Financial Markets, Diversification, and Allocative Efficiency: International Evidence*

Simone Manganelli
European Central Bank

Alexander Popov†
European Central Bank

February 2010

Abstract

We study the effect of financial markets on "optimal" diversification defined as a pattern of output reallocation across industrial sectors which simultaneously accounts for the sectors' growth, volatility, and correlations. Our findings imply that financial markets increase substantially the speed with which the observed sectoral allocation of output converges towards the benchmark optimally diversified one. This convergence is relatively faster for sectors that have a higher "natural" long-term risk-adjusted growth and are more dependent on external finance. We also find that optimal diversification is associated with lower downside risk. Our results are robust to different benchmarks, to the endogeneity of finance, and to accounting for investor's protection, contract enforcement, and barriers to entry. Crucially, the observed patterns disappear when we employ a mechanical measure of diversification.

JEL classification: E32, E44, G11, O16

Keywords: Financial development, Growth, Volatility, Diversification, Mean-variance efficiency, Downside risk

*We thank Luc Laeven for sharing with us a variety of data. We thank Geert Bekaert, Enrica Detragiache, Gabriel Fagan, John Fernald, Philipp Hartmann, Jean Imbs, Urban Jermann, Sebnem Kalemli-Ozcan, Dirk Krueger, Leslie Lipschitz, Florencio Lopez-de-Silanes, Sergio Rebelo, and Peter Tufano, as well as seminar participants at the European Central Bank, the IMF, and the ECB-ECFIN workshop "The Crisis: Impact So Far and Possible Lessons" for useful comments as this project was taking shape. The opinions expressed herein are those of the authors and do not necessarily reflect those of the ECB or the Eurosystem.

†Corresponding author. European Central Bank, Financial Research Division, Kaiserstrasse 29, D-60311 Frankfurt, email: Alexander.Popov@ecb.int

1 Introduction

The evolution of diversification over the development cycle has spurred great interest in the economic profession in recent years. In general, diversification is expected to increase in the early stages of development as countries move away from safe technologies and the early exploitation of their natural resources (Acemoglu and Zilibotti (1997)). Sectoral specialization is expected to increase in later stages of the development path as a natural consequence of pecuaniary externalities and costly trade (Krugman (1991), Imbs and Wacziarg (2003)), although insufficient risk-sharing may be limiting that process (Kalemli-Ozcan, Sorensen, and Yosha (2003)). However, economists have so far neglected the role of finance in that process. In particular, how does financial market development affect countries' diversification patterns? Does finance simply work into the direction of spreading output across sectors, regardless of growth differentials? Does it rather pool resources towards fast-growing sectors, ignoring risk? Or do financial markets rather exploit investment opportunities with an eye on the interplay between various sectors' long-run growth opportunities and volatility patterns? Bringing evidence to bear on these important mechanisms is the task undertaken in the present paper.

To that end, we proceed by first defining "optimal" diversification in the sense of allocative efficiency rather than the mechanical spreading of economic activity across industrial sectors, and then linking it empirically to finance. While financial development has been shown to lead to a more efficient use of resources through sectoral reallocation from "dying" to "booming" sectors (Wurgler (2000)), a complete picture of allocative efficiency should have a diversification side to it, namely, it should take into account both sectoral growth and volatility, as well as inter-sectoral correlations. For example, financial markets are expected to help economies insure away idionsyncratic risk and exploit better their productive opportunities, regardless of whether these arise from natural resources, investment in human capital, or the advent of new technologies. Consider now a representative investor who is embarking on such strategy regarding the whole economy; institutional investors like pension funds or mutual funds would be good examples. The optimal diversification objective would then imply not simply that investment is reallocated towards fast-growing sectors, or simply spread across sectors to diminish risk, but rather that it is allocated towards sectors whose own volatility and growth correlations with the other sectors decrease the economy's overall volatility for a given level of growth.

We adopt a simple empirical strategy borrowed from mean-variance portfolio theory. For a set of 28 OECD countries observed between 1970 and 2007, we first define our measure of optimal diversification as the set of optimal allocations of output across industrial sectors which minimize long-term sectoral volatility for a given level of sectoral returns, taking into account the correlations of long-term growth across industrial sectors.[1] This definition differs from the ones used by, for example, Imbs and Wacziarg (2003) and Kalemli-Ozcan, Sorensen, and Yosha (2003) who define diversification and specialization as mechanical measures of the relative sizes of industrial sectors. We then check whether better deeper financial markets - in particular, credit markets - are associated with lower distance to that allocation efficiency benchmark. To mitigate concerns that countries will naturally converge to this bencmark allocation efficiency as high-growth sectors become larger, we define the distance between actual and "optimal" diversification as the reduction of volatility necessary to move from the observed to the benchmark allocation, keeping the rate of growth constant. We guard against possible endogeneity bias by making sure that the observed relationship is not due to more "optimally" diversified economies developing larger financial sectors. We also account for the fact that the degree of financial market development may be accompanied by similar legal and regulatory developments aimed at sustaining an optimally diversified economy, thus confounding identification. Finally, we also check whether the observed degree of optimal diversification is associated with more downside risk to the economy, and whether finance decreases that risk by improving overall allocative efficiency.

