branching deregulation could therefore play as important a role as intra-state deregulation, if not more, in attaining allocative efficiency.

Third, our measures of sectoral risk and return are based on state-level sectoral data on value-added output. These data embed more small, non traded entrepreneurial firms than typical measures used for financial investments, which are based on equity returns of relatively large, publicly-listed firms. We assume that the efficient diversification of bank loans can be approximated by the efficient diversification of sectoral risks from output data. Vice versa, the presence of small firms in output data also justifies why the deregulation of the banking sector is relevant for the realized allocation of output across sectors.

Finally, we consider each state in the U.S. as a separate economy as far as our analysis of efficient allocations is concerned. While this assumption is meant to reflect information and regulatory frictions, and is primarily driven by the feasibility of efficient frontier computations, it will also be justified under the following. Suppose that sectoral returns were uncorrelated across states but correlated within each state. Then, the efficient allocation across the U.S. would consist of shares of efficient portfolios within states. While sectoral returns are clearly driven by a national as well as state-specific shocks, we document later that (i) states in the U.S. exhibit sizable dispersion in their realized allocations, in spite of the gradual integration of the real sectors across states, and (ii) crucially, this heterogeneity can be explained entirely by the discrepancies in state-level efficient allocations.[6]

[5]Consistent with this assumption, Becker (2006) shows that prior to banking deregulation, local supply of deposits played twice as large a role in affecting credit outcomes, particularly for small banks with limited access to capital markets. Kashyap, Rajan and Stein (2002) argue that if there are common shocks to depositors and borrowers within a state, then inter-state diversification may be necessary to translate greater deposit collection from branches into greater lending. Finally, inter-state diversification should enable banks to get closer to the Diamond (1984) bank wherein all idiosyncratic risk is diversified, there is no bank-level moral hazard, and a maximal level of deposits can be raised.

We recognize, however, that there may be limitations due to scope and expertise that prevent such diversification from being fully realized. For instance, Acharya, Hasan and Saunders (2006) show using bank-level loan data for Italy that during 1993-2000, geographical diversification led to higher returns and lower risk for banks, but this was not the case when banks lent to newer sectors and asset categories. Similarly, Kamp, Pfingsten, Memmel and Behr (2006) document that specialized German banks between 1993 and 2000 had (slightly) higher returns, lower loan-loss provisions and non-performing assets (NPA), but a greater standard deviation of provisions and NPA.

[6]Note that overall, these four assumptions correspond to the view that the real effects of liberalizations

We use U.S. data on Gross State Product (GSP) from the Bureau of Economic Analysis (BEA) from 1977 to 2000 disaggregated at the level of 63 industries. GSP is the value-added output located in a state and can be considered as the state-level counterpart to the country's Gross Domestic Product (GDP).[7] We approximate the return for an industry by the growth rate in value-added output. Using these returns, we calculate for each state the time-invariant expected returns and variance-covariance matrix of returns on investment in eighteen as well as ten consolidated industries. We fully depart from the view that investment patterns seek first and foremost to equate the marginal product of capital across sectors. The marginal product of capital is effectively exogenous in our paper. This is not meant to suggest that time invariance of sectoral returns is a better representation of reality. Rather, we move away from the standard mechanism used to explain real investment allocation, and focus instead on a portfolio-theory based alternative, which builds on the assumption that returns are exogenous.[8]

We numerically compute the efficient frontier for each state in the mean return - standard deviation space, and identify the resulting tangency portfolio, considering several alternative choices for the risk-free rate assumption. This determines each state's efficient Sharpe ratio, and the weights corresponding to an efficient allocation of investment across industries in the state. These vary both across industries within states, and acros states. Next, for each state and at each point of time, we compute the Euclidean distance between the efficient frontier and the effective expected return and volatility for the state. Our assumption of time-invariant expected returns and variance-covariance matrix of returns at the sectoral level implies that the effective expected return and volatility for a state fluctuate over time due only to changes in the observed industry shares in its output. We also compute the gaps between efficient growth, volatility or investment weights and their effective counterparts, observed at each point in time. We then ask how these discrepancies relate to liberalization dates for the banking sector.

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work themselves through the supply of bank finance. An simple alternative would assume that firms find themselves credit constrained because of bank-branching restrictions. Then, lifting the regulations would result in convergence towards efficiency, but because of investment demand.

[7]There are differences however. Unlike GDP, GSP excludes the compensation of federal civilian and military personnel stationed abroad and the government consumption of fixed capital for military structures located abroad and for military equipment (except office equipment). GSP and GDP also have different revision schedules.

[8]Formally, implicit in our approach is the assumption that observed growth rates in sectoral output approximate investment returns reasonably well. This will happen, for example, in an AK economy where sectoral output grows at the constant (exogenous) rate given by the sectoral marginal product of capital, net of depreciation and normalized by the elasticity of intertemporal substitution. In an AK economy, the assumption that returns are time-invariant is consistent with approximating sector-level returns with output growth rates.

We find that the distance to the efficient frontier shrinks significantly faster following both intra- and interstate branching liberalization.[9] Realized volatility and Sharpe ratios also converge faster to their efficient counterparts. But we do not find a significant effect of liberalization on convergence of the level of output growth. This implies that Sharpe ratios converge to efficiency following liberalization not because the level of growth is enhanced, but rather because volatility converges quickly to its efficient level. Put another way, the primary effect of branching restrictions appears to be a limit to the scope of banks from an efficient diversification standpoint. This, in turn, limits the diversification of investment activity in the state as a whole.

Similarly, observed sectoral shares of output converge significantly faster towards their efficient levels - as implied by the tangency portfolio - after bank branching deregulation. A number of sectors have weights equal to zero according to the mean-variance efficient allocation. We find that an essential component of convergence to efficiency is the disappearance of these industries. This illustrates indirectly the importance of frontier computations that account for the variance-covariance properties of sectoral returns in each state. Specifically, the frontier implies efficient patterns of specialization (or diversification) rather than ones that simply average investments across *all* sectors. Some sectors should indeed see their output share shrink, and in the data they do, especially following bank branching deregulation.

We run a horse-race between the inter- and intra-state liberalization dates. We find that convergence primarily becomes faster after interstate liberalization. In addition, even after all branching deregulations are completed, we find that the extent of out-of-state bank capital still acts to hasten convergence. Both these findings are consistent with our assumption that access to greater finance through interstate banking flows is essential in order to realize fully the economic benefits of intrastate branching. Indeed, in the spirit of Diamond (1984), we find that the crucial outcome of branching deregulation that affects efficiency of capital allocation is the emergence of larger, better-diversified and healthier banks, rather than simply an increase in the number of banks or branches operating in a state.

We next turn to an analysis of the channels through which convergence occurs. We examine which industries and which states converge faster toward efficiency as a result of interstate liberalization. In the spirit of Rajan and Zingales (1998), we find that output shares converge fastest for industries that are characterized by young and small firms (more likely to be financially constrained and dependent on bank finance), and that rely on external

[9]Consequently, it is also true that long-run distance is significantly smaller in liberalized state-years.

finance. We also show that sectors with younger and smaller firms have higher average growth and higher growth volatility. The shares of these sectors are significantly below their efficient levels at the beginning of our sample, but not at the end. What is more, these sectors contribute increasingly to overall state output following banking deregulation. These findings are reminiscent of the theoretical arguments in Acemoglu and Zilibotti (1997) who argue that investments in high risk, high return technologies may be attained only after sufficiently high levels of diversification have been reached. Rather than assuming the returns themselves increase with risk-taking behavior, we stress a re-composition effect following diversification, whereby more resources are allocated to risky industries with high growth prospects.[10]

It is conceivable that branching deregulation could arise because of an exogenous need to move away from a given pattern of specialization in production, for instance because of technological change. Then, financial liberalization and convergence would both occur because of unobserved developments, and our estimates would be biased. If these unobserved developments are economy-wide, then the bias should prevail equally in sectors populated by young or old, small or large firms, and irrespective of a technological need for external finance. Evidence of differential effects between firms which seem constrained and others alleviates endogeneity concerns to some extent. We also explicitly demonstrate that the liberalization dates are not related to likely benefits from liberalization, measured, for example, by initial distance to efficiency.

In a similar vein, we find that states experiencing fastest convergence following deregulation are the ones for which there is a greater share of industries populated by young firms, greater proportion of small firms and greater initial distance to the frontier. Interestingly, they also tend to be large states, where the geographical and informational distance between firms and banks is likely to be higher on average, and, in turn, efficiency gains from branching deregulation are likely to be higher as well.

Finally, we rule out several alternative hypotheses. First, we show that there is no convergence if efficient allocations are simply assumed to imply equal shares across sectors, or if covariance terms are simply ignored when computing the efficient frontier. Second, aggregate allocations for the U.S. do not converge to the aggregate efficient frontier, computed on the basis of aggregate sectoral returns for the U.S. as a whole. This suggests state-level heterogeneity continues to be relevant in our data. In fact, we find that although industry returns have become less dispersed across states since 1977, the cross-state discrepancies in

[10]Our empirical estimates account for the possibility that returns themselves respond to liberalizations.

production patterns display some significant permanent differences. Interestingly, this permanent component is well explained by cross-state differences in *efficient* allocations. Taken together, these results suggest that the state continues to be a relevant scale of analysis for the allocative efficiency question. We conjecture this may be due to persistent local informational advantages. Third, we discuss the possibility that liberalizations should affect directly the levels of output growth, volatility or the Sharpe ratio. We show none exhibit systematic patterns around liberalization dates; it is only the rates of convergence towards their respective efficient levels that do.

Overall, our findings imply that financial development has important consequences for the specialization of investment in a manner that depends directly on the variance-covariance properties of investment returns, as implied by the literature on mean-variance efficiency. The paper's contribution is also methodological. The simple notion of efficiency based on a trade-off between risk and return has been argued to have limitations when viewed from a dynamic allocation perspective. It nevertheless stands useful in a positive sense. Even if one did not consider the mean-variance efficient frontier to be the optimal one, observed production shares indeed converge towards it. The frontier serves as an attractive tool for understanding the direction in which the production patterns of economies evolve over time and in response to financial development.

The rest of the paper is organized as follows. Section 2 discusses related literature. Sections 3 and 4 describe in detail the econometric methodology and data we employ. Section 5 presents the results on the convergence properties of state-level investment allocation and Section 6 investigates the channels through which banking deregulation affects this convergence. Section 7 presents a discussion of robustness tests and related issues. Section 8 concludes.

2 Related Literature

In closely related work, Jayaratne and Strahan (1996) establish a link between the lifting of intrastate bank-branching restrictions and economic growth at the US state level. Strahan (2003) refines this finding and shows this growth acceleration was particularly pronounced in the entrepreneurial sector. We differ from this literature in our focus on allocative efficiency, measured by taking sectoral returns as given rather than allowing for the possibility that returns themselves respond to liberalization. In what we do, realized industry shares, and only industry shares, respond to liberalizations, as would happen if more developed financial markets were encouraging high investment in fast-growing, innovative, risky activities. In this sense, our approach is directly complementary to the literature pioneered by Jayaratne and Strahan (1996) and Rajan and Zingales (1998).

Since only industry shares respond, it is also to be expected that the effect on aggregate state-level average growth will be muted, and perhaps smaller than the effects on aggregate volatility, since the latter involves squared output shares. This is exactly what we find. In a recent paper, Huang (2006) constructs a treatment effect regression, on the basis of pairs of counties on both sides of U.S. state-borders where the two states deregulated at different times. Consistent with our findings, and in contrast to much of the existing literature, he documents relatively weak growth effects. Out of the 23 deregulation events examined, only five gave rise to statistically significant growth accelerations. Our approach is slightly different, in that we assume returns are exogenous and time-invariant. Importantly, we show later how our estimation approach is robust to returns shifting with banking liberalizations for sectors with smaller, younger and external finance dependent firms. What is more, our focus on efficiency gains is vindicated by the channels stressed by Jayaratne and Strahan (1996), namely increased *efficiency* in bank lending.[11]

At first blush, our results may also appear to contrast with the literature which documents that more concentrated banking structures result in less bank financing for small firms with existing bank relationships (Petersen and Rajan (1994, 1995)). However, we stress that this is not necessarily the case. First, note that bank branching restrictions in the U.S. encouraged competition within the state (in the limited sense of there being many banks) but restricted any competition from out-of-state banks. Second, they restricted the scope of banks for diversification, thereby preventing banks from lending efficiently, for example, to new firms far from their current branches. Deregulation in the U.S. may thus have been coincident with reduction in bank lending to existing small and young firms (Zarutskie (2005)), and, simultaneously, an increase in lending to new, potentially more efficient firms. Indeed, Black and Strahan (2005) show that new incorporations increased in the U.S. post interstate banking deregulation and more so where the fraction of assets held by large banks was greater.[12]

[11]At the bank level, deregulation should also offer the best performers more scope for growth and introduce discipline through a higher likelihood of being taken over. Both of these should result in larger, better banks and increased efficiency. Indeed, Strahan (2003) shows that deregulation led to larger banks operating across a wider geographical area and Jayaratne and Strahan (1998) report that non-interest costs, wages and loan losses all fell after states deregulated branching, which resulted in lower prices on loans. This is entirely consistent with the improved risk-return trade off we contend is present in these data.

[12]Bertrand, Schoar and Thesmar (2004) study deregulation of the French banking sector in the mid-1980s and document that in bank-dependent industries, it led to decline in bank credit for worse-performing firms,

Given our focus is on the overall sectoral-level output rather than on re-allocation of credit to existing or new firms in the sector, our results suggest the alternative theory of Acemoglu and Zilibotti (1997) may also be at work: Investments in riskier sectors characterized by smaller and younger firms may not take off until investors (in our case, banks) have a critical level of portfolio diversification.

Recent empirical papers have also described the effect of bank financing and market structure on volatility of output growth and risk sharing. Morgan, Rime and Strahan (2004) show that state-level macroeconomic stability has increased in the U.S. post banking deregulation, a result that echoes with our findings. Demyanyk, Ostergaard and Sorensen (2006) show that the amount of interstate personal insurance increased, particularly for insurance of proprietors' income relative to wage income, following the deregulation of U.S. banking restrictions. We later make use of the very data they introduced. Larrain (2006) provides evidence that access to bank finance dampens output volatility at the industrial level thanks to better risk-sharing among firms in financially constrained industries. This strikes a chord with the findings in Raddatz (2003) at the international level: Sectors with large liquidity needs, measured by the relative importance of inventories, have greater volatility of output growth and lower output growth in underdeveloped financial markets.

The determinants of the production patterns at the sectoral level are also the object of a substantial literature in macroeconomics, and several authors have underlined the role that access to finance in general (with no particular focus on bank finance) may have in influencing real production shares across industries. For instance, Saint-Paul (1992), Obstfeld (1994), Black (1987) and Ramey and Ramey (1991) all propose theories of production where access to finance facilitates specialization in attractive yet risky activities. And indeed, access to finance does appear to affect specialization patterns empirically, as established for instance for the U.S. states by Kalemli-Ozcan et al (2003). They find that financially integrated states - in the sense of estimated interstate income insurance - tend to be highly specialized. But their results are silent on the characteristics, determinants and efficiency of the specialization they document.

Understanding this specialization is at the heart of our paper. In related work, Koren and Tenreyro (2006) estimate the efficiency frontier for a large sample of countries, and relate distance from the frontier to levels of per capita GDP in cross-section, reasoning that

higher firm-creation and exit rates, and higher market share for better-performing firms. Though the French regulation was in place to channel savings and deposits into priority industries, their results offer a nice parallel to those observed for the U.S. banking deregulation.

rich countries tend to have more efficient allocations of capital. However, they do not link their results to financial development, nor do they identify the characteristics of specializing sectors. Their purpose is to decompose aggregate volatility, not to examine the link between finance and allocative efficiency.

3 Methodology

Let $Y_{i,s,t}$ denote nominal output, measured by GSP, for industry i in state s in year t. We calculate the realized return $R_{s,i,t}$ as the output growth rate, $Y_{i,s,t}/Y_{i,s,t-1}$.[13] A key assumption is that the distribution properties of these returns are time-invariant in our sample. We estimate their first two moments, $E[R]_s$ and Σ_s, the vector of expected (average) returns and the variance-covariance matrix of returns on industries in state s.[14] Let $w_{i,s}$ denote the weight on industry i in total output of state s. We compute the mean-variance portfolios for state s as the vector of weights w across sectors i obtained from the program

$$\max_{w\geq 0} w'E[R] \text{ such that } \sqrt{w'\Sigma w} \leq \sigma,$$

for varying values of σ, the volatility of investment returns. State indexes are omitted for simplicity.

The efficient frontier is the set of points $\{(\hat{\mu}(\sigma), \sigma)\}$ in the mean - standard deviation space, where $\hat{\mu}(\sigma) = w'E[R]$, the maximized expected return from the above program for volatility σ. It is well-known from portfolio theory that the efficient frontier is a hyperbola so we restrict the mapping $\hat{\mu}(\sigma)$ to correspond to the higher of the two possible mean returns for a given volatility σ. The inverse mapping will be denoted as $\hat{\sigma}(\mu)$. We define the Euclidean distance to the efficient frontier of state s in year t as:

$$D_{s,t} = \sqrt{(\mu_{s,t} - \hat{\mu}(\sigma_{s,t}))^2 + (\sigma_{s,t} - \hat{\sigma}(\mu_{s,t}))^2}\ .$$

[13]Investment data are not available at the sector level for US states. We approximate the return on investment with the mean output growth (following Wurgler (2000) among others), which is consistent with our assumption of return exogeneity, and risk by the volatility of output growth.

[14]We argue later that through inclusion of suitable fixed-effects, our convergence specification is robust to there being a structural shift in expected returns of sectors around liberalization dates. The assumption of time invariance underpins a large literature in international macroeconomics, which seeks, for instance, to decompose aggregate shocks into sectoral, regional, national or global components. Stockman (1988), Costello (1993), Forni and Reichlin (1988), and Koren and Tenreyro (2006) all assume a time-invariant structure of shocks. Kose et al (2003) use Bayesian techniques to assess whether the relative importance of different components has changed over time.

In words, from a given point $(\mu_{s,t}, \sigma_{s,t})$ in the mean - standard deviation space, we traverse distances moving west and north separately (in a straight line) until the efficient frontier is met. While this definition of distance to the frontier runs throughout the paper, we will also demonstrate robustness of our results to alternative definitions.