We first find that financial deepening accelerates the speed with which the actual output allo-

[1] See Acharya et al. (2007) for an application of this framework to the effect of U.S. bank branching deregulation on efficiency. Because of the dimensional constraints imposed by the calculation of the mean-variance efficient frontier over as much as 38 years of data, we work with the 9 SIC 1-digit industries and 20 OECD 2-digit industries rather than the 73 SIC 2-digit industries. See Appendices A and B for details.

cation converges to the benchmark one. Numerically, a two-standard deviation increase in financial development results in a speed of convergence to the benchmark allocation higher by about 4% annually. As in Acharya et al. (2007), our calculations imply that a number of sectors have very small optimal weights, close to zero. This doesn't necessarily imply that they have low long-term growth, but also that they may have high long-term volatility or are highly correlated.[2]

Second, we find that while financial markets affect the speed with which economies converge to our measure of "optimal" diversification, they have no effect on a set of measures that define diversification in a purely mechanical way. This finding illustrates one important point: financial markets allocate resources not just to fast-growing sectors, but they also take into account industrial sectors' intrinsic volatility, as well as the cross-correlations between sectoral returns. Imbs and Wacziarg's (2003) "U-shaped" diversification pattern comes to mind: countries first specialize in activities which constitute their comparative advantage, then diversify away from those and towards a larger set of high-growth high-risk opportunities, and finally returns to sectoral specialization in order to exploit pecuniary externalities and economies of scale. Our finding that financial development does not increase mechanical diversification, but rather improves the allocation of resources towards sectors with high risk-adjusted growth, is an indirect confirmation of their finading, and an illustration of one channel of the relationship between development and diversification

We also ask, via which industry-specific channels does finance exert its effect on optimal diversification? In the spirit of Rajan and Zingales (1998), we find that finance disproportionately affects convergence to the benchmark for sectors that naturally have a higher share of small firms and higher long-run risk-adjusted growth. To the degree to which the share of young, small, and informationally opaque firms is a proxy for external financial dependence, the result is in line with previous findings in the literature. As for the sectors with the naturally highest Sharpe ratios, they are associated with booming industries like health, education, business services, financial services, and communications. Among the sectors with the lowest Sharpe ratio are agriculture and manufac-

[2] However, sector 1 (Agriculture, hunting, forestry, and fishing) indeed has a negative long-term average growth rate of -0.014 in the sample.

turing, so our cross-country analysis implies that those two sectors are initially too large given their "optimal" share. The fact helps illustrate the way we think of "optimality": while agriculture and manufacturing are essential sectors, and their optimal weight is hardly zero, given their long-term growth, volatility, and correlations with the returns in other sectors, a large share of those two implies a sub-optimally diversified economy.

Finally, we find that higher allocative efficiency translates into a lower probability of country- and industry-level recessions. Taken together with our previous findings, this last piece of evidence implies that financial markets indirectly decrease downside risk through the reallocation of resources towards lower overall volatility.

We address a number of issues along the way regarding the robustness of our findings. First, our results might be capturing the demand-driven move towards activities like health, education, and government services, which are by nature less volatile than manufacturing or agriculture. In that regard, an estimate of a positive effect of finance on convergence to frontier might be biased by a preference-driven global move away from volatility. We employ a panel specification which allows us to net out that effect with global or country-specific time trends, and so in the end we indeed only measure the contribution of the time-varying country-specific component of finance to convergence. Second, our results might be biased by left-out variables bias and reverse causality. For example, unobserved entrepreneurial culture might be driving both optimal allocation and financial development. Or, a more efficient economy might be requiring a broader and more efficient financial services sector. We address both concerns by employing a Rajan and Zingales-type cross-country cross-industry regression in which we include country and industry fixed effects. These fixed effects control for any potential feedback from the level of diversification to finance, as well as for the effect of omitted variables that affect diversification and vary by countries and industries. In some specifications, we also include country-industry dummy interactions, to sweep away the effect of time-invariant unobservables that vary by *both* country and industry. We also replace our volume measures of finance with data on liberalization events in credit markets. This *de jure* measure is largely exogenous and should additionally address concerns about the endogeneity of financial development. To correct for the possibility that convergence is mainly driven by institutional factors, we allow our empirical procedure to account for the main legal and regulatory characteristics of the environment that might be correlated with financial development and thus bias our estimates. Finally, we address concerns that our benchmark allocation may be contaminated by financial underdevelopment resulting in artificially low initial growth and high initial overall volatility. Our main findings remain robust to all these alternative specifications.

The rest of the paper is structured in the following way. Section 2 discusses the related literature on the links within financial markets, growth, volatility, and efficiency. Section 3 describes the construction of the allocative efficiency benchmark, our empirical methodology, and the data. Section 4 presents the empirical results and also discusses endogeneity and robustness. Section 5 concludes with a discussion of the main results and the future extensions of the paper.

2 Related literature

Our paper relates to several branches of literature which have studied different aspects of the link between financial markets and allocative efficiency. For a start, a growing body of literature has studied the link between economic growth and volatility of growth. From a theoretical point of view, the link is ambiguous: for example, endogenous growth is affected by business cycle volatility negatively in the presence of diminishing returns to investment, and positively in the presence of precautionary savings, creative destruction, liquidity constraints, or high-return high-risk technologies[3]. When testing these predictions, researchers have found that growth and volatility tend to relate negatively at the country level (for example, Ramey and Ramey (1995)), but positively at the industry level (for example, Imbs (2007)). This apparent contradiction is resolved by noticing that the positive correlation between risk and return at the industry level is masked by aggregation, as aggregation only captures the covariance between sectoral growth and the country-specific com-

[3] See Imbs (2007) for an exposition of these arguments

ponent of aggregate variance, but not the sector-specific component of volatility. This approach of distinguishing between the country-specific and sector-specific elements of volatility is shared, among others, by Koren and Terneyro (2007), who show that in large part the reduction of country-specific volatility over the development cycle is due to the reallocation of output to sectors with intrinsically lower volatility.

An even larger stream of literature has looked at the link between finance and growth, or finance and risk, both at the country and sector level. Various contributions to the literature spurred by King and Levine (1993) have looked at the effect of equity markets on growth (for example, Levine and Zervos (1998) and Beck and Levine (2004)), credit markets development and growth (for example, Rajan and Zingales (1998), Beck et al. (2000), Beck and Levine (2002), and Raddatz (2006)), or financial liberalization and growth (see, for example, Bekaert et al. (2005)). This literature has generally found that financial development has a positive effect on the level of growth, especially in industrial sectors that rely on external finance for technological reasons. In addition to the level effect, and more relevant to our work, some studies have looked at the impact of finance on growth via reallocation of output across industrial sectors (see, for example, Wurgler (2000)).[4]

The effect of finance on volatility has also been studied extensively (see, for example, Beck et al. (2006), Bekaert et al. (2006), and Larrain (2006)). The broad finding is that financial development and liberalization lower the volatility of output and consumption. This finding is theoretically motivated by, among others, Carranza and Galdon-Sanchez (2004) who show that in economies with imperfect credit markets, output volatility tends to be higher due to the effect of strategic complementarities in the production sector.

Several recent papers have aimed to study the link between finance, growth, and volatility. For example, Levchenko et al. (2009) show that financial liberalization increases both the growth

[4]The idea to link finance and growth in a causal way is usually attributed to Schumpeter (1912), with later contributions by Goldsmith (1969) and McKinnon (1973). For recent surveys, see Beck et al. (2001), Wachtel (2001), and Levine (2005).

and volatility of output at the industry level, and that this effect is driven by greater capital accumulation, greater employment, and higher firm entry. And Acharya et al. (2007) use a mean-variance efficiency framework in order to study the effect of bank branching deregulation on optimal reallocation of output across sectors. They find that deregulation broadly accelerates convergence to the mean-variance efficiency frontier. Our contributions relative to these studies is that we show how financial deepening affects sectoral growth and volatility patterns not individually, but by allocating investment across growth and risk patterns in an optimal portfolio sense, and that we study the international dimension of this phenomenon.

Finally, our paper relates to the literature which has looked at the effect of finance on downturns, with mixed results. For example, Raddatz (2006) finds that credit markets development decreases the severity of industry-level recessions in sectors with high natural liquidity needs. Easterly et al. (2002) use a country panel data analysis and find the opposite result, namely, that finance has a marginally positive effect on the probability of recessions. However, Acemoglu et al. (2003) find that the effect of finance on downturns disappears once institutional factors are controlled for.

3 Methodology and data

3.1 Constructing an allocation efficiency benchmark

While there is a variety of possible benchmarks for optimal diversification (see, for example, Kalemli-Ozcan, Sorensen, and Yosha (2003) and Imbs and Wacziarg (2003)), we focus on the concept of allocative efficiency. The idea is the following. A country's GDP is made up of the contributions of its industrial sectors. A country's expected growth and volatility is therefore determined by:

1) its sectors' growth, volatility and correlations;

2) its sectoral composition.

Thinking of a country's growth rate as the return on a portfolio, and its sectors as individual assets in that portfolio, we can construct Markowitz (1952) mean-variance efficient frontiers and compare them across countries.

Let $y_{c,s,t}$ be the rate of growth of sector s in country c at time t, and $w_{c,s,t}$ the corresponding weight. By construction, it must be that $\sum_{s=1}^{S} w_{c,s,t} = 1$ for all c and t, where S denotes the number of sectors. Each country's rate of growth $y_{c,t}$ can therefore be rewritten as:

$$y_{c,t} = \sum_{s=1}^{S} w_{c,s,t} y_{c,s,t} \tag{1}$$

Assuming that investors, citizens, governments have preferences over growth and volatility, it is possible to find the optimal industrial weights, which maximize a utility function which is increasing in return and decreasing in risk, in the same way an investor wishes to determine the utility maximizing portfolio from a given set of assets. Assuming a quadratic utility over growth and volatility, we can estimate expected utility as

$$\hat{U}_c(\mathbf{w}_c) = \hat{E}(\mathbf{w}_c' \mathbf{y}_{c,t}) - \lambda_c \hat{V}(\mathbf{w}_c' \mathbf{y}_{c,t}) \tag{2}$$

where λ_c is the risk aversion coefficient, $\hat{E}$ and $\hat{V}$ denote the estimated expected value and variance, and we formatted vectors in boldface. For a given level of risk aversion, the optimal trade-off between growth and volatility is given by the solution to the following constrained optimization problem:

$$\left\| \begin{array}{ll} \max_{\mathbf{w}_c} \hat{U}_c(\mathbf{w}_c) & \\ s.t. & \mathbf{w}_c \geq 0 \\ & \sum_{s=1}^{S} w_{c,s} = 1 \end{array} \right. \tag{3}$$