Our first convergence test examines how distance for state s converges to its efficient counterpart (which is zero), and whether liberalization of the banking sector has had any effect on this relationship. We estimate the convergence equation

$$D_{s,t+1} = (\alpha + \beta * LIB_{s,t})\ D_{s,t} + \gamma * LIB_{s,t} + \delta_s + \theta_t + \varepsilon_{s,t}\ , \tag{1}$$

where $LIB_{s,t}$ is a binary variable taking value one if the banking sector in state s has been deregulated by year t. We employ intrastate and interstate liberalization dates separately to create two versions of the liberalization variable, and two sets of estimations for all our tests. The inclusion of state and time fixed effects enables us to capture the pure within-state effects of liberalization. We allow for clustered standard errors by state. We are interested in whether $\beta < 0$, that is whether liberalization hastens the convergence towards efficiency.[15]

We next define a tangency portfolio on the efficient frontier. For a constant risk-free rate r, we can define an efficient allocation of production for each state corresponding to the tangency point between the frontier and a straight line arising from holding the risk-free asset.[16] A mean-variance efficient investor (say, a bank) with complete access to the risk-free asset and the investment portfolio of the state would choose a risk-return tradeoff along this tangency line. The tangency portfolio for state s is denoted as (μ_s^*, σ_s^*), and the corresponding output shares for each sector i as $\{w_{s,i}^*\}$. The Sharpe ratio of efficient investments is thus given by $SR_s^* = [\mu_s^* - r]/\sigma_s^*$.

We compute the time-varying expected return, volatility and Sharpe ratio for state s on the basis of realized output shares, and investigate how they relate to their efficient counterparts – the return, volatility and Sharpe ratio of the tangency portfolio. In particular, we seek to establish whether the liberalization of the banking sector has affected this relationship. Realized weights for state s in year t are denoted as $\{w_{s,i,t}\}$, where $w_{i,s,t} = Y_{i,s,t}/\sum_i Y_{i,s,t}$, is the share of industry i's output in the total gross output of state s. The expected return and volatility of state s for investments made in year t, given the realized weights in year t, are denoted as $\mu_{s,t}$ and $\sigma_{s,t}$, respectively, where $\mu_{s,t} = w'_{s,t}E[R]_s$, and, $\sigma_{s,t} = \sqrt{w'_{s,t}\Sigma_s w_{s,t}}$,

[15] Once again, $\beta > 0$ also implies that distance in the long run is significantly smaller in liberalized states.

[16] The assumption of a constant risk-free rate is made for simplicity: What matters is that the rate is identical for all US states, an assumption that is largely uncontroversial.

with obvious vector notation. The expected Sharpe ratio of realized investments is thus $SR_{s,t} = [\mu_{s,t} - r]/\sigma_{s,t}$.

We estimate

$$\begin{aligned}
\mu_{s,t+1} - \mu_s^* &= (\alpha + \beta * LIB_{s,t})\ (\mu_{s,t} - \mu_s^*) + \gamma * LIB_{s,t} + \delta_s + \theta_t\ , & (2)\\
\sigma_{s,t+1} - \sigma_s^* &= (\alpha + \beta * LIB_{s,t})\ (\sigma_{s,t} - \sigma_s^*) + \gamma * LIB_{s,t} + \delta_s + \theta_t\ , & (3)\\
SR_{s,t+1} - SR_s^* &= (\alpha + \beta * LIB_{s,t})\ (SR_{s,t} - SR_s^*) + \gamma * LIB_{s,t} + \delta_s + \theta_t\ , \text{ and} & (4)\\
w_{s,i,t+1} - w_{s,i}^* &= (\alpha + \beta * LIB_{s,t})\ (w_{s,i,t} - w_{s,i}^*) + \gamma * LIB_{s,t} + \delta_{s,i} + \theta_t\ . & (5)
\end{aligned}$$

As in equation (1), the inclusion of state (or state-by-industry) and time fixed effects helps us isolate the within-state (within-state-by-industry) effect of liberalization. We are again interested in whether the coefficient β estimated from these equations is non positive. This would have two implications. First, equations (2)–(5) test whether liberalization hastens convergence towards efficiency in expected returns, volatilities and Sharpe ratios. Second, equation (5) verifies whether liberalization fosters allocative efficiency in the sense of accelerating convergence towards efficient output shares.[17]

To summarize, equations (1)–(4) are tests of the convergence of state-level aggregates towards efficiency, whereas equation (5) is a test of allocative efficiency at the industry-level within a state. The latter will be the lynch-pin of our analysis in Section 6 where we investigate the channel through which liberalization affects allocation efficiency. In particular, we will examine the characteristics of those industries whose convergence to efficiency is faster in response to liberalization.

4 Data

Our data on nominal Gross State Product (GSP) for the 50 US states and the District of Columbia come from the Bureau of Economic Analysis (BEA). Output is decomposed into 63 sectors over the period 1977 through 2000. Given the time-series limitation, computing the efficient frontier requires collapsing the number of assets (industries) in the portfolio. We therefore aggregate the NAICS 63 industries up to 18 and 10 industries, as per the recommended classification in Dyck and Zingales (2004). The resulting sectors are based on

[17] Since the weights across industries in a given state add up to one, we drop one industry, Agricultural services, from the estimation of equation (5).

the BEA grouping of two-digit SIC codes, and are listed in the Appendix. We omit industries with negligible output shares, i.e. less than 0.1 percent of GSP. Convergence to an efficient frontier becomes impossible when including very small sectors.

The tangency portfolio on the efficient frontier requires that we employ a specific value for the risk-free rate r. We choose a single interest rate over our entire sample period. The idea here is similar to that in estimations of the capital asset-pricing model in the finance literature, where mean-variance efficiency is assumed to apply period after period and the risk-free rate taken to be the average return realized on government treasuries for a one-year horizon.[18] For most of the paper, we take the risk-free rate to be simply zero. As a robustness check in Section 7, we show that our results are not sensitive to the choice of specific value for the risk-free rate. In particular, we employ alternatives of 2, 4 or 7 percent.

Our intra- and interstate liberalization dates, and the measures of interstate linkages in the banking sector are from Morgan, Rime and Strahan (2004). Deregulation of the U.S. banking sector began in earnest in the 1970s (see Kroszner and Strahan (1999) and Kroszner (2001) for a detailed description). Until then, U.S. banking regulation existed at both the intra- and interstate level. At the intrastate level banks were prevented from expanding through either acquisition (of existing banks or branches) or simple branching. Growth was only possible within a multi-bank holding company (BHC) whereby a bank could acquire existing banks or open new ones but not roll these up into its existing operations. Under the Douglas Amendment to the 1956 Bank Holding Company Act interstate, a BHC was prohibited from acquiring banks outside the state where it was headquartered, unless the target bank's state permitted such acquisitions. The first state to offer such permission was Maine in 1978 but it was not reciprocated until 1982. This form of reciprocal deregulation offered BHCs the opportunity to acquire banks, but it did not affect interstate branching. Acquirers could not fold newly acquired banking assets into banking operations outside the target's state. By 1994, with the passing of Reigle-Neal Interstate Banking and Branching Efficiency Act, interstate banking was complete, recommended and introduced by all states except Texas and Montana. Before intrastate deregulation a bank holding company (BHC) could expand as a group by buying banks but could not group these into a single bank. Post interstate deregulation (but pre-1994) the same was true: banks could move into a new state but not as a single bank.

[18]Using the observed rate on Treasury Bills or equivalent creates issues of non-stationarity which prevent a solution to the mean-variance problem.

5 Efficiency and Banking Deregulation

We first examine the convergence of a state towards its efficient frontier in the mean-standard-deviation space of investment returns. This does not require taking a stance on the tangency portfolio of the efficient frontier, and does not require a risk-free rate. Next, we investigate the convergence of effective output growth and volatility towards their level at the tangency portfolio. Finally, we study the convergence of investment weights towards those implied by the tangency portfolio.

5.1 Distance to Frontier

In Table 1A, we provide the salient descriptive statistics of distance to frontier for the ten U.S. states with highest convergence as measured by the ratio of final (2000) to initial (1977) distance from the frontier. Similarly, Table 1B reports the ten states with the lowest convergence. The first and second columns present the average and initial distances, respectively, for these states.

These states are not too different on the basis of their initial distances to the frontier. However, they differ vastly in terms of their average distance and the ratio of final to initial distances. While the fast-converging states such as Delaware, Illinois, D.C., New Jersey, Pennsylvania and Minnesota experience a fall in their distance to the frontier by about a half, the slow-converging states experience little decrease at all. In fact, Alaska, Montana and Nevada have gone through an increase. In the fast-converging states, North Dakota is especially interesting as it achieved significant convergence over the period in spite of one of the highest initial distances in our sample. In the slow-converging states, Nevada and Hawaii are the counterparts with a small initial distance that hardly fell over time.

Is this convergence (or divergence) related to the deregulation date? We first provide some raw evidence in this regard. Columns 4 and 5 report intra- and interstate liberalization dates. Note that several states experienced intrastate liberalization before 1977. Using these in Columns 6 and 7 we report the ratio of average distance post relative to pre intrastate (interstate) liberalization. The first observation is that the states with fastest convergence measured by the final to initial distance ratio also rank as fastest when measured around the liberalization dates. The second observation is that the slow-converging states of Montana and Hawaii experienced particularly late liberalization, especially on the interstate branching front.

These patterns are illustrated in Figure 1A for two of the fast-converging states, Minnesota and New Jersey, and in Figure 1B for two of the slow-converging states, Montana and Oklahoma. Figure 1A shows that Minnesota and New Jersey converge to their efficient allocations at an accelerating rate with branching liberalization. In contrast, in Figure 1B, Montana and Arkansas tend to diverge first, and then converge toward the frontier once branching is liberalized. New Jersey experienced intrastate and interstate liberalizations relatively early compared to Montana and Arkansas, and Minnesota experienced interstate liberalization somewhat earlier.

We verify these patterns in rigorous econometric fashion. We estimate the convergence equation (1) for two levels of aggregation. The results are reported in Table 2A. The direct auto-regressive coefficient on distance to frontier implies a yearly reduction of about 63% of the gap between effective and efficient distance. Importantly, the effects of intra- and interstate liberalization are significant, and interact negatively with distance. In words, liberalization hastens the convergence to the efficient frontier. In terms of magnitude, intrastate liberalization accelerates convergence by 10 percent per year, and interstate liberalization by 18 percent. The magnitudes are roughly similar across the two levels of aggregation.

In Tables 2B to 2D, we consider alternative measures of distance, which unlike our first definition rely on the specific tangency portfolio for each state, denoted as (μ_s^*, σ_s^*). In 2B, we employ the euclidian distance to the tangency portfolio computed as

$$D_{s,t} = \sqrt{(\mu_{s,t} - \mu_s^*)^2 + (\sigma_{s,t} - \sigma_s^*)^2} \ .$$

In 2C and 2D, we employ respectively the horizontal and the vertical distances to the tangency portfolio, computed as $|\sigma_{s,t} - \sigma_s^*|$ and $|\mu_{s,t} - \mu_s^*|$. The convergence results are robust to these alternative measures of distance. In all cases, there is around 20 to 30 percent reduction in distance each period, and liberalization of branching restrictions increase this reduction by 10 to 20 percent. For the rest of the paper, we employ the first measure of euclidian distance to the frontier from Table 2A.

5.2 Growth, Volatility and Sharpe Ratio

We investigate next whether the movement of states towards the efficient frontier following banking deregulation happens through changes in volatility, in growth, or in both. Both would bring a state closer to its frontier, either via leftward movements (involving volatility) or via upward changes (involving growth), or both. We also verify that convergence towards the frontier translates into convergence towards the tangency portfolio, i.e. a convergence in Sharpe ratios. In Table 3, we first present summary statistics for the same twenty states sampled in Table 1.

We observe that states with the highest average distance to frontier in Table 1 are also the ones with the smallest realized Sharpe ratios - Alaska and North Dakota. The average Sharpe ratios for these states are about 40% of their efficient (tangency-portfolio) levels. The fast-converging and slow-converging states in Table 3A and 3B, respectively, are not too different in terms of their efficient or tangency-portfolio Sharpe ratios (perhaps with the exception of Alaska and Hawaii). They are more dispersed in terms of their realized Sharpe ratios, especially as pertains to the overall change in Sharpe ratios. In particular, Alaska, Nevada, Idaho and Oregon have in fact experienced deterioration in their Sharpe ratios from 1977 to 2000. In contrast, all fast-converging states have improved their Sharpe ratios, North Dakota having more than doubled it in spite of it being low to start with.

How do realized and efficient output growth and volatility line up with realized and efficient Sharpe ratios. That is, if we take Sharpe ratios as a measure of the efficiency of investments in the state, does a ranking of states based on efficiency essentially mirror that based on the level of output growth? Or, is volatility also a significant contributor to state differences in efficiency? Tables 3A and 3B suggest that the fast-converging states differ from the slow-converging ones essentially in terms of the final to initial ratio of volatility, rather than in differences in growth. Table 3C corroborates this. We compute the time average of cross-state correlation in each of the realized and efficient growth, volatility and Sharpe ratio. We find that the realized Sharpe ratio has a correlation around 0.6 with realized growth but -0.8 with realized volatility. That is, from a Sharpe ratio standpoint, the level of growth is not individually sufficient for determining the efficiency of state-level investments. It is also interesting that while efficient levels of growth and volatility are positively correlated across states, the realized levels are negatively correlated, a pattern that we will revisit in Section 6.

Two salient examples further illuminate the non-trivial role played by volatility in affecting efficiency. First, the two-fold increase in the Sharpe ratio of North Dakota is almost entirely attributable to a reduction in volatility over the sample period. Output growth has increased by 17% whereas volatility has shrunk to 57% of its original level. A second example works in the opposite direction. Alaska experienced a 29% improvement in the level of output growth but its volatility increased by 49%, which results in a fall by 13% in its efficiency (i.e. its

Sharpe ratio). Alaska is in fact the worst performer on the Sharpe ratio dimension over the entire sample period.

Of primary interest to this paper is how the cross-state correlation between realized and efficient quantities has moved over time. We plot the time-series of these correlations in Figure 2. Note that the cross-state correlations depicted here capture how well the states line up when ranked by realized quantity relative to their ranking by efficient quantity. In particular, if all states were ranked identically under the two schemes and converged to efficient levels at the same speed, there would be no significant change in this correlation. In 1977, the correlation between realized and efficient growth, volatility and Sharpe ratio were respectively 0.65, 0.55 and 0.52. Over time, the correlation between realized and efficient growth has stayed the same, whereas that between realized and efficient volatility and Sharpe ratio has increased steadily, reaching around 0.7 by 2000. This suggests that state ranking based on realized volatility and Sharpe ratio is becoming similar to that based on efficient volatility and Sharpe ratio. This outcome is consistent with a faster convergence of those states whose realized quantities are farther away from the efficient ones.

What has caused this convergence pattern? Table 4 provides rigorous econometric evidence purporting to answer the question with estimates of equations (2)-(4). We examine the convergence properties of expected output growth, volatility and Sharpe ratio, around the liberalization dates. Across both tables (4A for 18 sectors and 4B for 10 sectors) convergence in volatility accelerates post-liberalization, by about 10% for intrastate and 20% for interstate liberalization. In contrast, liberalization dates do not affect the convergence of output growth level towards its efficient level: estimates of α are around 80%, but the effect of liberalization is unstable in sign and always insignificant.

The effect of liberalization on volatility is sufficient to affect the state Sharpe ratios. For example, in Table 4A, the convergence rate towards the efficient Sharpe ratio increases by about 4% for intrastate and 3.3% for interstate liberalization. Together, these findings are consistent with the pattern documented in Figure 2, and suggest that the convergence of states towards the efficient Sharpe ratios occurs through convergence in the volatility of output growth following liberalization dates, rather than convergence in the level of growth itself. By implication, the primary effect of branching restrictions is to limit the diversification scope of its banks from a risk standpoint, which in turn limits the diversification of investment activity in the state as a whole.[19]

[19] As discussed in the Introduction, this may partly be an artefact of our assumption that returns are

5.3 Investment Weights

We have so far focused on aggregate performance at the state level. To understand the effect of banking deregulation at a microeconomic level, we investigate the convergence properties for the sector-wise allocation of investment around liberalization dates. Figure 2 provides a preview of our results. In 1977, the cross-sectional correlation between effective and efficient weights was below 0.2. By 2000, it had increased to around 0.3. This result forms the backbone of much of our further discussion in the paper.

For each of the twenty states sampled in Table, we provide in Table 5 the efficient and realized weights for the four industries with largest efficient weights across eighteen industries. There are large differences between efficient and realized weights, which confirms the question of convergence to the efficient frontier is potentially of sizable economic importance. The Table also raises some concerns. The top four industries typically account for between 80% and 90% of total investment for the state, based on efficient weights. This kind of weight structure is not uncommon to estimations of efficient frontiers: stable sectors end up getting most of the weight and the unconstrained estimation generally suggests short-selling some sectors, which all get truncated to zero as per the restriction in our estimation. In contrast, the realized weights taper off in terms of their contribution to aggregate investment quite sharply starting with the third top industry. In any case, the realized weights even for the top two industries are smaller than the actual weights by a large factor. A reason for this is that a number of sectors with weights truncated to zero in the estimation of an efficient frontier have realized weights that are greater than zero (even if tiny) and the sum of realized weights across these sectors adds up to being a non-trivial amount.

To address these concerns, we make two adjustments. The first is implemented in Table 5, and subsequently in the main text. Since the realized weights do not add up to one for sectors whose efficient weights turn out to be non-zero, we scale the realized weight of each such sector by the sum of realized weights of all such sectors. The resulting weights are reported in Table 5, under the "Non-zero Weight" heading. The truncation brings the scaling of the efficient and realized weights more in line with each other. In results that follow, we report convergence properties where we retain all sectors but also where we focus on non-zero weight sectors as described above.

time invariant, and only output shares respond to liberalizations. That said, Section 6.1 shows that our estimations remain valid even if returns respond to branching deregulations, as documented for instance by Jayaratne and Strahan (1996). Taking returns as given, the allocation of capital across sectors following branching deregulation simply has little growth consequences. But it has substantial diversification effects.

The second adjustment we undertake is to eliminate the two most stable sectors in our data, as determined by their implied efficient weights, namely Government, and Health and Education. These also tend to be heavily regulated activities and investment there may not abide by the efficiency criteria at the heart of this paper.[20] We report in Section 7.1 the results from complete exclusion of these two sectors from our analysis. Our conclusions are largely unchanged. In fact, the correlations between efficient weights resulting from a complete universe and one where low volatility sectors are excluded are at least equal to 0.7.

In Table 6, we report the convergence properties of investment weights in industrial sectors based on our estimations of equation (5). The effect of liberalization, as estimated by the coefficient β, is again to hasten convergence. Except for the case of interstate liberalization and non-zero weight sectors, where the effect is statistically insignificant, liberalization hastens the convergence rate by about 0.6% to 0.8% per year. The magnitude of this effect is small relative to estimates of α, around 88% to 94%, and estimates of β in Tables 2 and 4 are substantially larger. It must be the case therefore that relatively gradual convergence in *all* sectoral investment weights following liberalization dates is sufficient to induce a more rapid convergence in aggregates such as the distance to frontier, volatility, and Sharpe ratio.