The non-negativity constraint reflects the fact that in this context it is not economically meaningful to have negative weights for the industrial composition. The solution of such a problem requires the knowledge of the coefficient of risk aversion. As this is unknown, we modify the optimization problem as follows:

$$
\left\|
\begin{array}{ll}
\min_{\mathbf{w}_{c,t}} \hat{V}(\mathbf{w}'_{c,t}\mathbf{y}_{c,t}) & \\
s.t. \quad \mathbf{w}'_{c,t}\hat{E}(\mathbf{y}_{c,t}) \geq \tilde{\mathbf{w}}'_{c,t}\hat{E}(\mathbf{y}_{c,t}) & \\
\qquad \mathbf{w}_{c,t} \geq 0 & \\
\qquad \sum_{s=1}^{S} w_{c,s,t} = 1 &
\end{array}
\right. \tag{4}
$$

where we denote with $\tilde{\mathbf{w}}_{c,t}$ the vector of observed weights for country c at time t. That is, we choose the point on the frontier which minimizes the country's output variance for the realized level of growth. The distance between such a point and the actual levels of volatility can be interpreted as a measure of allocative efficiency, because it measures by how much a country could have reduced its macroeconomic volatility, while achieving the same level of growth, by simply allocating differently its resources across sectors.

Denoting the vector solution to this problem by $\mathbf{w}^*_{c,t}$, and by $w^*_{c,s,t}$ the individual elements of this vector, we can construct the following measures of country's allocative efficiency:

$$
\begin{aligned}
D_{c,t} &= \sqrt{\sum_{s=1}^{S} \left(\mathbf{w}^*_{c,s,t} - \tilde{\mathbf{w}}_{c,s,t}\right)^2} = \left\|\mathbf{w}^*_{c,t} - \tilde{\mathbf{w}}_{c,t}\right\| \\
D_{c,s,t} &= |w^*_{c,s,t} - \tilde{w}_{c,s,t}|
\end{aligned} \tag{5}
$$

where $\tilde{\mathbf{w}}_{c,t}$ is the observed vector of actual allocations, and $\tilde{w}_{c,s,t}$ denotes its individual elements. Therefore, $D_{c,t}$ is the Euclidean distance between the optimal and actual vectors of weights, $\mathbf{w}^*_{c,t}$ and $\tilde{\mathbf{w}}_{c,t}$, while $D_{c,s,t}$ is the distance between each component of those same vectors. We will interchangeably refer to both distances as distance to allocative efficiency frontier, or distance to an optimal diversification benchmark.

Figure 1 gives an idea of the evolution of our measure of distance to frontier over time for a set of chosen countries. It illustrates an important quality of convergence to a so-chosen allocative efficiency benchmark: countries naturally converge in the growth dimension as fast-growing sector become larger over time. To avoid the possibility that we are simply capturing a mechanical property, we measure the difference between efficient and actual allocation as distance in the dimension of volatility.

3.2 Empirical methodology

Our first convergence test estimates the degree to which distance for country c converges to the allocative efficiency frontier following higher financial development. We estimate the convergence equation

$$D_{c,t} = \alpha D_{c,t-1} + \beta D_{c,t-1} \cdot Finance_{c,t} + \gamma Finance_{c,t} + \delta_c + \eta_t + \varepsilon_{c,t} \quad (6)$$

where $Finance_{c,t}$ is equal to a standard measure of financial market development, and $D_{c,t}$ is defined in Equation (5) above. Our coefficient of interest is β: if $\beta < 0$, then greater financial development (liberalization) is associated with faster convergence to allocative efficiency.[5] The inclusion of country and year fixed effects allow us to purge our estimates from the the effect of unobservable global trends (like the "Great Moderation") and unobservable institutional influences, and isolate the within-country effect of financial development. Figure 2 gives an illustration of how the reduction in average distance to frontier relates to finance in the group of countries in our data.[6]

Next, we perform the same test on the country-sector level disaggregated data, and define $D_{c,s,t}$ as in Equation (5) above. This allows us to directly look into the issue of reallocation and examine which sectors move faster to their implied optimal weight following financial development/integration. Formally, we estimate the convergence equation

[5] As pointed out by Acharya et al. (2007), the frontier is estimated with an error, and hence there is an attenuation bias in estimating convergence. This works against finding an effect and hence what we see in the data should be interpreted as a lower bound for the true effect.

[6] It's important to note that equation (6) can be rewritten as

$$D_{c,t} = \alpha D_{c,t-1} + (\beta D_{c,t-1} + \gamma) \cdot Finance_{c,t} + \delta_c + \eta_t + \varepsilon_{c,t}$$

and so the full effect of finance on distance to the allocative efficiency frontier is given by $\beta D_{c,t-1} + \gamma$. For example, if both β and γ are negative, then more finance decreses distance to frontier, but if $\beta < 0$ and $\gamma > 0$, then the total effect of finance depends on $D_{c,t-1}$, and for low levels of $D_{c,t-1}$, finance could lead to divergence even if $\beta < 0$. However, for the sample mean value of private credit, the distance beyond which more finance leads to divergence is 0.0024 in the MVE metric, a value attained by 1.7% of the country-sector-time observations in our sample.

$$D_{c,s,t} = \alpha D_{c,s,t-1} + \beta D_{c,s,t-1} \cdot Finance_{c,t} + \gamma Finance_{c,t} + \delta_c \cdot \phi_s + \eta_t + \varepsilon_{c,s,t} \tag{7}$$

As in the previous specification, the inclusion of country, sector, and year fixed effects allow us to purge our estimates from the effect of unobservable global trends (like the "Great Moderation") and unobservable industry and institutional influences, and isolate the within-country-by-sector effect of financial development. Equation (7) estimates whether financial development/integration accelerates the reallocation across sectors within a country in the direction of the implied optimal sectoral shares in this country. In comparison, while equation (6) is a test of convergence of country-level aggregates towards the optimal diversification benchmark, equation (7) estimates reallocation across sectors in the direction of the optimal weights.

We next proceed to estimate the effect of finance on downside risk and economic downturns. While we would ideally like to separate the direct effect of finance on the business cycle from its effect via the channel of optimal diversification, we opt for a simpler test which circumvents tricky econometric questions. In particular, we simply estimate the conditional probability of a 1-year negative value added growth, at the country or sector level, as a function of distance to allocative efficiency frontier:

$$\begin{aligned} q_{c,t} &= \Phi(\alpha D_{c,t-1} + \beta D_{c,t-1} \cdot Finance_{c,t} + \gamma Finance_{c,t} + \delta_c + \eta_t + \varepsilon_{c,t}) \\ q_{c,s,t} &= \Phi(\alpha D_{c,s,t-1} + \beta D_{c,s,t-1} \cdot Finance_{c,t} + \gamma Finance_{c,s,t} + \delta_c \cdot \phi_s + \eta_t + \varepsilon_{c,s,t}) \end{aligned} \tag{8}$$

where $q_{c,t} = \Pr ob(y_{c,t} < 0)$ and $q_{c,s,t} = \Pr ob(y_{c,s,t} < 0)$, $y_{c,t}$ and $y_{c,s,t}$ being the growth rate of country c at time t, or of industry s in country c at time t, respectively. $D_{c,t}$ and $D_{c,s,t}$ are calculated as in equation (5). If indeed we have already established that finance increases the speed of convergence to the efficiency frontier, $\alpha > 0$ would imply that finance decreases the probability of recessions via the channel of optimal diversification, and $\beta > 0$ would imply that for the same distance to frontier, further financial development increases the risk of recessions. Together $\alpha > 0$ and $\beta > 0$ would imply that the effect of financial development on downside risk is ambiguous.

Finally, we address the issue of the endogeneity of financial development/integration in two alternative ways. First, we replace our volume measures of finance with dummies equal to 1 after the year in which domestic financial markets were liberalized. It is commonly believed that policy decisions are more exogenous than volume measures of finance. Second, we employ the Rajan and Zingales (1998) method of interacting our measure of finance with a measure of each sector's natural characteristic, in this case, long-term industry-level benchmark Sharpe ratio, and benchmark share of small/young firms. By identifying one channel via which finance should speed convergence - that is, more so for sectors which naturally offer lower risk for the same level of return, and which are naturally more credit-constrained - we aim to purge the bias in our estimates induced by simultaneity.

3.3 Data

Our main data - on nominal value added, which we deflate to get real values - comes from the STAN Database for Structural Analysis and covers 28 countries over the period 1970-2007[7]. The data is decomposed alternatively into 9 SIC 1-digit and 20 SIC 2-digit sectors. Further disaggregation is impossible because of the dimensionality problem in calculating our benchmark diversification measure, which requires that the number of years in the data more than neglibibly exceeds the number of sectors. While it would seem natural to focus on the finer disaggregation, as with 9 industries we lose substantial variation, focusing on SIC 1-digit industries as well makes sure that we don't include sectors with negligible output share in the calculation of the allocative efficiency frontier. It is also worth noting that if anything, aggregation into a set of so coarsely defined industrial sectors makes it harder rather than easier to detect an effect of finance on the reallocation of resources across economic activities.

[7] For 6 countries - Czech Republic, Germany, Hungary, Poland, Slovakia, and Switzerland - coverage only starts in the early 1990s - see Table 1 for details.