The fact that we do not identify a convergence acceleration following liberalization when we restrict attention to non-zero efficient-weight sectors implies that the complementary set of sectors is crucial to the analysis. The number of sectors with zero efficient weights is large, as mentioned above, and their exclusion can cloud inference on sector-level convergence. This suggests that an important effect of liberalization seems to be a re-composition away from investment in those sectors where the efficient weights are in fact zero. That is, zero efficient weights should not be dismissed as merely an artefact of the procedure computing the efficient frontier: they in fact contain relevant information regarding the efficient disappearance of certain industries in the state. In unreported results, we find that the average rate of disappearance of such a sector, measured as the annual percentage change in sectoral weights, is 1.03% in liberalized state-years and only 0.21% in non-liberalized state-years.

The magnitude of the convergence effects we document is best gauged using effective specialization episodes that happened around liberalization dates. Consider for instance North Dakota, where intrastate liberalization happened in 1987, four years prior to interstate deregulation. North Dakota's Sharpe ratio increased by as much as 70 percent with the

[20] When we employ the 10-sector aggregation, the industries which dominate the efficient weights are Manufacturing (SIC codes 20-39), Finance, insurance and real estate (60-67), Services (70-89), and Government.

deregulation. The change in output weights around the liberalization dates is almost perfectly predicted by the ratio of efficient to initial weights: the correlation equals 0.93. In other words, around the liberalization dates, the sectoral allocation of output in North Dakota altered almost exactly in the way predicted by portfolio theory. For instance, Lumber and Wood doubled its weight in the state's economy, a sector whose efficient weight is twenty times its pre-liberalization level. In contrast, Retail fell by a fifth, and its efficient weight is half of its pre-liberalization level. Interestingly, between 1977 and 2000 the share of industries with zero efficient weights also fell by 10 percent in North Dakota.

Similarly, Illinois which liberalized interstate branching in 1986 and intrastate branching in 1988, saw the share of Food and Paper fall by a quarter (its efficient share is half the initial level), Transport fell by 20 percent (it should fall by half), and Leisure and Business Services increased by 15 percent (its efficient weight is 150 percent of its initial level). Minnesota and New Jersey, two other fast-converging states, always reveal shifts in sectoral allocation around liberalization that are consistent with the efficient weights.

5.4 The Role of Out of State Capital

If the only impediment to efficient investment at the state level is intrastate branching restriction, then its relaxation should produce an increase in the speed of convergence to state-level efficiency. However, suppose that in order to branch within the state, banks need additional capital. Suppose furthermore that the ability to diversify enables banks to raise greater deposits and external capital as in Diamond (1984). Then, intrastate branching liberalization may be effective in spurring convergence to efficiency only if accompanied by interstate branching liberalization, which allows for a free flow of banking capital across state borders.

To investigate whether it is branching per se or access to capital that generates efficiency, we run a horse-race between intra- and interstate liberalization dates in Table 7. Specifically, we estimate equations (1)-(5) including both liberalization dates as proxies for $LIB_{s,t}$. We find that by and large, interstate liberalization is the relevant event. Except for convergence in Sharpe ratios, intrastate liberalization is not significant in speeding convergence to efficiency when interstate liberalization is controlled for. In contrast, interstate liberalization is always significant, except for convergence in the level of output growth.

To further substantiate that it is access to finance that hastens convergence to efficiency, we replace $LIB_{s,t}$ in the estimation of equations (1)-(5) by $Flow_{s,t}$, a continuous variable which captures the magnitude of interstate banking flows following interstate liberalization. In particular, we employ the Other State Asset Ratio measure introduced by Morgan, Rime and Strahan (2004) and defined as the total out-of-state assets held by holding companies operating in state s in year t, divided by total assets in state s.[21] This captures the share of state bank assets held by banks also operating out of the state, and thus approximates the intensity of out-of-state capital inflows.

Table 7C estimates the convergence equations (1)-(5) replacing $LIB_{s,t}$ with $Flow_{s,t}$ and restricting data to the post interstate liberalization periods. The restriction is natural since $Flow_{s,t}$ is by definition zero prior to interstate branching deregulation. It also helps assess whether the effect we document effectively responds to the effective amount of interstate bank linkages, rather than solely to a binary variable capturing liberalization. The results are overall similar to those obtained for interstate liberalization in Tables 2, 4, 6, 7A and 7B. Specifically, Table 7C illustrates that even during the post interstate liberalization period, convergence is faster in those years when out-of-state banks have a large participation in local banks' capital. The only exception is the convergence in Sharpe ratios where β is estimated to be weakly significant and positive.

Finally, we illustrate that it is the emergence of larger, better-diversified and healthier banks following interstate branching deregulation which leads to improvement in allocation efficiency. We test this hypothesis against a simple, mechanical change in the market structure of the banking sector. In Table 7D, we run a horse-race between $Flow_{s,t}$ and the Herfindahl index of bank concentration in the state, with weights based on the deposit base of each bank. We find that the effect of interstate banking flows on convergence to efficiency is robust to controlling for bank concentration in the state, and that in fact bank concentration by itself (after controlling for flows) impedes convergence. In unreported results, we find that replacing the Herfindahl index by the number of banks or branches in the state produces similar results.

Since convergence due to out-of-state flows may be faster simply because in-state banks were inefficient, we control in Table 7E for the effect of the health of banks operating in a state. We approximate this with the average state capital to assets ratio, i.e. the total capital of banks operating in the state divided by their total assets. Again, we find that the acceleration of convergence to efficiency is robust to this control. In this case however, the health of the banking sector also contributes to the acceleration.

[21] Morgan, Rime and Strahan (2004) show that this ratio is positively correlated with Interstate Asset Ratio, the fraction of bank assets in a state that are owned by a holding company that owns bank assets in one or more other states.

Overall, these results point towards one common theme. The linkage between bank branching deregulation and allocation efficiency is primarily due to inter-state deregulation. This led to the creation of larger, better-diversified and healthier banks, and not simply to an increase in the number of banks or branches. In what follows, we focus on inter-state liberalizations as a proxy for $LIB_{s,t}$.

6 The Efficiency Channel

Our results so far have established a strong relationship between state-level banking deregulation and state-level allocative efficiency in real investment. Did the liberalization of branching restrictions for banks *cause* this improvement in allocative efficiency? To answer this important question, we examine the channels through which liberalization affects changes in investment allocation. As we explain below, this also helps allay concerns of reverse causality, based on the possibility that liberalization happened precisely in states that were expected to have sharp improvements in allocative efficiency (for example in anticipation of exogenous technology shocks).

6.1 Which Industries Converge Faster?

We appeal to the methodology of Rajan and Zingales (1998) who study the effect of financial development on sectoral-level growth in an international setting. They conclude that financial development helps disproportionately more those sectors which are heavily dependent on external finance. Dependence on external finance or the inability to support investments through internal cash flows is (at least partly) attributable to sectoral-level technological factors such as payback periods and fixed costs of investment. The significance of an interaction term between financial development (a country characteristic) and external dependence (a sectoral characteristic common across countries) in explaining sector growth helps putting at ease the issue of endogeneity of financial development to anticipated growth.

If expected technology shocks were the reason why financial liberalization became of the essence (perhaps to accommodate future growth), it is hard to think of reasons why these shocks would disproportionately concern sectors with an exogenous, given need for external finance, or ones that tend to be populated by young or small firms. Using data on capital expenditures and external finance issuance, Rajan and Zingales (1998) calculate explicit measures of external financial dependence. They also employ implicit measures, such as the age and size of firms. These latter sectoral characteristics should imply informationally opaque activities, which may preclude easy access to capital markets and make them more reliant on bank finance.

Our investigation of the channel through which banking-sector deregulation affects allocation efficiency is in the same spirit. If branching restrictions limit the access of banks to the entire spectrum of activities within a state, then the limitation is likely to be felt most severely by those sectors which are most dependent on external finance. If the limitation arises because of information frictions, then sectors with young and small firms may be restricted from obtaining bank financing and also suffer in terms of investment allocation relative to activities populated by more mature or larger firms. Thus, the relaxation of branching restrictions should move these sectors closer to their efficient output shares.

This leaves open the question of where is capital allocated away *from* to finance faster convergence in constrained activities. It is possible, as we assume, that banks are able to raise more capital following financial liberalization (since they can become more diversified). It is also possible that they become more efficient in general, for instance, because increased competition improves the pricing of loans, as documented in Jayaratne and Strahan (1998). Finally, it is possible that the pool of capital remains unchanged with liberalization, in which case convergence to the frontier entails a pure reallocation from unconstrained to constrained activities. In all these cases, new investments will favor activities that need it most, where we should therefore see faster convergence. Convergence in unconstrained sectors may still happen, but not necessarily. That will depend on the overall availability of capital in the state. In other words, convergence should be clear in constrained sectors, but not in unconstrained ones.

We split our sample according to a variety of external dependence measures, and estimate equation (5) separately for all sub-samples. We use four measures of external-dependence for each sector, computed using the COMPUSTAT dataset for all firms in that sector over the period 1994 to 2005.[22] We compute: (i) Age, measured as the average age of firms in the sector; (ii) FINDEP which, as in Rajan and Zingales (1998), is defined as the ratio of

[22]We choose to measure the external dependence variables over the period 1994 to 2005, since we wish to measure external dependence over a period when the claim of fully-developed capital markets is tenable within the U.S. This is akin to Rajan and Zingales (1998), who measure this variable in the U.S. for the 1970s and 80s, and run their test over the 90s. For this period post 1994, all the states had fully liberalized their banking markets and deregulation was complete with the passage of the Interstate Banking and Branching Efficiency Act of 1994. Furthermore, about half of the measurement period 1994 to 2005 is outside of our estimation period 1977 to 2000.

net external finance issues (sale of common and preference stock and debt minus purchase of common and preference stock and debt) to capital expenditures; (iii) Sales, a proxy for firm size measured by the average sales of firms in the sector; and, (iv) Assets, another proxy for firm size, measured by the book value of firm assets. Based on these four measures, we partition our sectors into below- and above-median samples, and label them Young and Old, Unconstrained and Constrained, Small and Large, and Low and High, respectively.

In Table 8A, we report the convergence properties of sectoral investment weights based on these four sample splits. Overall, the results are consistent with our priors. We find that liberalization hastens most convergence to efficient investments in Young, Constrained, Small and Low Assets sectors, where the coefficient β is negative, significant and at least two to three times larger. It is also often times the only one that is significant.

To further illuminate the mechanisms at play, we ask whether Young, Constrained, Small and Low Assets sectors have initial allocations that are below their efficient ones, but final allocations that are efficient. In Table 8B, we present probit estimates of the probability that initial weights be below their efficient level, $Pr(w_{i,s,0} < w^*_{i,s})$, as a function of the median values for Age, FINDEP, Sales and Assets for industry i. Note that since any non-zero realized weight is mechanically greater than a zero efficient weight, we are forced in this analysis to restrict attention to sectors with non-zero efficient weights. The results are striking. The sample splits matter uniformly for the initial level of realized allocation: in 1977, the probability of a sector being below its efficient size is significantly decreasing in Age, (the inverse of) FINDEP, Sales and Assets. In contrast, in 2000 these industry characteristics are not as relevant. In particular, Age, Sales and Assets have become irrelevant in explaining the probability of inefficient allocation (though FINDEP has not).

Taken together, these results suggest that banking deregulation in the US has led to allocative efficiency by primarily re-directing capital towards younger, smaller and more external finance dependent firms. We next examine the ensuing state-level effects.

We analyze mean and volatility in effective industry returns across constrained and unconstrained sectors, and their share of overall Gross State Product. This is motivated by the theoretical contribution of Acemoglu and Zilibotti (1997), who argue that investments in high risk, high return sectors may not be attractive unless a critical level of diversification is reached. A direct implication is that risky sectors should contribute more to overall growth once diversification is possible. In Table 9A, we regress the average of realized returns $R_{s,i,t}$ and their time-series volatility on binary variables capturing whether sector i is populated by

Old, Unconstrained, Large and High Assets firms. In all cases, returns are lower for mature, unconstrained and large industries, by around 1 percent. Volatility is lower for Large and High Assets sectors but surprisingly higher for Old and Unconstrained sectors.

Table 9A suggests that it is only small firms, as predicted by sales and assets, that tend to have both high returns and high volatility. In Table 9B, we verify whether their share in overall state output has increased with liberalization. We estimate whether the probability that the share of constrained sectors in GSP has increased between t and $t+1$ depends on liberalization dates. The results are mixed but interesting. Industries populated by small firms, as measured by their sales, are also most likely to increase as a share of GSP after liberalization. Put differently, the fraction of state value added that is generated by industries with both high returns and high volatility is likely to increase. The same is true of sectors populated by young firms.

In the raw data, the cross-state average share of GSP contributed by Young, Constrained, Small and Low Assets sectors had 1977 values of 51%, 40%, 52%, and 43%, respectively. By 2000, they had grown to 60%, 44%, 60%, and 48%, respectively. These sectors which on average grow faster by 1 percent a year have become more important to state economies, by 10 to 15 percent. This finding is potentially consistent with the prediction in Acemoglu and Zilibotti (1997): Following banking deregulation, banks and thus states have become more diversified and as a result are undertaking greater investment in riskier sectors. It is also consistent with the possibility that aggregate growth respond to financial liberalization via a re-composition effect, although the end aggregate effect is too small for *our* estimations to capture it.

A word of caution is in order. We assume throughout a time-invariant return matrix. What if returns were systematically higher in constrained sectors post-liberalization? Would assuming this away not bias our estimates in the sample splits performed in this section? We now detail why our results are robust to this possibility. Suppose we do not measure the true efficient weights, as a result of a violation of our time invariance assumption along the sectoral dimension. In particular, assume the efficient weights we compute, $\hat{w}_{s,i,t}$ be different from their true efficient level as follows

$$\hat{w}_{s,i,t} = w^*_{s,i} + \tilde{\gamma}_1 \; LIB_{s,t} + \tilde{\gamma}_2 \; LIB_{s,t} \; . \; CONSTR + \tilde{\delta} \; CONSTR \tag{6}$$

We have allowed for our computed efficient weights to differ from the true optimum because returns may be higher (and/or less volatile) after liberalization ($\tilde{\gamma}_1$), in constrained sectors

($\tilde{\delta}$) or indeed in constrained sectors after liberalizations ($\tilde{\gamma}_2$), as demonstrated in Rajan and Zingales (1998).

Consider now the specification in equation (5). It is easy to convince oneself these measurement errors are not going to affect our estimates of interest. Indeed, $\tilde{\delta}$ will only affect estimates of δ, and $\tilde{\gamma}_1$ and $\tilde{\gamma}_2$ will only affect estimates of γ. In other words, our results are robust to time varying returns, even if these behave in a systematically different manner across constrained versus unconstrained industries, as Rajan and Zingales (1998) argue.

6.2 Which States Converge Faster?

We now focus on the cross-section at the state level, and examine the characteristics of the states that converge faster post-liberalization. We split states according to four criteria, which are summarized in Tables 10A and B. Table 10A lists again the fast- and slow-converging states that were sampled in Table 1. Panels A and B are suggestive that fast-converging states are populated by relatively small and young firms, and are far from their efficient allocation to begin with. We now turn to a rigorous exploration of these conjectures.

We first consider a simple variant of the industry splits employed in the previous section. Specifically, we divide states into two groups based on above and below median value of state-level firm age, calculated as an industry-weighted average of industry-level firm age for the state in 1977. We report estimates of convergence equations (1)-(5) in Table 10C. The results are consistent with those for industry splits. States with a greater share of industries populated by younger firms converge faster post-liberalization. The β coefficient for these states is negative, significant, and usually at least three to four times as large as that for the complementary set of states (where β is often insignificant).

Rather than report state-level splits for the other measures employed above, namely FINDEP, Sales and Assets, we bring in alternative data available at the state-level for the US. In particular, in a recent paper Demyanyk, Ostergaard and Sorensen (2006) employ firm-level data on the number of employees, from the Geospatial and Statistical Data Center, maintained at the University of Virginia library.[23] Using these data, we calculate Firm Size as the 1977 share of firms with fewer than 20 employees in overall state employment. We then split states into samples around the median values of Firm Size. Table 10D reports estimates of equations (1)-(5). States with many small firms have negative and significant

[23]They also document that small businesses are important to the economy: In the average state, they find that businesses with less than 100 employees made up 58 percent of total employment in 1978.

values of β that are at least two to three times larger than in states populated by fewer small firms.

The results in 10C and 10D are thus consistent with greater effects of banking deregulation in states characterized by younger and smaller firms, that are likely to be more reliant on bank financing. Next, we investigate whether convergence post liberalization is greater for those states where distance to the frontier is greater to start with. This would happen if the repressive effect of bank branching restrictions on allocative efficiency were the most stringent for these states, which as a result were rendered inefficiently specialized in their sectoral allocations. To this end, we split states in Table 10E into two samples around the median 1977 value of distance to the frontier. Once again the effect of liberalization on convergence predominantly happens in those states that have a relatively high distance to the frontier to begin with.

Finally, in Table 10F we exploit the idea that bank branching restrictions are less likely to restrict efficiency in those states that are small. There, we conjecture, the information frictions that prevent a bank from lending to the entire spectrum of borrowers in the state are less likely to bind. We split states around the US median value of state geographical area. We expect the convergence effect of liberalization should be stronger for larger states. The estimates of equations (1) and (5) in Table 10F confirm this conjecture.

6.3 Alternative Hypotheses

In this section, we consider some natural alternatives to our state-level mean-variance efficiency benchmark, and estimate the convergence equations they imply. For the sake of brevity, we focus in what follows on the weight-based equation (5).

6.3.1 The $\frac{1}{N}$ Allocation

In the literature on portfolio optimization, recent contributions have suggested that simple investment criteria such as allocating $\frac{1}{N}$ of the portfolio share to each of the N assets achieves better performance because of estimation error in the efficient weights. We show this criterion does a poor job at explaining real allocations for the US states. In Column 1 of Table 11A we estimate the convergence equation (5) with the efficient weights $w^*_{s,i}$ replaced by $\frac{1}{N}$. We find that not only is there little convergence toward this benchmark, as α is close to one, but there is no effect of liberalization on convergence either, as β is zero. We conclude that $\frac{1}{N}$ is not a useful benchmark for the issue at hand.

6.3.2 Allocation Without Covariance

In order to illustrate that the covariance structure of sectoral returns plays a crucial role in the determination of efficiency frontiers, we estimate a benchmark frontier where all covariance terms in estimation are set to zero (sectoral variances are still allowed to vary across states). Column 2 of Table 11A shows that this benchmark is equally unable to explain the convergence properties we document. Estimates for α and β are close to one and zero, respectively. This is not surprising since covariances arise naturally across sectors due to state and national cycles. This is also easily verified in examining the properties of the efficient frontiers obtained when covariance terms are set to zero. The Sharpe ratios are two to three times as large as those obtained for frontiers with covariance terms.

6.3.3 Is There Convergence to a National Frontier?

As most states lift their (interstate) branching regulations, they become part of the larger, federal market of the Union. The relevant efficiency question then becomes whether aggregate allocations are approaching an aggregate efficient frontier, i.e. one for the US as a whole. This is an issue we have so far ignored altogether, focusing instead on state-level allocations and state-level efficient frontiers.

Estimating the variance-covariance matrix of the returns on 50 states (plus DC) by 18 (or even 10) industries is not feasible given the time series available. Instead we calculate aggregate returns for 18 sectors, based on value added growth rates for each sector in the US GDP as a whole. We infer the aggregate efficient frontier from the resulting variance-covariance matrix and expected returns. The realized aggregate weight of a sector is also calculated using the share of that sector in overall US GDP. We then estimate a global convergence equation (5) in Columns 3-5 of Table 11A. We must take a stand as to what is the relevant liberalization date for the U.S. as a whole. We employ three variants: (i) 1994, when all states have liberalized (Column 3); (ii) a weighted average of interstate liberalization dates, with weights given by each state's share in aggregate GDP (Column 4); and, finally (iii) a simple average of interstate liberalization dates (Column 5).

There is little evidence consistent with the convergence of aggregate weights to an aggregate frontier. The magnitude of α is above 0.95 for all three choices of liberalization dates, implying extremely gradual movement towards the frontier. And β is essentially zero and insignificant, so that there is no effect of liberalizations on the speed of convergence.

There are two candidate explanations for this negative finding. The first one is that our estimated global frontier is inappropriate. It is methodologically intractable to compute the "true" global frontier for the US. Deregulation in the US banking sector was not fully achieved until 1994: until then the relevant frontier consists of a changing aggregate formed by the set of investments available in liberalized states, rather than the whole federation. The correct sample period as regards global convergence should therefore begin in 1994. This is too short to conduct a meaningful convergence analysis. The global frontier we derived is potentially but a poor proxy for this elusive alternative.

The second candidate explanation is that the convergence of aggregate allocations to the aggregate frontier is an extremely slow process, as suggested by the estimates of α in Columns 3-5 of Table 11A. This could happen because local information advantages continue to prevail as far as bank lending is concerned. A large body of recent literature has suggested that local effects are important, for example, in understanding home bias in country-level equity portfolios, or a regional bias in within-country equity portfolios. According to Petersen and Rajan (2002), even though banks are clearly lending to firms located farther and farther as time passes, the mean and median distance between the main office of the borrowing firm to the office or branch of the lender remain still quite small: 67.8 miles and 5.0 miles, respectively, based on 1993 data. This suggests that local information advantages, and possibly also organizational scale and scope restrictions, make individual states the relevant laboratory for understanding sectoral allocations and their efficiency.

6.3.4 Real Integration of Industries Across States

Another reason why an aggregate frontier may be an economically appealing alternative is that industries may become increasingly integrated across states, e.g. via vertical linkages or firms operating across states. The question is important because if industry returns across states are converging towards identical properties, then there is in fact only one frontier and the relevant question would be whether each state's allocations converge to this frontier. This is fundamentally different from convergence of aggregate allocations to an aggregate frontier, which could still allow for state-level specializations that are distinct from those of the aggregate frontier.

We first show in Table 11B that a certain amount of real integration of industries across states has occurred over time. We compute the standard deviation of returns $R_{s,i,t}$ for each industry i across all states at a given time t. This dispersion measure has a mean of 8.14%

and a standard deviation (across the 18 industries) of 4.91% in 1978. The mean falls to 4.47% and its standard deviation falls to 2.6% by 2000. This is evidence that industries are becoming less dispersed across states over time. A simple panel regression of the log of dispersion measure with a time trend shows that dispersion has been falling (in log measure) by about 1.35 percent every year.

Have the realized allocations across states also converged as a result? To answer this question, we compute a measure of the bilateral similarity in the allocations of investment between states. We calculate the sum of absolute distances between realized investment allocations at a given point of time. For a pair of states s and u, define $Gap_t = \sum_i |w_{s,i,t} - w_{u,i,t}|$. In Table 11C, we examine the convergence properties of Gap_t in an auto-regressive specification. In Column 1, we allow for year effects and state-pair fixed effects, whereas in Columns 2 and 3, we only have year effects. In Column 1, we show the dis-similarities of investment allocations across states have a permanent component, as testified by the significant intercept. This continues to be the case in Column 2, where country-pair specific intercepts are omitted

What is the source of a permanent component in the bilateral discrepancy in allocations across states? An answer is provided in Column 3 where instead of Gap_t, we compute $Gap_t^* = Gap_t - \sum_i |w_{s,i}^* - w_{u,i}^*|$, which controls for the cross-states discrepancies in *efficient* investment allocations. By definition, efficient investment is time-invariant. Column 3 shows that an intercept ceases to be significant once permanent differences in efficient investment are accounted for. In other words, the bilateral gap in allocations across states has a permanent component, unlike what would happen if there were complete real integration across states. Furthermore, this permanent component is explained away by the gap in efficient weights between states, computed according to our proposed efficient benchmark.

To summarize, although the intuitively simple notion of mean-variance efficiency has been argued to have limitations, it is at least a useful benchmark for positive analysis. In particular, for individual states in the US, observed production shares of different sectors converge towards the mean-variance frontier. Alternatively defined frontiers do not appear successful in explaining the convergence properties of sectoral production shares.

6.3.5 Does Liberalization Affect Levels?

We have so far focused on the effect of liberalization on second moments, and in particular how quickly distance, output growth, its volatility and the implied Sharpe ratio *converge* to efficiency. Does liberalization have a direct effect on the levels of these variables? Our stand has been that significant level effects may be elusive because of unobserved heterogeneity across states, for example in the specificity of capital they employ. We now investigate the question further.

Our specifications of the convergence process in equations (1)-(4) do in effect have consequences for the long-run gap between realized variables and their efficient counterparts. In particular, the fact that the autoregressive coefficient $(\alpha + \beta * LIB_{s,t})$ is smaller in liberalized state-years is strictly equivalent to low values of Γ in

$$\begin{aligned} D_{s,t} &= \Gamma * LIB_{s,t} + \delta_s + \theta_t \ , & (7) \\ \mu_{s,t} - \mu_s^* &= \Gamma * LIB_{s,t} + \delta_s + \theta_t \ , & (8) \\ \sigma_{s,t} - \sigma_s^* &= \Gamma * LIB_{s,t} + \delta_s + \theta_t \ , \text{ and} & (9) \\ SR_{s,t} - SR_s^* &= \Gamma * LIB_{s,t} + \delta_s + \theta_t \ , & (10) \end{aligned}$$

since $\Gamma = \frac{1}{1-(\alpha+\beta * LIB_{s,t})}$. In other words, the significant results we obtained in Tables 2, 4 and 6 imply that $D_{s,t}$ is significantly lower in liberalized state-years, and so are $(\sigma_{s,t} - \sigma_s^*)$ and $(SR_{s,t} - SR_s^*)$. Recall that we did not find significant convergence effects for $(\mu_{s,t} - \mu_s^*)$.

In addition we have implemented the following specifications to investigate whether the levels of growth or volatility were directly affected by liberalization

$$\begin{aligned} \mu_{s,t} &= \Gamma' * LIB_{s,t} + \delta_s + \theta_t \ , & (11) \\ \sigma_{s,t} &= \Gamma' * LIB_{s,t} + \delta_s + \theta_t \ , \text{ and} & (12) \\ SR_{s,t} &= \Gamma' * LIB_{s,t} + \delta_s + \theta_t \ . & (13) \end{aligned}$$

These are effectively difference-in-differences estimations, where we evaluate whether liberalized states tend to display higher growth, lower volatility and/or higher Sharpe ratios than ones whose branching regulations have not been altered yet. The fixed effects hold constant any time-invariant characteristics of each state, and control for a putative aggregate business cycle. In results that are available upon request, we find that the estimates of Γ' are on the whole insignificant, with only one exception. There is some evidence that intra-state liberalization has a positive effect on the level of state-level Sharpe ratios.

This absence of significance in level effects confirms the importance of specifying the target towards which growth and volatility converge across states. While we do find evidence that volatility of output and Sharpe ratios converge towards their efficient levels in a way that depends on branching regulations, there appears to be little evidence that their levels are systematically affected by the liberalization status.

7 Robustness

We first consider some quantitative checks on the estimations presented so far, and then discuss the issue of the endogeneity of liberalization dates.

7.1 Excluding Stable and Regulated Sectors

We check whether our conclusions are altered by the exclusion of exceptionally stable sectors that end up having large weights in the typical efficient portfolio. In particular, Government and Health and Education (GHE) consistently receive large investment, because their average returns tend to be high with low volatility. This may happen for reasons that are partly artificial, and the sectors should therefore not necessarily enter portfolio optimization. We also exclude the Finance, Insurance and Real Estate (FIRE) sector since its returns are likely to be endogenous to the specific regulation under study in this paper. Table 12A presents estimates for equation (5) evaluated over the remaining industries. In all cases, we actually re-compute the frontier as if these activities were simply not part of the economy. The estimated coefficients reveal clearly that the interaction between convergence and branching liberalization does not depend on these specific activities. Estimates for β continue to be significant in all cases where they were significant in Table 6, and indeed are of similar economic magnitude.

7.2 Alternative Values for the Risk-Free Rate

In the tests reported in Sections 4 and 5, we set the risk-free rate to be zero when identifying tangency portfolio. Our results are not particularly sensitive to the choice of a risk-free rate. In Table 12B, we reproduce Table 6 with alternative values for the risk-free rate. In particular, we present evidence based on 18 sectors and three values for the risk-free rate of 2, 4 and 7 percent. There is no substantial difference. Our interpretation is that since convergence to efficiency operates primarily through volatility changes - a leftward movement along the efficiency frontier, a specific choice of the risk-free rate, and, in turn, of the tangency portfolio, is not the critical driver of convergence in weights. Weights would converge towards that of a candidate tangency portfolio as long as that tangency portfolio is reached through a leftward move towards the frontier. This does not depend crucially on the level of the risk free rate.[24]

7.3 GMM Estimation

It is well known that first-differenced estimations in the presence of lagged dependent variables induce biases, particularly on the coefficient of the lagged dependent variable itself. In this section we verify this is not driving our results. Table 12C estimates convergence equations for both equations (1) and (5) using the generalized method of moments approach (GMM) introduced by Arellano and Bond (1991) to tackle the bias. The results are virtually unchanged. In particular, comparison with Tables 2 and 6 suggests that estimates of β increase in magnitude when GMM is implemented. As for sectoral allocations, the coefficient β is now significant even when estimation is restricted to sectors with non-zero efficient weights.

7.4 The Endogeneity of Liberalization Dates

We finally consider the possibility that the reform of branching in the US was endogenous to growth prospects in various states. We have already shown that liberalizations have heterogeneous effects across sectors, depending on exogenous characteristics, which assuages some endogeneity concerns. In addition, Kroszner and Strahan (1999) and Kroszner (2001) provide support that widespread banking failures in the 1980s and technological advance were two main, exogenous, events that triggered deregulation. In related work, Jayaratne and Strahan (1996) show that the magnitude of bank lending and investment remained broadly unchanged around liberalization dates. If liberalization had been warranted by high growth prospects, it is likely that bank lending would have accelerated as a whole. Jayaratne and Strahan conclude that it is the efficiency of lending that improved, a result that is entirely consistent with this paper's results. Our methodology simply provides a direct metric by which to gauge this improved efficiency, whereas theirs focuses on end growth effects.

We verify that liberalization is indeed unrelated to the prospect of efficiency gains, which we measure using our frontier metric. Figures 3a and 3b plot the number of years since either branching deregulations, against respectively the initial distance to the efficient frontier and

[24] In fact, efficient weights as implied by different values of the risk free rate are highly correlated. For instance, the correlation between weights as implied by a 2 percent (4 percent) risk free rate and those implied by a 0 percent rate equals 0.91 (0.77).

the initial distance between efficient and realized Sharpe ratios.[25] If liberalization responded to attractive prospects, the correlation should be positive. Such is not the case. Linear fits to the data in both the figures reveals zero or mildly negative slope coefficients.

The negative slopes are in fact not surprising. Kroszner and Strahan (1999) document that the primary rationale for states introducing branching restrictions was to increase state revenues from local banks, to restrict competition, create local monopolies, grant more charters and simply extract greater rents. The delay in liberalization and the resulting allocative inefficiency may thus both be linked to the underlying political economy of the state government, an endogeneity that in fact may bias us against the effects we find.

Figures 3c and 3d verify that a similar endogeneity concern with regard to the extent of interstate bank capital flows does not find much merit in our data. Figure 3c shows the relationship between the initial distance to the frontier and interstate flows, and Figure 3d between the initial Sharpe ratio distance and interstate flows. In both cases, the relationships are either flat or slightly negative. In fact, the slightly positive slope between initial distance and interstate capital flows (correlation of 0.15) is due to two outliers, Alaska and Wyoming. Excluding them renders the correlation negative (-0.05). Since interstate banking was liberalized as the result of reciprocal arrangements, the size of interstate bank capital flows may actually reflect the political economy in different states, which probably makes endogeneity even less problematic for our purposes. We conclude that our results are unlikely to be an artefact of branching deregulation and interstate bank capital flows being linked to the inefficiency of a state's capital allocation relative to the benchmark frontier.

8 Conclusion

In this paper, we applied the concept of portfolio efficiency to real production data, and quantified the efficiency of capital allocation in U.S. states. We documented that convergence to the efficient frontier accelerates following the lifting of branching restrictions in the banking sector. In particular, both the effective volatility and the Sharpe ratio of each state's output growth converge faster to their efficient counterparts in liberalized states. This convergence translates at the sector level, where effective output shares converge rapidly to their efficient levels after liberalization. In particular, sectors whose efficient shares are zero disappear

[25] The Sharpe ratios are computed using 18 sectors and a 0% risk free rate, but the exact same conclusion obtains under alternative assumptions.

more rapidly following liberalization. By contrast, financial deregulation has no effect on the overall growth rate at the state level. These results suggest that financial development has important consequences for the specialization (or diversification) of investments in a manner that depends crucially on the variance-covariance properties of investment returns.

The convergence to efficient allocations accelerated primarily after the liberalization of inter-state, rather than intra-state, branching restrictions. Further, states experiencing larger in-flows of out-of-state banking capital experienced greater acceleration. An important policy implication of these results, verified in our data, is that it is the creation of larger, better-diversified and healthier banks, and not a greater number of banks, that leads to efficient output allocations.

We stress that the kind of financial development we examined in this paper affects efficiency through its effect on the volatility of output growth, rather than through its average. This is not necessarily a contradiction with the findings that finance (and in particular banking deregulation) has an effect on aggregate economic growth. We find that the share of fast-growing, volatile sectors in the overall (state) economies actually increases with liberalization. High growth industries effectively become more important in liberalized states. Our conclusions are strongest in industries that are populated by young, small and financially constrained firms, and they are indeed often absent from the complementary samples. They are also strongest in U.S. states that are populated by high numbers of small and young firms, and, interestingly, in large states. These differential effects assuage some endogeneity concerns. But they also identify the empirical importance of banks for small, young, financially constrained firms, and the local component of expertise in bank lending.

Finally, our contribution is methodological in nature. We hope to have shown that the notion of portfolio efficiency, most widely applied to financial quantities, can provide new insights when applied to real quantities, in spite of a priori fundamental differences. With a large ongoing interest in quantifying the real effects of financial integration, and in particular a mounting body of evidence supportive of real effects on economic growth, our approach unbundles some of the mechanisms at play. We are able to pinpoint whether finance improves efficiency via diversification or through higher returns. We are further able to characterize the very nature of finance-induced specialization: which activities and sectors benefit, which do not, and why. The richness of our methodology may thus be useful in a variety of contexts, for instance for analyzing the nature and effects of international financial flows.

Appendix 1: Industry Classification

63 Sector SIC Classification	18 Sector BEA Classification	10 Sector Dyck-Zingales Classification
Agric., Farming and Fisheries	1	1
Agric. Services	2	1
Metal Mining	3	2
Coal mining	3	2
Oil & Gas	3	2
Nonmetalic Minerals	3	2
Construction	4	3
Lumber & Wood	5	4
Furniture and Fixtures	5	4
Stone, Clay, Glass	6	4
Primary Metals	6	4
Fabricated Metals	6	4
Industrial Machinery	6	4
Electronic Equipment	6	4
Motor Vehicles	6	4
Other Transport Equip.	6	4
Instruments and Related	6	4
Misc.Manufacturing	6	4
Food & kindred products	7	4
Tobacco products	7	4
Textile mill products	7	4
Apparel & textile	7	4
Leather products	7	4
Paper products	7	4
Printing & publishing	7	4
Chemicals	7	4
Petroleum Products	7	4
Rubber & Plastics	8	4
Leather Products	8	4
Railroad Transportation	9	5
Trucking and Warehousing	9	5
Water Transportation	9	5
Transportation by Air	9	5
Pipelines, ex. Nat. Gas	9	5
Transportation Services	9	5
Communications	10	5
Electric, Gas, & Sanitary	11	5
Wholesale Trade	12	6
Retail trade	13	7
Depository Institutions	14	8
Nondepository Institution	14	8
Security Brokers	14	8
Insurance Carriers	14	8
Insurance Agents	14	8
Real Estate	14	8
Holding and Investment	14	8
Hotels & Lodging	15	9
Personal Services	15	9
Business Services	15	9
Auto repair & Parking	15	9
Misc. Repair Services	15	9
Motion Pictures	15	9
Amusement and Recreation	15	9
Health Services	16	9
Legal Services	16	9
Educational Services	16	9
Social Services	16	9
Other Services	16	9
Membership Organizations	16	9
Private Households	16	9
Business serv. + Other serv	17	9
Government	18	10

Notes: The left hand column describes the 63 SIC industrial sectors (omitting "Unclassified" which is excluded from both the 18 and 10 sector classifications), the middle column describes the 18 BEA industrial sectors and the right hand column describes the 10 industry classification as described by Dyck-Zingales. The 18 industrial sector classification is used for the main results and the 10 industrial sector classification is included for robustness.

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Table 1A: Summary of state-wise distance to efficient frontier for the ten states with highest convergence as measured by final/initial distance from frontier.

State	Average Distance	Initial Distance	Final/Initial Distance	Intrastate Lib Year	Interstate Lib Year	Post-Intra /Pre-Intra Average Distance	Post-Inter /Pre-Inter Average Distance
Delaware	0.026	0.035	0.462	1970	1988		0.614
Illinois	0.028	0.042	0.468	1988	1986	0.684	0.677
Dist. of Col.	0.009	0.012	0.485	1970	1985		0.799
New Jersey	0.018	0.025	0.515	1977	1986		0.664
Pennsylvania	0.020	0.028	0.527	1982	1986	0.661	0.694
Minnesota	0.037	0.047	0.541	1993	1986	0.662	0.675
South Dakota	0.034	0.046	0.550	1970	1988		0.756
North Dakota	0.066	0.080	0.554	1987	1991	0.710	0.731
Nebraska	0.043	0.055	0.568	1985	1990	0.832	0.809
Kansas	0.038	0.046	0.573	1987	1992	0.783	0.778

Table 1B: Summary of state-wise distance to efficient frontier for the ten states with lowest convergence as measured by final/initial distance from frontier.