Two data clarifications are in order. First, disaggregated data tends to be arbitrary in the sense that some economic activities are classified more coarsely than others. If data on one type of economic activity is consistently collected in a more disaggregated fashion, convergence to allocative efficiency may emerge as a mechanical property of that process (Acharya et al. (2007)). We address this issue by employing data at different levels of disaggregation; however, given the dimensionality limitation imposed in calculating the mean-variance efficiency frontier, we resorted to using the data at the SIC 1-digit and OECD 2-digit aggregation. Second, while the UNIDO has been the preferred data in the finance and growth literature, it only includes data on the manufacturing sector, and so STAN is more suited to studying optimal reallocation in the context of the major shift during the sample period from manufacturing towards services, for example.

The financial variables used in this paper come from two different sources. The main measure of financial markets development is PRIVATE CREDIT / GDP. What goes into the numerator is the value of total credits by financial intermediaries to the private sector (lines 22d and 42d in the International Financial Statistics), and so this measure excludes credits issued by the central banks. The reason for this exclusion is that is that in many cases it is likely to be determined by political rather than economic considerations. It also excludes credit to the public sector and cross claims of one group of intermediaries on another. Finally, it counts credit from all financial institutions rather than only deposit money banks. The data on this variable comes from Beck et al. (2000, updated 2008) and is available for all 28 countries in the data set between 1970 and 2005.

In robustness checks we replace this measure with STOCK MARKET CAPITALIZATION/GDP and ACCOUNTING STANDARDS in order to shed light on the channels through which financial markets affect optimal diversification, especially the role of information and market structure. However, both measures are problematic. For most of the countries, the former is available only starting in the 1980s, which decreases substantially the time dimension of the data. Accounting standards, on the other hand, almost do not vary during the sample period. Hence, using both measures diminishes severely the effectiveness of the panel framework used in the paper. In addition, averaging the two measures over time and using them in a cross-country cross-industry empirical framework, like Rajan and Zingales (1998) and Raddatz (2006) do, would leave us with a severely crippled way of estimating changes in convergence speed over time. For all those reasons, we leave these results - which do not change our main findings - unreported.

While the main measure of domestic financial development considered in the paper is ubiquitous in empirical research, it is intrinsically likely to contain measurement error. For one, it is difficult to capture all aspects of financial development in one empirical proxy. Second, there are idiosyncratic differences across countries in the availability of unobservable sources of working capital, such as trade credit or family ownership. In addition to that, financial development measured in terms of volumes or shares of GDP is notoriously endogenous to unobservable characteristics of the business environment. To confront these issues, we replace our *de facto* measure of financial development with a *de jure* measure of it. Namely, we replace PRIVATE CREDIT / GDP with information on banking sector liberalization dates. This alternative indicator is constructed by assigning a value of 0 for the years in which the country's domestic credit market was not liberalized, and 1 for the years after it became liberalized. The indicator comes from Bekaert et al. (2005).

Finally, we use the data from the STAN Database for Structural Analysis to define recession episodes. Consistent with the well accepted taxonomy, we define recessions as negative-growth events, both at the country and industry level.

Table 1 summarizes the sectoral data, for both the SIC 1-digit and the OECD 2-digit classification used, along with initial date for which the sectoral data is available. Table 2 summarizes the data on both the *de facto* and the *de jure* measures of financial development.

4 Empirical results

4.1 Finance and distance to allocative efficiency frontier

The first empirical question addressed in this paper is whether finance accelerates the country's convergence to the allocative efficiency frontier implied by its sectoral long-term growth and volatility of growth. We study this effect in Panels A and B of Table 3. Column (1) reports the estimates of equation (6) on the full sample of countries and industries. The estimate of the direct auto-regressive coefficient on distance to frontier so defined, α, implies a yearly reduction of between 5% and 14% in our sample, contrasting somewhat with the 24% annual reduction measured by Acharya et al. (2007) in the sample of 50 U.S. states. Importantly, the effect of finance interacts negatively with distance as implied by the estimate of the coefficient β. Therefore, our estimates imply that financial development has a positive effect on the speed with which countries converge to their efficiency frontier. Numerically, a two-standard deviation increase in financial development results in a speed of convergence to the frontier by higher by about 4% annually. The magnitudes of the effect are roughly similar across 1-digit and 2-digit disaggregation of the data, and equally significant.

Next, we address the fact that data on sectoral value added is available for too few years for a number of countries, as indicated by Table 1. In particular, while in most cases the data starts in the 1970s and ideally in 1970, it only starts in 1990 for Switzerland, 1991 for Germany and Hungary, 1993 for the Czech Republic and Slovakia, and 1994 for Poland. This leaves us with a substantially lower number of observations to compute long-term growth and volatility of growth (12 in the case of Poland). In addition, the long-term mean-variance efficiency frontiers are now calculated for radically different time periods, namely, they are based only on the period of rapid post-communist growth in Hungary, but include the period of sluggish growth in 1970s Sweden. Of course, including pre-1989 data on the transitional economies would not make much sense given the meaninglessness of any measure of financial development from the times of central planning, and including pre-unification data on Germany would make equally little sense. Nevertheless, in order to address these concerns on the construction of the allocative efficiency frontier, in Column (2) we estimate equation (6) after dropping the 6 countries in question from the dataset. The results remain largely unchanged - private credit continues to accelerate the speed at which the economy converges to the our benchmark "optimal" diversification.