State	Average Distance	Initial Distance	Final/Initial Distance	Intrastate Lib Year	Interstate Lib Year	Post-Intra /Pre-Intra Average Distance	Post-Inter /Pre-Inter Average Distance
Alaska	0.105	0.054	1.501	1970	1982		1.009
Montana	0.032	0.027	1.109	1990	1993	0.963	0.933
Nevada	0.015	0.015	1.000	1970	1985		0.907
Idaho	0.031	0.034	0.967	1970	1985		0.919
Oregon	0.027	0.032	0.896	1985	1986	0.894	0.905
Hawaii	0.018	0.018	0.892	1986	1994	0.977	0.904
Vermont	0.037	0.038	0.848	1970	1988		0.889
Iowa	0.035	0.035	0.848	1970	1991		0.853
Indiana	0.037	0.041	0.847	1989	1986	0.821	0.826
Oklahoma	0.038	0.041	0.826	1988	1987	0.751	0.754

Notes: Distance measures represent the distance between the realized portfolio and the efficient frontier in return-standard deviation space. A zero distance indicates that the realized portfolio is on the efficient frontier. Distances are calculated year by year for the average distance calculations.

Table 2A: Euclidian distance to frontier: Convergence properties.

	D_{t+1} - 18 sectors		D_{t+1} - 10 sectors	
	Intra-state	Inter-state	Intra-state	Inter-state
D_t	0.6365^{***}	0.6267^{***}	0.7049^{***}	0.6718^{***}
	(0.0397)	(0.0694)	(0.0432)	(0.0587)
$LIB\ .\ D_t$	-0.1018^{***}	-0.1839^{***}	-0.1408^{**}	-0.1618^{***}
	(0.0389)	(0.0393)	(0.0701)	(0.0290)
LIB	0.0039^{***}	0.0065^{***}	0.0041^{**}	0.0047^{***}
	(0.0010)	(0.0020)	(0.0017)	(0.0012)
Obs	1,173	1,173	1,173	1,173

Table 2B: Euclidian distance to tangency portfolio: Convergence properties.

	D_{t+1} - 18 sectors		D_{t+1} - 10 sectors	
	Intra-state	Inter-state	Intra-state	Inter-state
D_t	0.7442^{***}	0.7323^{***}	0.7930^{***}	0.7792^{***}
	(0.0277)	(0.0285)	(0.0198)	(0.0293)
$LIB\ .\ D_t$	-0.1056^{***}	-0.1869^{***}	-0.1190^{**}	-0.2217^{***}
	(0.0255)	(0.0489)	(0.0204)	(0.0516)
LIB	0.0024^{**}	0.0047^{***}	0.0027^{***}	0.0051^{***}
	(0.0010)	(0.0017)	(0.0009)	(0.0016)
Obs	1,173	1,173	1,173	1,173

Table 2C: Horizontal distance to tangency portfolio: Convergence properties.

	D_{t+1} - 18 sectors		D_{t+1} - 10 sectors	
	Intra-state	Inter-state	Intra-state	Inter-state
D_t	0.7502^{***}	0.7188^{***}	0.7853^{***}	0.7480^{***}
	(0.0168)	(0.0240)	(0.0171)	(0.0334)
$LIB\ .\ D_t$	-0.1245^{**}	-0.1934^{***}	-0.1299^{**}	-0.2207^{***}
	(0.0291)	(0.0367)	(0.0244)	(0.0385)
LIB	-0.0025^{***}	0.0042^{***}	0.0024^{***}	0.0041^{***}
	(0.0008)	(0.0013)	(0.0007)	(0.0012)
Obs	1,173	1,173	1,173	1,173

Table 2D: Vertical distance to tangency portfolio: Convergence properties.

	D_{t+1} - 18 sectors		D_{t+1} - 10 sectors	
	Intra-state	Inter-state	Intra-state	Inter-state
D_t	0.7658^{***}	0.7165^{***}	0.7736^{***}	0.7160^{***}
	(0.0228)	(0.0232)	(0.0289)	(0.0281)
$LIB\ .\ D_t$	-0.1297^{**}	-0.1722^{***}	-0.1407^{***}	-0.1790^{***}
	(0.0375)	(0.0376)	(0.0408)	(0.0369)
LIB	0.0087^{***}	0.0130^{***}	0.0072^{***}	0.0102^{***}
	(0.0027)	(0.0041)	(0.0020)	(0.0031)
Obs	1,173	1,173	1,173	1,173

Notes: All estimations include a state-specific intercept and year fixed effects. Standard errors are reported between parentheses. *** (**, *) denote significance at the 1% (5%, 10%) confidence level. Standard errors are clustered by state.

Table 3A: Summary of realized and efficient state-level growth, volatility and Sharpe ratio for the ten states with highest convergence as measured by final/initial distance from frontier.

	Realized			Efficient			Final/Initial		
State	μ	σ	SR	μ	σ	SR	μ	σ	SR
Delaware	0.0786	0.0271	2.90	0.0647	0.0135	4.77	1.3704	1.1537	1.1878
Illinois	0.0608	0.0222	2.74	0.0683	0.0139	4.90	1.1788	0.7614	1.5483
Dist. of Col.	0.0592	0.0249	2.38	0.0745	0.0276	2.70	1.1783	1.0568	1.1150
New Jersey	0.0736	0.0283	2.60	0.0793	0.0246	3.22	1.1438	0.9697	1.1795
Pennsylvania	0.0605	0.0209	2.89	0.0707	0.0163	4.33	1.1417	0.8808	1.2963
Minnesota	0.0708	0.0286	2.48	0.0808	0.0190	4.25	1.1502	0.7340	1.5672
South Dakota	0.0657	0.0377	1.74	0.0832	0.0178	4.67	1.1573	0.7081	1.6344
North Dakota	0.0542	0.0757	0.72	0.0786	0.0241	3.26	1.1717	0.5748	2.0384
Nebraska	0.0618	0.0356	1.74	0.0777	0.0160	4.87	1.1345	0.6581	1.7238
Kansas	0.0622	0.0294	2.12	0.0726	0.0147	4.93	1.1439	0.7804	1.4657

Table 3B: Summary of realized and efficient state-level growth, volatility and Sharpe ratio for the ten states with lowest convergence as measured by final/initial distance from frontier.

	Realized			Efficient			Final/Initial		
State	μ	σ	SR	μ	σ	SR	μ	σ	SR
Alaska	0.0571	0.1403	0.41	0.0692	0.0363	1.91	1.2944	1.4893	0.8691
Montana	0.0535	0.0396	1.35	0.0813	0.0203	3.99	1.1400	0.8070	1.4128
Nevada	0.1000	0.0326	3.07	0.0921	0.0182	5.07	1.0265	1.0689	0.9603
Idaho	0.0721	0.0363	1.99	0.0801	0.0192	4.18	1.2287	1.3093	0.9384
Oregon	0.0726	0.0318	2.28	0.0752	0.0188	4.00	1.2018	1.2101	0.9931
Hawaii	0.0655	0.0386	1.70	0.0663	0.0305	2.17	1.0708	1.0478	1.0220
Vermont	0.0739	0.0378	1.96	0.0827	0.0204	4.05	1.0650	0.9573	1.1125
Iowa	0.0533	0.0382	1.40	0.0612	0.0118	5.18	1.1448	0.5715	2.0032
Indiana	0.0609	0.0303	2.01	0.0809	0.0189	4.28	1.0979	0.8056	1.3629
Oklahoma	0.0585	0.0616	0.95	0.0768	0.0269	2.85	1.0985	0.8015	1.3706

Table 3C: Correlation matrix for realized and efficient growth, volatility and Sharpe Ratio.

	Realized μ	Realized σ	Realized SR	Efficient μ	Efficient σ	Efficient SR
Realized μ	1					
Realized σ	-0.209	1				
Realized SR	0.587	-0.785	1			
Efficient (Optimized) μ	0.598	-0.142	0.372	1		
Efficient (Optimized) σ	-0.029	0.629	-0.514	0.172	1	
Efficient (Optimized) SR	0.270	-0.565	0.626	0.263	-0.873	1

Notes: Realized variables for a state are the level of output growth (μ), standard deviation of output growth (σ) and Sharpe ratio (SR) over the period 1977–2000. Efficient variables are the properties of the tangency portfolio obtained from the efficient frontier, calculated using the realized average growth and variance-covariance matrix over the period 1977-2000. The final and initial variables are the realized variables in the year 2000 and 1977, respectively. Correlations are time-averaged state-wise correlations across the period 1977-2000.

Table 4A: Growth, volatility and Sharpe ratio: Convergence properties - 18 sectors.

	$\sigma_{t+1} - \sigma^*$			$\mu_{t+1} - \mu^*$			$SR_{t+1} - SR^*$	
	Intra-state	Inter-state		Intra-state	Inter-state		Intra-state	Inter-state
$\sigma_t - \sigma^*$	0.7567^{***} (0.0186)	0.7311^{***} (0.0199)	$\mu_t - \mu^*$	0.8076^{***} (0.0703)	0.7925^{***} (0.0628)	$SR_t - SR^*$	0.8052^{***} (0.0315)	0.7887^{***} (0.0397)
$LIB.(\sigma_t - \sigma^*)$	-0.1285^{***} (0.0298)	-0.2043^{***} (0.0398)	$LIB.(\mu_t - \mu^*)$	-0.0041 (0.0082)	0.0122 (0.0104)	$LIB.(SR_t - SR^*)$	-0.0410^{***} (0.0092)	-0.0327^{***} (0.0100)
LIB	0.0021^{**} (0.0009)	0.0038^{***} (0.0013)	LIB	$-6.18e^{-5}$ ($1.06e^{-4}$)	$8.75e^{-5}$ ($1.18e^{-4}$)	LIB	-0.0703^{***} (0.0189)	-0.0584^{***} (0.0199)
Obs	1,173	1,173	Obs	1,173	1,173	Obs	1,173	1,173

Table 4B: Growth, volatility and Sharpe ratio: Convergence properties - 10 sectors.

	$\sigma_{t+1} - \sigma^*$			$\mu_{t+1} - \mu^*$			$SR_{t+1} - SR^*$	
	Intra-state	Inter-state		Intra-state	Inter-state		Intra-state	Inter-state
$\sigma_t - \sigma^*$	0.7895^{***} (0.0126)	0.7611^{***} (0.0274)	$\mu_t - \mu^*$	0.8788^{***} (0.0570)	0.8841^{***} (0.0539)	$SR_t - SR^*$	0.7930^{***} (0.0334)	0.7717^{***} (0.0428)
$LIB.(\sigma_t - \sigma^*)$	-0.1256^{***} (0.0213)	-0.2199^{***} (0.0403)	$LIB.(\mu_t - \mu^*)$	-0.0048 (0.0044)	-0.0099 (0.00126)	$LIB.(SR_t - SR^*)$	-0.0372^{***} (0.0090)	-0.0345^{***} (0.0099)
LIB	0.0019^{**} (0.0008)	0.0034^{***} (0.0012)	LIB	$-1.83e^{-5}$ ($8.60e^{-5}$)	$-1.73e^{-4}$ ($1.77e^{4}$)	LIB	-0.0481^{***} (0.0150)	-0.0514^{***} (0.0150)
Obs	1,173	1,173	Obs	1,173	1,173	Obs	1,173	1,173

Notes: All estimations include a state-specific intercept and year fixed effects. Standard errors are reported between parentheses. *** (**, *) denote significance at the 1% (5%, 10%) confidence level. Standard errors are clustered by state.

Table 5A: Industry Weights by State for the ten states with highest convergence as measured by final/initial distance from frontier.

State	Industry 1	Efficient Weight	Realized Weight	Non-zero Weight	Industry 2	Efficient Weight	Realized Weight	Non-zero Weight	Industry 3	Efficient Weight	Realized Weight	Non-zero Weight	Industry 4	Efficient Weight	Realized Weight	Non-zero Weight
Delaware	Government	0.772	0.101	0.349	Trans.	0.069	0.018	0.062	Const.	0.066	0.044	0.152	Comm.	0.053	0.015	0.052
Illinois	Government	0.388	0.096	0.164	Health, ed.	0.196	0.102	0.174	Leis, Bus. S	0.158	0.067	0.114	Food, pap.	0.077	0.071	0.121
Dist. of Col.	Health, ed.	0.378	0.211	0.241	Government	0.232	0.385	0.439	Other serv.	0.152	0.082	0.094	Leis, Bus. S	0.134	0.061	0.070
New Jersey	Fin. Inst.	0.350	0.182	0.305	Government	0.218	0.101	0.169	Comm.	0.215	0.032	0.054	Wholesale	0.086	0.081	0.136
Pennsylvania	Fin. Inst.	0.296	0.156	0.327	Government	0.168	0.104	0.218	Other serv.	0.129	0.047	0.099	Rub., plast.	0.127	0.007	0.015
Minnesota	Government	0.407	0.105	0.194	Fin. Inst.	0.183	0.153	0.283	Other serv.	0.164	0.047	0.087	Retail	0.115	0.088	0.163
South Dakota	Health, ed.	0.498	0.092	0.279	Leis, Bus. S	0.194	0.046	0.139	Wood	0.108	0.007	0.021	Food, pap.	0.059	0.031	0.094
North Dakota	Health, ed.	0.436	0.098	0.340	Retail	0.167	0.089	0.309	Wood	0.141	0.003	0.010	Leis, Bus. S	0.102	0.043	0.149
Nebraska	Health, ed.	0.452	0.085	0.204	Leis, Bus. S	0.236	0.056	0.134	Retail	0.232	0.085	0.204	Const.	0.038	0.037	0.089
Kansas	Health, ed.	0.330	0.085	0.184	Government	0.224	0.130	0.281	Retail	0.151	0.089	0.193	Const.	0.140	0.040	0.087

Table 5B: Industry Weights by State for the ten states with lowest convergence as measured by final/initial distance from frontier.

State	Industry 1	Efficient Weight	Realized Weight	Non-zero Weight	Industry 2	Efficient Weight	Realized Weight	Non-zero Weight	Industry 3	Efficient Weight	Realized Weight	Non-zero Weight	Industry 4	Efficient Weight	Realized Weight	Non-zero Weight
Alaska	Health, ed.	0.673	0.053	0.329	Comm.	0.204	0.020	0.124	Wood	0.053	0.008	0.050	AFF	0.035	0.016	0.099
Montana	Health, ed.	0.478	0.099	0.423	Other serv.	0.220	0.031	0.132	Leis, Bus. S	0.184	0.054	0.231	Elect, gas	0.060	0.044	0.188
Nevada	Government	0.512	0.111	0.392	Retail	0.163	0.094	0.332	Trans.	0.129	0.033	0.117	Elect, gas	0.076	0.029	0.102
Idaho	Government	0.306	0.134	0.315	Health, ed.	0.261	0.085	0.200	Agric. serv.	0.138	0.009	0.021	Leis, Bus. S	0.133	0.054	0.127
Oregon	Government	0.381	0.122	0.233	Health, ed.	0.199	0.091	0.174	Leis, Bus. S	0.140	0.058	0.111	Food, pap.	0.111	0.042	0.080
Hawaii	Government	0.425	0.225	0.477	Trans.	0.224	0.045	0.095	Health, ed.	0.176	0.087	0.184	Elect, gas	0.118	0.018	0.038
Vermont	Health, ed.	0.579	0.105	0.333	Government	0.239	0.115	0.365	Rub., plast.	0.080	0.005	0.016	Trans.	0.072	0.023	0.073
Iowa	Government	0.692	0.112	0.331	Leis, Bus. S	0.109	0.049	0.145	Const.	0.073	0.037	0.109	Wood	0.055	0.009	0.027
Indiana	Health, ed.	0.586	0.085	0.213	Leis, Bus. S	0.217	0.046	0.115	Retail	0.141	0.091	0.228	Const.	0.031	0.044	0.110
Oklahoma	Health, ed.	0.670	0.083	0.353	Agric. serv.	0.121	0.003	0.013	Leis, Bus. S	0.069	0.053	0.226	Comm.	0.064	0.024	0.102

Notes: Weights are presented for each state for the four industries that have the greatest efficient weights. The realized weights and the non-zero weights (the realized weights normalized by aggregate weights for those industries where the efficient weight strictly positive) are both presented.

Table 6A: Investment weights on industries: Convergence properties - 18 sectors.

	Intra-state		Inter-state	
$w_{t+1} - w^*$	All weights	Non-zero weights	All weights	Non-zero weights
$w_t - w^*$	0.8884^{***} (0.0299)	0.9286^{***} (0.0100)	0.8857^{***} (0.0311)	0.9272^{***} (0.0102)
$LIB.(w_t - w^*)$	-0.0064^{**} (0.0025)	-0.0055^{**} (0.0026)	-0.0077^{**} (0.0028)	-0.0029 (0.0024)
LIB	$-1.33e^{-5}$ $(1.44e^{-4})$	$2.56e^{-6}$ $(7.18e^{-6})$	$-1.45e^{-8}$ $(1.14e^{-8})$	$-4.06e^{-9}$ $(5.70e^{-9})$
Obs	$20,631$	$8,257$	$20,631$	$8,257$

Table 6B: Investment weights on industries: Convergence properties - 10 sectors.

	Intra-state		Inter-state	
$w_{t+1} - w^*$	All weights	Non-zero weights	All weights	Non-zero weights
$w_t - w^*$	0.9238^{***} (0.0248)	0.9468^{***} (0.0083)	0.9180^{***} (0.0270)	0.9466^{***} (0.0081)
$LIB.(w_t - w^*)$	-0.0070^{***} (0.0026)	-0.0004 (0.0029)	-0.0083^{**} (0.0034)	-0.0014 (0.0024)
LIB	$1.79e^{-8}$ $(5.80e^{-8})$	$2.45e^{-9}$ $(2.20e^{-8})$	$4.51e^{-8}$ $(6.97e^{-8})$	$1.92e^{-8}$ $(4.45e^{-8})$
Obs	$11,707$	$4,876$	$11,707$	$4,876$

Notes: All estimations include a state-industry specific intercept and year fixed effects. Standard errors are reported between parentheses. *** (**, *) denote significance at the 1% (5%, 10%) confidence level. Standard errors are clustered by state. We drop the "Agricultural Services" sector since weights sum to unity.

Table 7A: Horse Race between Intra- and Inter-state liberalization for euclidean distance to frontier, D_t, and distance between realized and efficient sectoral weights, $w_t - w^*$.

	D_{t+1}			$w_{t+1} - w^*$	
	18 Sectors	10 Sectors		18 Sectors	10 Sectors
D_t	0.6106^{***} (0.0372)	0.6890^{***} (0.0430)	$w_t - w^*$	0.8859^{***} (0.0310)	0.9182^{***} (0.2691)
$INTRA.D_t$	0.0411 (0.0072)	-0.0350 (0.105)	$INTRA.(w_t - w^*)$	-0.0136 (0.0013)	-0.0015 (0.0012)
$INTRA$	-0.0006 (0.0020)	-0.0016 (0.0024)	$INTRA$	$-1.11e^{-5}$ $(1.42e^{-5})$	$-2.67e^{-8}$ $(5.83e{-8})$
$INTER.D_t$	-0.2050^{***} (0.0055)	-0.1578^{***} (0.0539)	$INTER.(w_t - w^*)$	-0.0065^{**} (0.0027)	-0.0075^{**} (0.0035)
$INTER$	-0.0071^{***} (0.0024)	0.0045^{***} (0.0015)	$INTER$	$3.95e^{-6}$ $(7.59e^{-6})$	$4.60e^{-8}$ $(6.27e^{-8})$
Obs	$1,173$	$1,173$	Obs	$20,631$	$11,707$

Table 7B: Horse Race between Intra- and Inter-state liberalization for distance between realized and efficient standard deviation, $\sigma_{t+1} - \sigma^*$, growth, $\mu_{t+1} - \mu^*$, and sharpe ratio, $SR_{t+1} - SR^*$.

	$\sigma_{t+1} - \sigma^*$			$\mu_{t+1} - \mu^*$			$SR_{t+1} - SR^*$	
	18 Sectors	10 Sectors		18 Sectors	10 Sectors		18 Sectors	10 Sectors
$\sigma_t - \sigma^*$	0.7223^{***} (0.0264)	0.7469^{***} (0.0183)	$\mu_t - \mu^*$	0.8008^{***} (0.0599)	0.8820^{***} (0.0588)	$SR_t - SR^*$	0.7908^{***} (0.0392)	0.7727^{***} (0.0425)
$INTRA.(\sigma_t - \sigma^*)$	0.0213 (0.0483)	0.0339 (0.0479)	$INTRA.(\mu_t - \mu^*)$	-0.0253^{*} (0.0140)	0.0045 (0.0105)	$INTRA.(SR_t - SR^*)$	-0.2707^{***} (0.0085)	-0.0215^{**} (0.0090)
$INTRA$	$-5.09e^{-6}$ $(5.90e^{-4})$	$-4.85e^{-5}$ $(4.02e^{-4})$	$INTRA$	$-2.73e^{-4*}$ $(153e^{-4})$	$7.58e^{-5}$ $(2.00e^{-4})$	$INTRA$	-0.0453^{***} (0.0172)	-0.0248^{*} (0.0151)
$INTER.(\sigma_t - \sigma^*)$	-0.2132^{***} (0.0425)	-0.2325^{***} (0.0444)	$INTER.(\mu_t - \mu^*)$	0.0263^{*} (0.0147)	-0.0115 (0.0160)	$INTER.(SR_t - SR^*)$	-0.0246^{**} (0.0101)	-0.0280^{***} (0.0096)
$INTER$	-0.0385^{***} (0.0013)	0.0035^{***} (0.0012)	$INTER$	$2.29e^{-4}$ $(1.45e^{-4})$	$-1.90e^{-4}$ $(2.14e^{-4})$	$INTER$	-0.0440^{**} (0.0194)	-0.0426^{***} (0.0141)
Obs	$1,173$	$1,173$	Obs	$1,173$	$1,173$	Obs	$1,173$	$1,173$

Table 7C: Convergence Regressions - Flow data (other state asset ratio).

	D_{t+1}		$w_{t+1}-w^*$		$\sigma_{t+1}-\sigma^*$		$\mu_{t+1}-\mu^*$		$SR_{t+1}-SR^*$
D_t	0.3052^{***} (0.0406)	w_t-w^*	0.7497^{***} (0.0066)	$\sigma_t-\sigma^*$	0.3965^{***} (0.0378)	$\mu_t-\mu^*$	0.7288^{***} (0.0320)	SR_t-SR^*	0.5874^{***} (0.0422)
$Flow_t.D_t$	-0.0101^{***} (0.0013)	$Flow_t.(w_t-w^*)$	$-4.00e^{-4***}$ ($7.22e^{-5}$)	$Flow_t.(\sigma_t-\sigma^*)$	-0.0085^{***} (0.0011)	$Flow_t.(\mu_t-\mu^*)$	$-1.19e^{-4}$ (0.00106)	$Flow_t.(SR_t-SR^*)$	0.0021^{*} (0.0013)
$Flow_t$	$3.18e^{-4***}$ ($9.68e^{-5}$)	$Flow_t$	$1.47e^{-6}$ ($1.33e^{-5}$)	$Flow_t$	$1.46e^{-4*}$ ($7.5e^{-5}$)	$Flow_t$	$-1.68e^{-5}$ ($1.03e^{-5}$)	$Flow_t$	0.0011 (0.0020)
Obs	470	Obs	8,261	Obs	470	Obs	470	Obs	470

Table 7D: Convergence Regressions - Horse race between Flow data (other state asset ratio) and state banking sector HHI.

	D_{t+1}		$w_{t+1}-w^*$		$\sigma_{t+1}-\sigma^*$		$\mu_{t+1}-\mu^*$		$SR_{t+1}-SR^*$
D_t	0.0850 (0.0586)	w_t-w^*	0.7510^{***} (0.0071)	$\sigma_t-\sigma^*$	0.2235^{***} (0.0558)	$\mu_t-\mu^*$	0.6483^{***} (0.0398)	SR_t-SR^*	0.5621^{***} (0.0463)
$Flow_t.D_t$	-0.0156^{***} (0.0018)	$Flow_t.(w_t-w^*)$	$-3.71e^{-4***}$ ($9.06e^{-5}$)	$Flow_t.(\sigma_t-\sigma^*)$	-0.0125^{***} (0.0016)	$Flow_t.(\mu_t-\mu^*)$	$-5.04e^{-5}$ (0.00105)	$Flow_t.(SR_t-SR^*)$	0.0016 (0.0013)
$Flow_t$	$5.26e^{-4***}$ ($1.03e^{-4}$)	$Flow_t$	$1.37e^{-6}$ ($1.43e^{-5}$)	$Flow_t$	$2.42e^{-4***}$ ($7.77e^{-5}$)	$Flow_t$	-6.39^{-6} ($1.07e^{-5}$)	$Flow_t$	$-1.27e^{-4}$ (0.0021)
$HHI_t.D_t$	$1.28e^{-4***}$ ($2.52e^{-5}$)	$HHI_t.(w_t-w^*)$	$-1.02e^{-6}$ ($1.94e^{-6}$)	$HHI_t.(\sigma_t-\sigma^*)$	$9.12e^{-5***}$ ($2.26e^{-5}$)	$HHI_t.(\mu_t-\mu^*)$	$4.42e^{-5***}$ ($1.64e^{-5}$)	$HHI_t.(SR_t-SR^*)$	$2.81e^{-5}$ ($2.31e^{-5}$)
HHI_t	$-5.41e^{-6***}$ ($1.43e^{-6}$)	HHI_t	$4.68e^{-9}$ ($2.55e^{-7}$)	HHI_t	$-3.04e^{-7*}$ ($1.15e^{-6}$)	HHI_t	$-3.10e^{-7*}$ ($1.53e^{-7}$)	HHI_t	$5.55e^{-5}$ ($3.43e^{-5}$)
Obs	470	Obs	8,261	Obs	470	Obs	470	Obs	470

Table 7E: Convergence Regressions - Horse race between Flow data(other state asset ratio) and state banking health(capital-asset ratio).

	D_{t+1}		$w_{t+1}-w^*$		$\sigma_{t+1}-\sigma^*$		$\mu_{t+1}-\mu^*$		$SR_{t+1}-SR^*$
D_t	0.9051^{***} (0.0839)	w_t-w^*	0.7657^{***} (0.0075)	$\sigma_t-\sigma^*$	1.0989^{***} (0.0727)	$\mu_t-\mu^*$	0.7299^{***} (0.0424)	SR_t-SR^*	0.6113^{***} (0.0534)
$Flow_t.D_t$	-0.084^{***} (0.0013)	$Flow_t.(w_t-w^*)$	$-2.37e^{-4***}$ ($8.02e^{-5}$)	$Flow_t.(\sigma_t-\sigma^*)$	-0.066^{***} (0.0010)	$Flow_t.(\mu_t-\mu^*)$	$1.78e^{-4}$ (0.0011)	$Flow_t.(SR_t-SR^*)$	0.0026^{*} (0.0015)
$Flow_t$	$3.25e^{-4***}$ ($8.92e^{-5}$)	$Flow_t$	$1.71e^{-6}$ ($1.35e^{-5}$)	$Flow_t$	$2.13e^{-4***}$ ($6.54e^{-5}$)	$Flow_t$	$-1.25e^{-5}$ ($1.05e^{-5}$)	$Flow_t$	0.0017 (0.0023)
$Health_t.D_t$	-7.574^{***} (0.9335)	$Health_t.(w_t-w^*)$	-0.2577^{***} (0.0557)	$Health_t.(\sigma_t-\sigma^*)$	-8.81^{***} (0.8017)	$Health_t.(\mu_t-\mu^*)$	-0.2093 (0.3914)	$Health_t.(SR_t-SR^*)$	-0.4039 (0.5528)
$Health_t$	0.1250^{***} (0.0430)	$Health_t$	$-6.76e^{-4}$ (0.093)	$Health_t$	0.0920^{***} (0.0329)	$Health_t$	-0.0132^{***} (0.0054)	$Health_t$	-0.5088 (0.9313)
Obs	470	Obs	8,261	Obs	470	Obs	470	Obs	470

Notes: All estimations include a state-industry specific intercept and year fixed effects. Standard errors are reported between parentheses. *** (**, *) denote significance at the 1% (5%, 10%) confidence level. Standard errors are clustered by state. In Table 7C the sample is reduced to fully liberalized state years (inter-state liberalization has occured).

Table 8A: Investment weights on industries: Sample splits by age, external finance dependence and size.

	Age		FINDEP		Sales		Assets	
$w_{t+1} - w^*$	Young	Old	Constrained	Unconstrained	Small	Large	Low	High
$w_t - w^*$	0.8776^{***}	0.8904^{***}	0.8687^{***}	0.9187^{***}	0.8910^{***}	0.8486^{***}	0.8708^{***}	0.9022^{***}
	(0.3895)	(0.0172)	(0.0362)	(0.0225)	(0.0310)	(0.0369)	(0.0356)	(0.0321)
$LIB.(w_t - w^*)$	-0.0092^{**}	-0.0032^{**}	-0.0102^{**}	-0.0039^{***}	-0.0099^{**}	-0.0034^{***}	-0.0134^{**}	-0.0013
	(0.0045)	(0.0015)	(0.0045)	(0.0014)	(0.0045)	(0.0010)	(0.0058)	(0.0012)
LIB	$-6.27e^{-5}$	$-2.92e^{-5}$	$1.03e^{-4}$	$7.75e^{-6}$	$1.14e^{-4}$	$-1.13e^{-4}$	$-6.28e^{-5}$	$-7.03e^{-5}$
	$(1.89e^{-4})$	$(1.75e^{-4})$	$(1.56e^{-4})$	$(1.42e^{-5})$	$(1.35e^{-4})$	$(1.25e^{-4})$	$(1.90e^{-4})$	$(1.42e^{-4})$
Obs	11,454	9,177	10,465	10,166	10,166	10,465	10,166	10,465

Notes: The Young (Old) sample corresponds to sectors where the average firm age is below (above) its median value. The Constrained (Unconstrained) sample corresponds to sectors where External Financial Dependence is below (above) its median. The Small (Large) sample corresponds to sectors where the average firm size (measured by sales) is smaller (larger) than its median value. The Low Assets (High Assets) sample corresponds to sectors where the average book value of assets is below (above) its median value. Liberalization is now measured by the inter-state dates only. All estimations include a state-industry specific intercept and year fixed effects. Standard errors are reported between parentheses. *** (**, *) denote significance at the 1% (5%, 10%) confidence level. Standard errors are clustered by state. We drop the "Agricultural Services" sector since weights sum to unity.

Table 8B: Initial and final position relative to the efficient portfolio.

	Initial	Final
Age	-0.0524^{**}	-0.0148
	(0.0259)	(0.0260)
Unconstrained	-0.5610^{***}	-0.6093^{***}
	(0.1641)	(0.1623)
Sales	-0.0023^{***}	$-7.03e^{-4}$
	$(8.71e^{-4})$	$(8.56e^{-4})$
Assets	$-9.97e^{-4**}$	$-6.31e^{-4}$
	$(4.40e^{-4})$	$(4.35e^{-4})$
Obs.	274	295

Notes: The table presents probit estimates of the probability that weights be below their (non zero) efficient level, as depending on the effective median age, financial independence, assets and sales and of the representative firm. All estimates include state effects, and are corrected for Huber-White heteroscedasticity. Standard errors are reported between parentheses. *** (**, *) denote significance at the 1% (5%, 10%) confidence level.

Table 9A: Cross-section of sectoral returns and volatility.

	Returns	Volatility
Age	-0.0128^{***} (0.0013)	0.0068^{**} (0.0027)
Unconstrained	-0.0045^{***} (0.0011)	0.0140^{***} (0.0024)
Sales	-0.0063^{***} (0.0012)	-0.0128^{***} (0.0026)
Assets	-0.0082^{***} (0.0010)	-0.0241^{***} (0.0027)
Obs.	897	897

Notes: Returns are the time-series average of sector specific growth rates for each State and Returns Volatility is measured as the time-series standard deviation of sector specific growth rates for each State. Each coefficient reported in the Table corresponds to an estimation including one regressor only, denoted by the variable name in the first column. All regressors are binary, and take value one for sectors whose average firm is older than the median across sectors (Age), is less dependent on external finance than the median (Unconstrained), has larger asset value than the median (Assets), or realizes more sales than the median (Sales). All regressions include state fixed effects, and are clustered by State. Standard errors are reported between parentheses. *** (**, *) denote significance at the 1% (5%, 10%) confidence level.

Table 9B: Probability that constrained sectors contribute increasingly to overall state growth.

	Inter	Intra
Age	0.3135^{**} (0.1591)	0.3268^{***} (0.1247)
Unconstrained	-0.0557 (0.1547)	-0.1607 (0.1124)
Sales	0.3851^{**} (0.1625)	0.4490^{***} (0.1287)
Assets	0.1404 (0.1633)	0.0661 (0.1224)
Obs.	1,224	1,224

Notes: The table presents results of a probit estimation that the contribution of constrained sectors to overall state growth increases with liberalization. The dependent variable is a binary variable, taking value one when the fraction of total state growth arising from constrained sectors is increasing over time. Constrained sectors are defined according to four criteria, pertaining to median firm age, median firm financial dependence, median firm assets and median firm sales. Only weights are allowed to change over time. All regressions include year effects. Standard errors are reported between parentheses. *** (**, *) denote significance at the 1% (5%, 10%) confidence level.

Table 10A: Summary of state characteristics for the ten states with highest convergence as measured by final/initial distance from frontier.

State	Firm Age	Firm Size	Initial Distance	Area
Delaware	6.09	28.22%	0.0354	1,954
Illinois	5.96	18.90%	0.0418	57,918
Dist. of Col.	3.08	13.07%	0.0117	68
New Jersey	5.81	25.20%	0.0247	8,722
Pennsylvania	6.04	20.86%	0.0276	46,058
Minnesota	5.83	24.49%	0.0473	86,943
South Dakota	5.37	34.96%	0.0461	77,121
North Dakota	5.35	33.77%	0.0810	70,704
Nebraska	5.43	27.15%	0.0550	77,358
Kansas	5.73	27.43%	0.0345	56,276
U.S. Average	5.64	27.19%	0.0371	74,253

Table 10B: Summary of state characteristics for the ten states with lowest convergence as measured by final/initial distance from frontier.

State	Firm Age	Firm Size	Initial Distance	Area
Alaska	5.81	25.62%	0.0269	52,243
Montana	5.67	39.97%	0.0268	147,046
Nevada	4.94	30.69%	0.0150	110,567
Idaho	5.97	37.73%	0.0343	83,574
Oregon	6.50	32.45%	0.0322	98,386
Hawaii	4.32	25.99%	0.0184	10,932
Vermont	5.84	35.22%	0.0383	9,615
Iowa	6.03	27.43%	0.0345	56,276
Indiana	6.42	21.63%	0.0413	36,420
Oklahoma	5.47	28.94%	0.0406	69,903
U.S. Average	5.64	27.19%	0.0371	74,253

Notes: States are selected on convergence as measured by final/initial distance as per Table 1. Firm Age is measured as the industry-weighted average firm age in 1977. Firm Size is the industry-weighted percentage of firms with less than twenty employees in 1977. Initial Distance is the distance to the efficient frontier in the return-standard deviation space measured in 1977. Area is the geographic state area, measured in square miles. The U.S. average of all characteristics is presented for reference.

Table 10C: Convergence properties of distance, volatility, growth and Sharpe ratio sorted by average firm age (by state).

	D_{t+1}			$w_{t+1}-w^*$	
	YOUNG	OLD		YOUNG	OLD
D_t	0.6373*** (0.0752)	0.5799*** (0.0847)	$w_t - w^*$	0.8436*** (0.0422)	0.9437*** (0.0120)
$LIB.D_t$	−0.2061*** (0.0404)	−0.0568** (0.0261)	$LIB.(w_t - w^*)$	−0.01056** (0.0041)	−0.0032*** (0.00113)
LIB	0.0084*** (0.0029)	0.00153* (0.00079)	LIB	$4.51e^{-6}$ ($7.62e^{-6}$)	0.00001 (0.82)
Obs.	598	575	Obs.	10,511	10,120

	$\sigma_{t+1}-\sigma^*$			$\mu_{t+1}-\mu^*$			$SR_{t+1}-SR^*$	
	YOUNG	OLD		YOUNG	OLD		YOUNG	OLD
$\sigma_t - \sigma^*$	0.7309*** (0.0247)	0.8571*** (0.0432)	$\mu_t - \mu^*$	0.6906*** (0.0795)	0.9049*** (0.0335)	$SR_t - SR^*$	0.7792*** (0.0573)	0.8298*** (0.0476)
$LIB.(\sigma_t - \sigma^*)$	−0.2203*** (0.0376)	0.0092 (0.0229)	$LIB.(\mu_t - \mu^*)$	−0.0173* (0.00926)	0.0142* (0.0070)	$LIB.(SR_t - SR^*)$	−0.0430*** (0.01322)	−0.01185 (0.0081)
LIB	0.00545** (0.00209)	−0.00001 (0.00022)	LIB	−0.00021* (0.00012)	0.00017 (0.00014)	LIB	−0.07944** (0.02878)	−0.02198 (0.0144)
Obs.	598	575	Obs.	598	575	Obs.	598	575

Notes: YOUNG and OLD represent sample splits based on whether firm age is below or above its median value across states. firm age is measured as the industry-weighted average firm age in 1977. All estimations include a state-specific intercept and year fixed effects. Standard errors are reported between parentheses. *** (**, *) denote significance at the 1% (5%, 10%) confidence level. Standard errors are clustered by state.