Another issue which must be addressed is the fact that the benchmark itself may have been affected by financial development. If finance affects both growth and volatility, as the literature on finance and growth has argued, then initial financial underdevelopment will result in artificially low early growth and high early volatility. Financial development (liberalization), therefore, will unconstrain growth and lower volatility, and that would effectively bias our efficient frontier. The solution is to calculate a "clean" frontier in which long-term growth and volatility have not been affected by finance mid-cycle. In Column (3) we do so by estimating equation (6) on a restricted sample of countries excluding those that liberalized domestic credit markets before the beginning of the sample period. In that way we make sure that we are measuring convergence to an allocative efficiency benchmark based on unconstrained long-term growth and volatility, and not to one contaminated by the initial underdevelopment of financial markets. The statistical significance of our estimates remains unchanged, and the economic meaning of the coefficients is marginally higher than in previous estimates.

We next use the disaggregated nature of our data to study the effect of finance on the difference between actual and optimal output shares for each country-sector. This procedure should give us a better idea of which sectors are primarily responsible for the speed of the convergence to a country-wide allocative efficiency frontier. For a start, we find that 6 sectors in the SIC 1-digit industrial classification account for 95% of the share in the "optimal" sectoral portfolio implied by long-term growth and volatility of growth. The remaining 3 sectors are Agriculture, hunting, forestry and fishing; Mining and quarrying; and Construction. The sectors with the biggest weight in the optimal portfolio are Community, social and personal services (32.3% in the SIC 1-digit case); Finance, insurance, real estate and business services (26.7% in the SIC 1-digit case); and Transport, storage and communication (14% in the SIC 1-digit case). The former two sectors of the last group also exhibit the biggest difference between actual and optimal share, 21.4% and 18.5% on average across countries and time, with their optimal share being higher than their actual one. On the other side of the spectrum, our estimates imply that on average, the actual share of manufacturing is higher than the optimal one by 14.5%. This suggests that in the sample of industrialized countries at least, there is "too much" manufacturing across the board given the optimal share of manufacturing implied by our benchmark calculations.

Panels C and D of Table 3 report the estimates of equation (7). We essentially repeat the same procedure from the country tests: in Column (1), we use the full sample of countries, in Column (2) we exclude countries for which data is available for too short a period only, and in Column (3) we exclude countries which liberalized domestic credit markets during the sample period. The regressions include time dummies to account for shifts associated with global unobservables, like the "Great moderation", for example, as well as country-industry interaction dummies. The effect of private credit on convergence survives the disaggregation. In this specification, we estimate that financial market development accelerates convergence to frontier by about 2% to 3% annually.

In Table 4 we repeat the empirical exercises from Table 3 using a GMM Arellano-Bond (1991) estimator rather than a OLS procedure. We do so in order to account for the presence of a lagged dependent variable in dynamic panel data. In unreported regressions, we also estimate the GMM estimator introduced by Blundell and Bond (1998) which corrects for the bias arising in fixed effects estimations in dynamic models. This correction is standard in panel estimation of the finance and growth nexus (see, for example, Acharia et al. (2007) and Bonfiglioli (2008)). Our results continue to hold.

In all, Tables 3 and 4 imply that part of the effect of finance is a re-structuring of output away from sectors with low optimal weight towards sectors with high optimal weight. This might be happening because these sectors have a negative long-term Sharpe ratio and so have to gradually disappear from an efficient portfolio. Hence, we partially capture the effect of finance on the natural disappearance of obsolete sectors. While in theory it could be that the total effect depends on initial condition, and so the overall effect of finance is confounded by a very inefficient initial sectoral allocation, limiting the effect of diversification as in Acemoglu and Zilibotti (1997), this is not confirmed in the data. However, the effect of finance could also be confounded by other political economy forces, for instance, large inefficient sectors might be using lobbying tools to acquire government resources and continue existing while their implied weight might be zero. We investigate this possibility later on.

It is important to point out that finance has a direct positive and statistically significant effect on the distance (for example, estimate of 0.003 in Column 1). This implies that close to the frontier, more finance is associated with a divergence rather than convergence to the frontier.[8]

4.2 The nature of reallocation and endogeneity issues

4.2.1 Which sectors converge faster?

We have so far established a positive correlation between financial development and convergence to an optimal diversification benchmark defined in the sense of allocative efficiency. However, the question of the causality between the two has been left largely unanswered. Given the evidence so far, the argument can still be made that financial development has simply increased in the wake of faster convergence to the allocative efficiency frontier, in itself driven by factors unobservable to the econometrician.

We now explicitly address this issue by employing the methodology first introduced by Rajan and Zingales (1998). They document the significance of the interaction term between a country-level characteristic of financial development and an industry-level characteristic of financial dependence. The innovation of the method is in that they use a U.S. benchmark to construct an exogenous

[8] However, that point is quite close to the frontier. For example, for the sample mean value of private credit, the distance beyond which more finance leads to divergence is 0.0024 in the MVE metric, a value attained by 1.7% of the country-sector-time observations in our sample.

measure of financial dependence in their sample of countries which excludes the U.S. This empirical strategy alleviates concerns about the endogeneity of financial development to anticipated growth. It also addresses questions about the joint determination of financial development and growth by a third, unobservable factor.