Table 10D: Convergence properties of distance, volatility, growth and Sharpe ratio sorted by firm size (by state).

	D_{t+1}			$w_{t+1} - w^*$	
	SMALL	LARGE		SMALL	LARGE
D_t	0.6548*** (0.0730)	0.5269*** (0.1117)	$w_t - w^*$	0.8379*** (0.0428)	0.9461*** (0.0107)
$LIB.D_t$	−0.2242*** (0.0412)	−0.0961*** (0.0230)	$LIB.(w_t - w^*)$	−0.0110** (0.0042)	−0.00300*** (0.00092)
LIB	0.00902*** (0.0029)	0.0031*** (0.0007)	LIB	$7.43e^{-6}$ ($7.63e^{-6}$)	$6.86e^{-6}$ (0.000014)
Obs.	598	575	Obs.	10,557	10,074

	$\sigma_{t+1} - \sigma^*$			$\mu_{t+1} - \mu^*$			$SR_{t+1} - SR^*$	
	SMALL	LARGE		SMALL	LARGE		SMALL	LARGE
$\sigma_t - \sigma^*$	0.7368*** (0.0243)	0.8381*** (0.0295)	$\mu_t - \mu^*$	0.7109*** (0.0701)	0.8880*** (0.0521)	$SR_t - SR^*$	0.7585*** (0.0584)	0.8517*** (0.0294)
$LIB.(\sigma_t - \sigma^*)$	−0.2165*** (0.0414)	−0.0134 (0.0348)	$LIB.(\mu_t - \mu^*)$	−0.00228 (0.0104)	0.01441* (0.0082)	$LIB.(SR_t - SR^*)$	−0.05115*** (0.0137)	−0.00741 (0.0068)
LIB	0.00490** (0.00216)	0.00049 (0.00050)	LIB	−0.00003 (0.00016)	0.00001 (0.0001)	LIB	−0.0855** (0.03101)	−0.0302* (0.0156)
Obs.	598	575	Obs.	598	575	Obs.	598	575

Notes: SMALL and LARGE represent sample splits based on whether the state's share of small firms is above or below its median value across states. Each state's share of small firms is measured by the 1977 share in overall employment of firms with fewer than 20 employees. All estimations include a state-specific intercept and year fixed effects. Standard errors are reported between parentheses. *** (**, *) denote significance at the 1% (5%, 10%) confidence level. Standard errors are clustered by state.

Table 10E: Convergence properties of distance, volatility, growth and Sharpe ratio sorted by initial distance from the efficient frontier.

	D_{t+1}			$w_{t+1} - w^*$	
	LOW	HIGH		LOW	HIGH
D_t	0.4587^{***} (0.0887)	0.6309^{***} (0.07967)	$w_t - w^*$	0.9391^{***} (0.0086)	0.8575^{***} (0.0447)
$LIB.D_t$	-0.0277 (0.0394)	-0.2199^{***} (0.0541)	$LIB.(w_t - w^*)$	-0.0037^{***} (0.00091)	-0.00923^{*} (0.00449)
LIB	0.0002 (0.0011)	0.0107^{***} (0.0038)	LIB	$6.57e^{-6}$ ($4.66e^{-6}$)	$1.83e^{-6}$ (0.00001)
Obs	575	598	Obs	9,982	10,649

Notes: LOW and HIGH represent sample splits based on whether the initial distance to the frontier is below or above its median value across states. All estimations include a state-specific intercept and year fixed effects. Standard errors are reported between parentheses. *** (**, *) denote significance at the 1% (5%, 10%) confidence level. Standard errors are clustered by state.

Table 10F: Convergence properties of distance, volatility, growth and Sharpe ratio sorted by state area.

	D_{t+1}			$w_{t+1} - w^*$	
	LARGE	SMALL		LARGE	SMALL
D_t	0.6365^{***} (0.0795)	0.6261^{***} (0.0670)	$w_t - w^*$	0.8370^{***} (0.0452)	0.9400^{***} (0.0123)
$LIB.D_t$	-0.2109^{***} (0.0493)	-0.1086^{**} (0.0393)	$LIB.(w_t - w^*)$	-0.00977^{**} (0.00443)	-0.00459^{***} (0.00123)
LIB	0.00910^{**} (0.0033)	0.0029^{**} (0.0020)	LIB	$3.29e^{-6}$ (0.00001)	$5.91e^{-6}$ ($6.70e^{-6}$)
Obs.	598	575	Obs.	10,649	9,982

Notes: LARGE and SMALL represent sample splits based on whether the state area is above or below the median state area respectively. All estimations include a state-specific intercept and year fixed effects. Standard errors are reported between parentheses. *** (**, *) denote significance at the 1% (5%, 10%) confidence level. Standard errors are clustered by state.

Table 11A: Alternative null hypotheses and aggregate weight convergence.

	Alternative Null Hypotheses		Aggregate Weight Convergence		
$w_{t+1} - w^*$	Equal Weights	Zero Covariance	1994	Weighted Average	Simple Average
$w_t - w^*$	0.9750*** (0.0031)	0.9757*** (0.0039)	0.9548*** (0.0132)	0.9514*** (0.0133)	0.9512*** (0.0134)
$LIB.(w_t - w^*)$	0.0016 (0.0037)	0.0003 (0.0077)	−0.00078 (0.00218)	−0.0025 (0.0019)	−0.0024 (0.00193)
LIB	$6.96e^{-6}$ (0.00001)	$9.30e^{-6}$ (0.00001)	$-4.66e^{-9}$ (0.0068)	$-1.32e^{-8}$ (0.00069)	$-1.24e^{-8}$ (0.00688)
Obs.	20,631	20,631	414	414	414

Notes: The first two columns present alternative null hypotheses for the efficient portfolio weights: Equal Weights represents efficient portfolio weights equal to 1/N and Zero Covariance represents the efficient portfolio weights where the non-diagonal terms are zero in the aggregate U.S. variance-covariance matrix. Columns three, four and five present convergence properties at the aggregate U.S. level for three different ways of computing the aggregate U.S. inter-state liberalization date. Regressions include year and industry effects (where appropriate), and standard errors are clustered by state. Standard errors are reported between parentheses. *** (**, *) denote significance at the 1% (5%, 10%) confidence level.

Table 11B: Dispersion of returns for an industry across states.

	1978	2000	Trend
Mean	8.14%	4.469%	−0.01350*** (0.00236)
Standard Deviation	4.91%	2.592%	
Obs.	18	18	414

Notes: We first report mean and standard deviation in returns dispersion. Column three reports the trend on a panel regression of sector-specific (log) dispersion measure allowing for industry specific intercepts. Standard errors are reported between parentheses. *** (**, *) denote significance at the 1% (5%, 10%) confidence level.

Table 11C: Bilateral distance between effective weights.

	Gap_t	Gap_t	Gap^*_t
Gap_{t-1}	0.8371*** (0.0031)	0.9855*** (0.00097)	
Gap^*_{t-1}			0.9969*** (0.0004)
$Cstt$	0.0644*** (0.00139)	0.00959*** (0.00085)	−0.0003 (0.00084)
Obs.	29,325	29,325	29,325

Notes: This Table estimates the auto-regressive properties of a measure capturing the total distance between two states' effective production allocation. For all pairs of states, $s \neq u$, we compute Gap= $\sum_i |w_{sit} - w_{uit}|$ at time t. All estimations include year effects. Column one only includes country-pair effects; Columns two and three investigate the significance of an intercept when country-pair gaps are calculated in deviation from the optimum, i.e. Gap*= $\sum_i |w_{sit} - w_{uit}| - \sum_i |w^*_{si} - w^*_{ui}|$. Standard errors are reported between parentheses. *** (**, *) denote significance at the 1% (5%, 10%) confidence level.

Table 12A: Robustness Test: Convergence properties of investment weights omitting Government, Health and Education (GHE) and Finance, Insurance and Real Estate (FIRE) sectors - Inter-state liberalization, 0% risk-free rate.

	GHE		FIRE	
$w_{t+1} - w_t$	All weights	Non-zero weights	All weights	Non-zero weights
$w_t - w^*$	0.8751^{***} (0.0359)	0.9234^{***} (0.0213)	0.8895^{***} (0.0310)	0.9290^{***} (0.0088)
$LIB.(w_t - w^*)$	-0.0095^{**} (0.0038)	-0.0109^{*} (0.0062)	-0.0099^{***} (0.0035)	-0.0040 (0.0025)
LIB	-0.0001 (0.0001)	0.0001 (0.0000)	$6.23e^{-08}$ ($6.65e^{-08}$)	$5.85e^{-08}$ ($7.12e^{-08}$)
Obs	17,135	7,452	19,458	8,027

Table 12B: Robustness Test: Convergence properties of investment weights with different risk free rates (RFR) - Inter-state liberalization.

	2% RFR		4% RFR		7% RFR	
$w_{t+1} - w_t$	All weights	Non-zero weights	All weights	Non-zero weights	All weights	Non-zero weights
$w_t - w^*$	0.8831^{***} (0.0312)	0.9299^{***} (0.0099)	0.8792^{***} (0.0317)	0.9184^{***} (0.0118)	0.8801^{***} (0.0310)	0.9007^{***} (0.0258)
$LIB.(w_t - w^*)$	-0.0083^{***} (0.0029)	-0.0030 (0.0024)	-0.0084^{***} (0.0027)	-0.0028 (0.0033)	-0.0061^{***} (0.0018)	-0.0110^{***} (0.0061)
LIB	0.0000 (0.00001)	-0.0000 (0.0000)	$2.24e^{-06}$ ($7.00e^{-06}$)	$8.10e^{-09}$ ($1.29e^{-08}$)	$2.62e^{-06}$ ($7.04e^{-06}$)	$-1.16e^{-08}$ ($2.51e^{-08}$)
Obs	19,481	7,107	20,631	6,555	20,631	4,255

Notes: In Tables 12A and 12B all estimations include a state and year fixed effect. Standard errors are reported between parentheses. *** (**, *) denote significance at the 1% (5%, 10%) confidence level. Standard errors are clustered by state. All results are for 18 sectors. In addition, we drop the "Agricultural Services" sector since weights sum to unity.

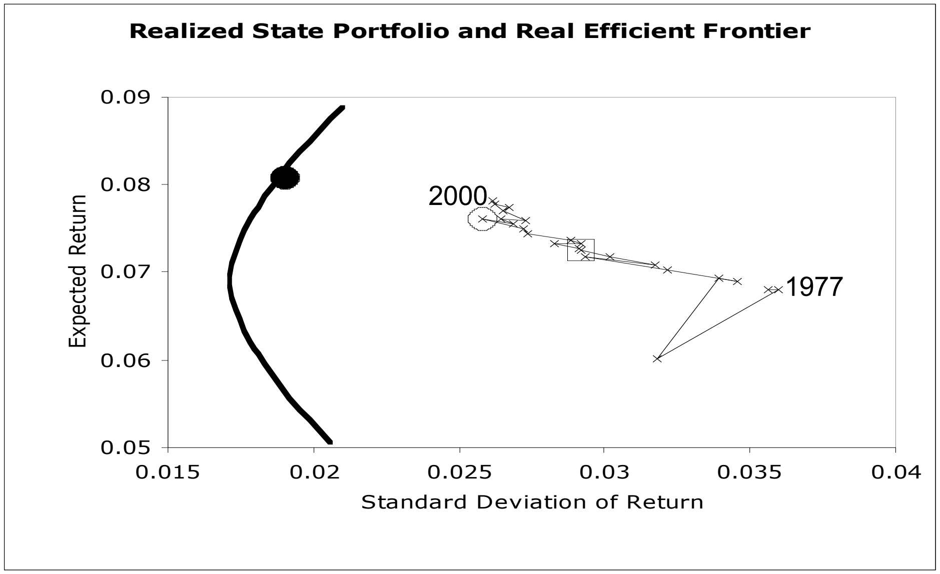
Table 12C: Robustness Test: GMM estimator of Euclidian distance and investment weights on industries - Inter-state liberalization, 0% risk-free rate.

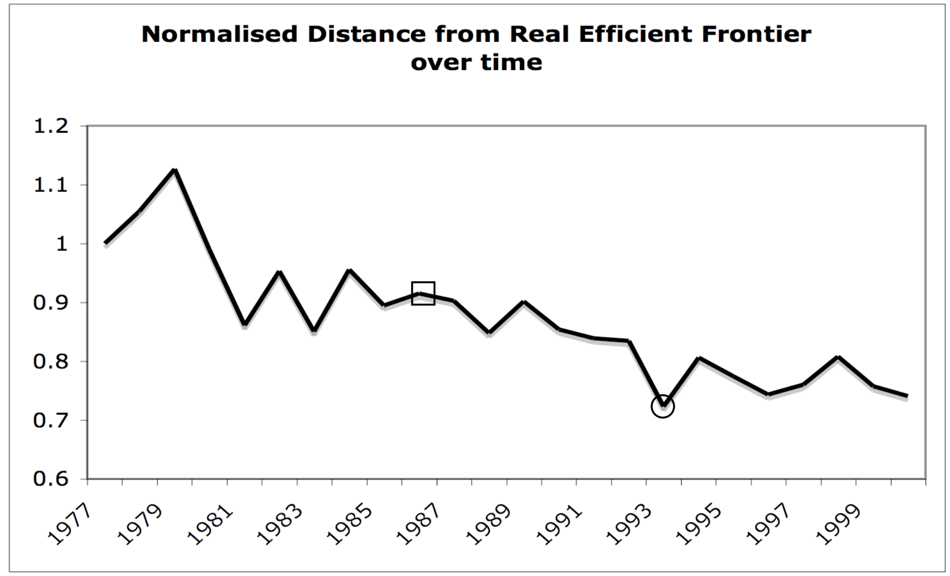
	D_{t+1}		$w_{t+1} - w^*$	
			All weights	Non-zero weights
D_t	0.6177^{***} (0.0282)	$w_t - w^*$	0.8037^{***} (0.0014)	0.9274^{***} (0.0012)
$LIB\ .\ D_t$	-0.2232^{***} (0.0207)	$LIB.(w_t - w^*)$	-0.0163^{***} (0.0006)	-0.0080^{***} (0.0003)
LIB	0.0089^{***} (0.0011)	LIB	-0.0001 (0.0000)	-0.0000 (0.0001)
Obs	1,122	Obs.	18,634	7,282
$p - value$	0.769		0.220	0.290

Notes: Estimations for Euclidean distance include a state-effect whilst estimations for investment weights include state-industry specific intercepts. Year fixed effects are included everywhere. Standard errors are reported between parentheses. *** (**, *) denote significance at the 1% (5%, 10%) confidence level. Estimates in Table 12C correspond to the two-step Arellano Bond GMM estimator. The reported standard errors correspond to a test that second-order serial autocorrelation is absent from the data. All results are for 18 sectors. We drop the "Agricultural Services" sector since weights sum to unity.

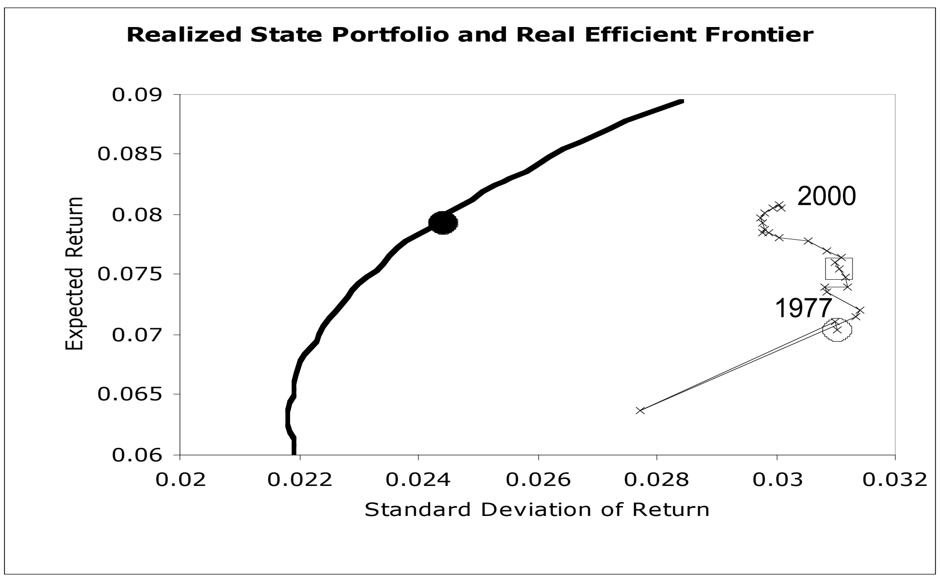
Figure 1A. Convergence properties of distance to frontier for two fast-converging states

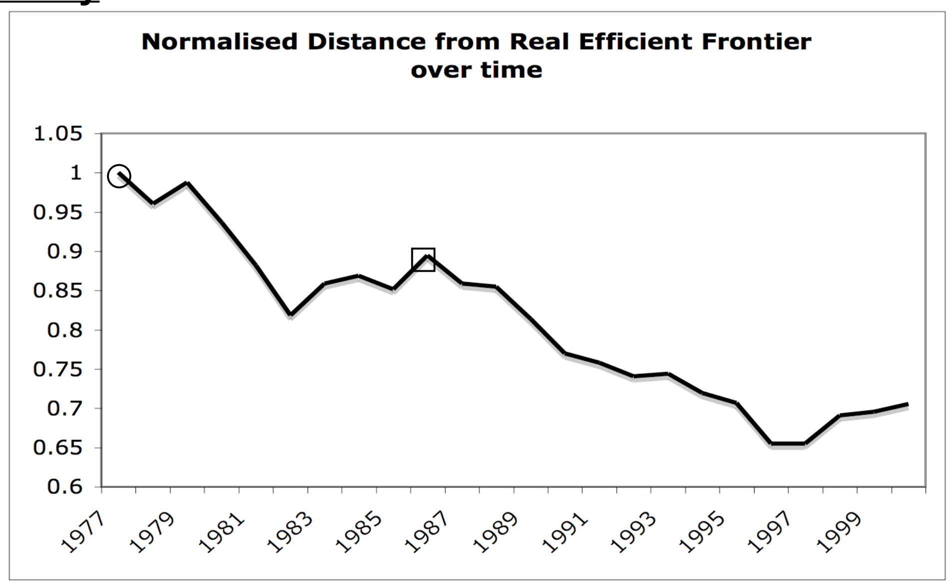
Minnesota





New Jersey





Key ○ Intrastate Liberalization □ Interstate Liberalization

Figure 1B. Convergence properties of distance to frontier for two slow-converging states

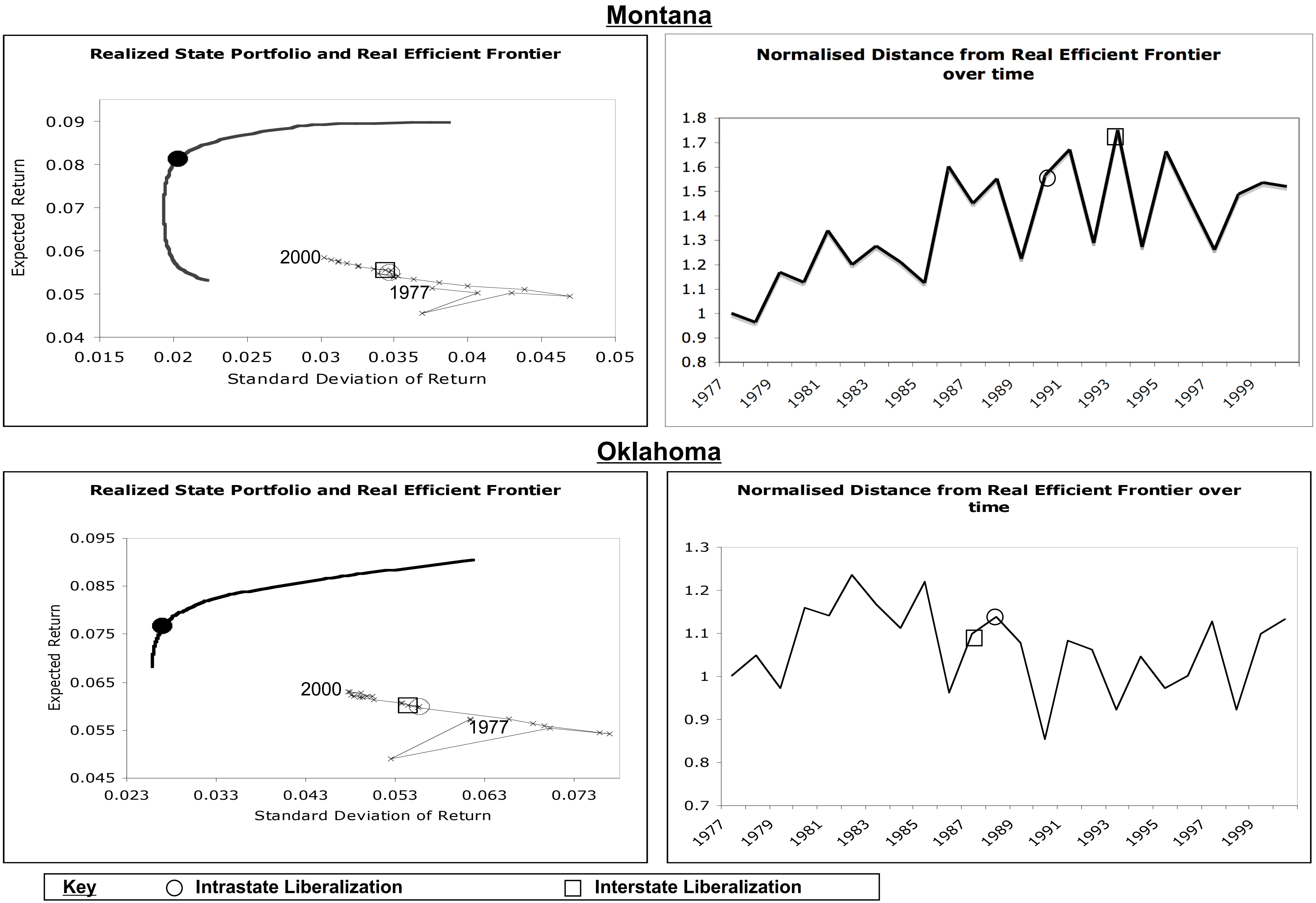


Figure 2. Time-series of cross-sectional correlation of realized to optimal returns, volatility, Sharpe Ratio and industry weights.

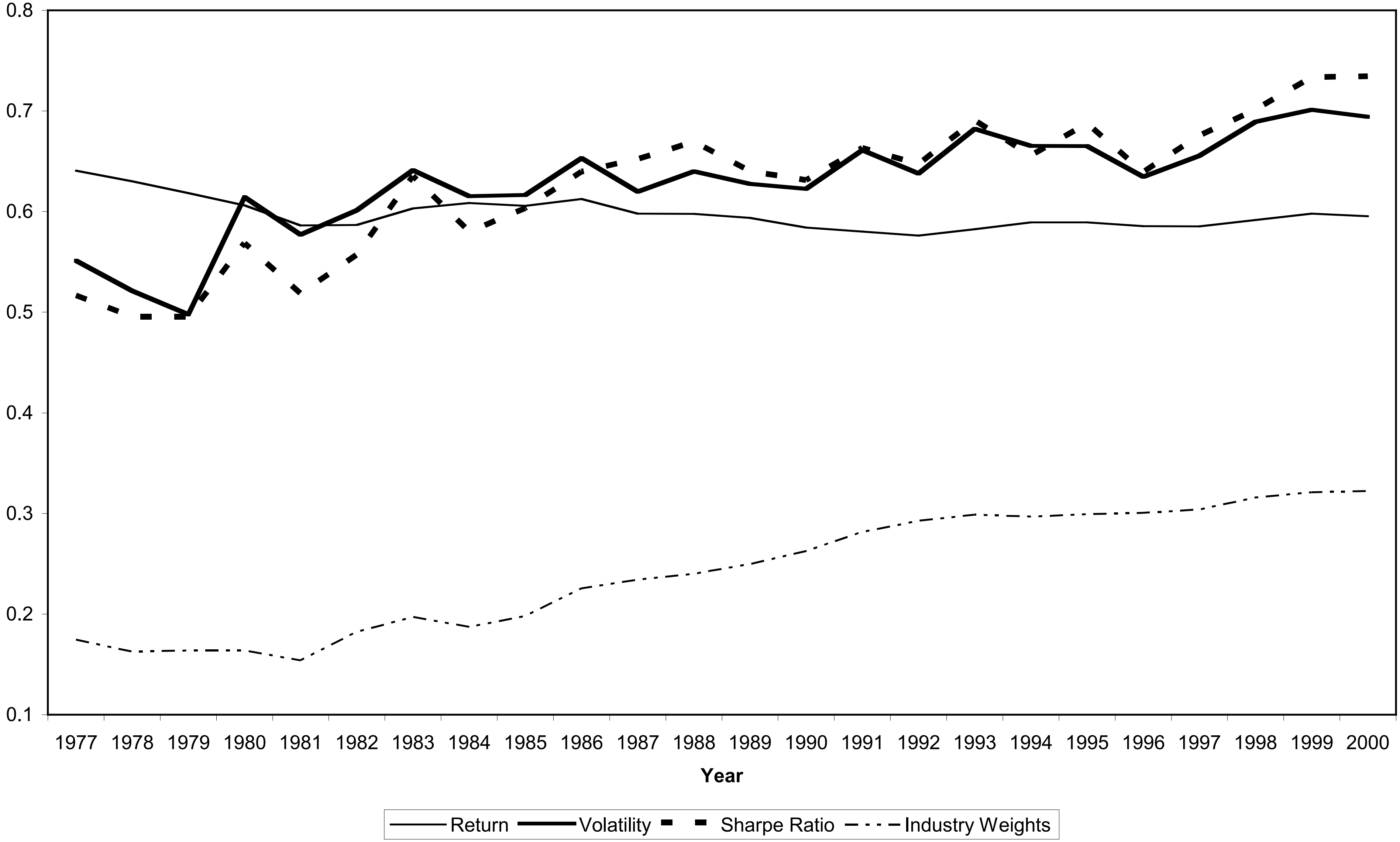


Figure 3a: Years Since Liberalization and Initial Distance

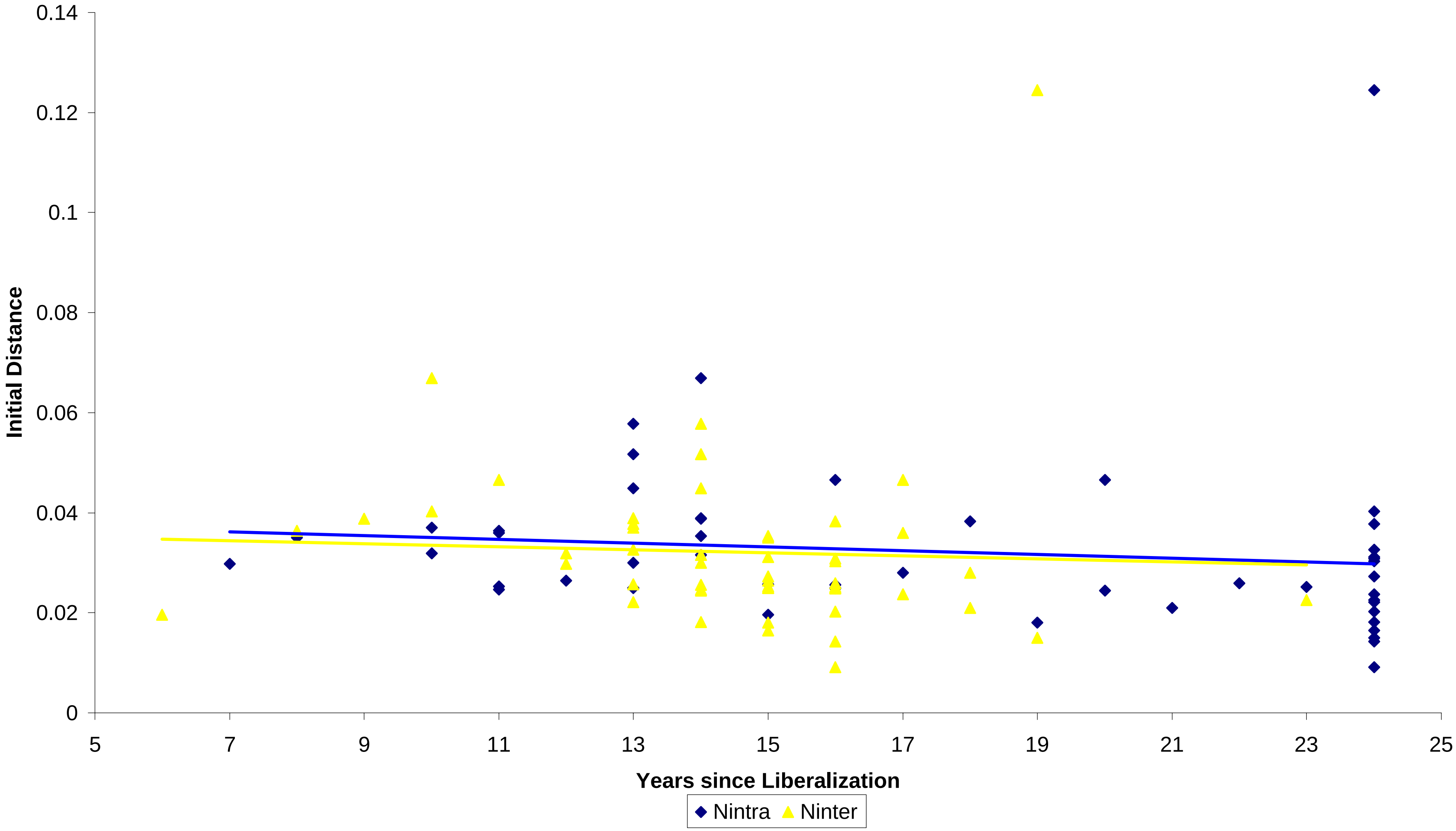


Figure 3b: Years since Liberalization and Initial Distance from Optimal Sharpe Ratio

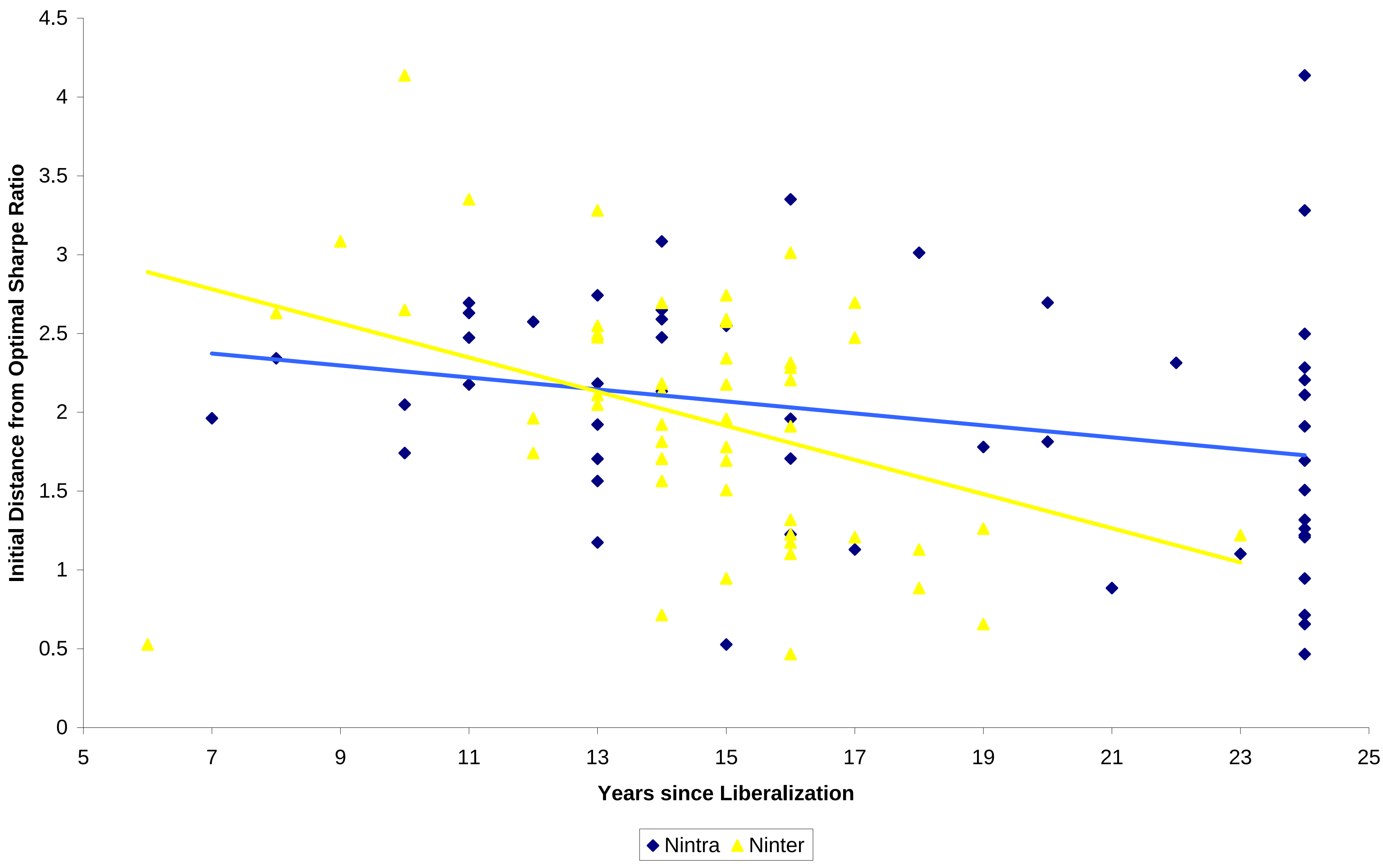


Figure 3c: Inter-state Capital Flow and Initial Distance

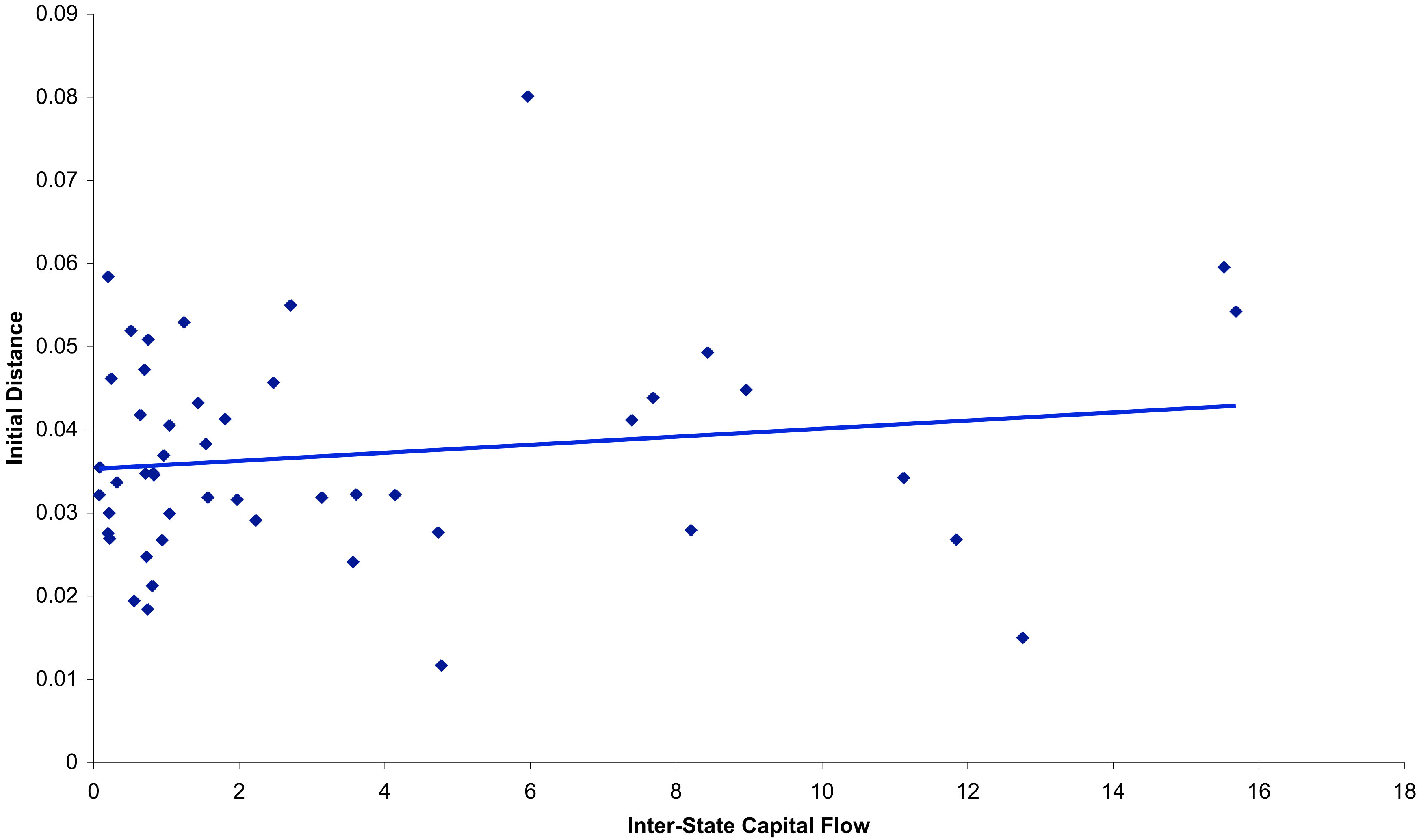


Figure 3d: Inter-state Capital Flow and Initial Distance from Optimal Sharpe Ratio