One natural channel via which finance is expected to exert a causal effect on convergence to frontier is the technological risk-adjusted growth of the sector. Movement towards the frontier is associated with an increase in the Sharpe ratio[9] of the portfolio via reduction of volatility for the same level of return, or alternatively, an increase in return for the same level of volatility. Hence, the effect of financial development on sectoral reallocation within the portfolio of industrial sectors should work most strongly on those sectors that exhibit the highest Sharpe ratio for technological reasons. For instance, if the communications sector offers the lowest volatility for the same return, then finance will be expected to reallocate resources towards that sector faster than for sectors with lower Sharpe ratio.[10]

Another natural channel exploited in related literature is a sector's natural dependence on external finance. If financial underdevelopment affects the allocation of output across business activities, that limitation will likely be most severe in sectors which naturally rely on external finance. Such sectors will likely have a high share of small as well as young firms (see, for instance, Aghion et al. (2007) and Acharya et al. (2007)). The share of small/young firms will therefore be a good proxy for the natural external finance need of the sector.

We investigate this channel in Table 5. Of course, using the sectors' country-specific Sharpe ratios and share of young/small firms would make the estimation prone to the same endogeneity concerns as before. For that reason, we follow Rajan and Zingales (1998) and compute the Sharpe ratio for each of the 9 SIC 1-digit sectors and 20 OECD 2-digit sectors in the U.S. Then, we interact the calculated value with the interaction term in equation (6), and exclude the U.S. from

[9] The Sharpe ratio is defined as the sector's long-term growth divided by the standard deviation of the sector's long-term growth.

[10] The idea is similar to Wurgler (2000). However, he looks at growth only and doesn't take into account the growth volatility of the sectors.

the regressions to follow. Finally, we follow Ciccone and Papaioanou (2006) and instrument the U.S. industry-level Sharpe ratio with the predicted sample one interacted with U.S. average financial development. This gives a measure of what the median sample risk-adjusted growth would be if it was observed in a country with the U.S. level of financial development. That allows us to address one of the main criticisms against the Rajan and Zingales methodology, namely that it uses a benchmark which is extracted from a specific industrial composition and thus is a noisy measure of "true" risk-adjusted growth. Notice also that the country-by-industry fixed effects eliminate the effect of the correlations across sectors. Regarding the share of young firms, we calculate it for each sector using data from the Dun and Bradstreet database, averaged for the 1985-1995 period, and again instrument it for with the sample measure of that share, using data from Amadeus, interacted with the U.S. measure of financial development.

The estimates, reported in Columns (1) and (2) of Table 5, confirm the effect that we already found in Table 4. Namely, financial development as proxied by PRIVATE CREDIT / GDP increases the speed at which sectors' shares converge to the benchmark ones implied by allocative efficiency, and this effect is stronger for sectors that naturally have higher Sharpe ratios. The exact same results are obtained when we differentiate by the share of young firms: sectors with a higher such share (presumably, sectors which are more credit constrained and which finance affects more strongly due to their natural need for external funds) see a faster reallocation following financial development. The results hold regardless of the degree of sectoral disaggregation.

It should be noted that each sector's benchmark Sharpe ratios are measured for the same time period as the sample countries' ones. This is contrary to Rajan and Zingales (1998) who average the US benchmark for the 1970s and 1980s and run their tests on the 1990s. The first reason for us doing so is that we want to calculate "natural" volatility over a relatively long period of time. The second reason is that we think of the US benchmark over the 1970-2007 period as a global ex-ante one given the technological opportunities of that sector. Then the question becomes, how does financial development (liberalization) affect sectoral reallocation given the *potential* performance of the countries' sectors.

Our empirical methodology so far has been very parsimonious: we have studied the effect of finance on the speed of convergence, accounting for natural convergence, global time trends, country-industry unobservables, and the sector's natural characteristics to address causality and omitted variable issues. In this section, we perform additional robustness checks addressing our method for constructing the allocative efficiency frontier, the sectors' optimal weights implied by the MVE procedure, the endogeneity of finance, and alternative characteristics of the business environment.

4.2.2 The endogeneity of finance

While the procedure described in the previuos sub-section is one way to account for the endogeneity of financial development, concerns still remain. In particular, our proxy of financial development can be related to optimal diversification in a reversed causal way, or both could be jointly determined by an unobservable characteristic of the business environment, like entrepreneurship or the propensity to invest. For that reason, in Column (3) of Table 5, we account for the endogeneity of finance in an alternative way. Namely, we replace our preferred measure of financial development with liberalization dates of domestic credit markets, as per Table 2. Although the argument has sometimes been made that liberalization may be endogenous as policy makers may be undertaking it at the times when the country is starting on the path of higher growth[11], it is certain that a policy measure is safely more exogenous to growth opportunities than the volumes measures we have used so far. Hence, we replace the financial proxy in equation (6) with a dummy equal to 0 if the country's banking sector, equity markets, and capital accounts (respectively) were not liberalized yet, and with 1 after the year in which they became liberalized. We continue to measure a positive effect of credit markets on the speed of convergence.[12]

[11] See Bekaert (2007) for details.

[12] This result is reminiscent of Bekaert and al. (2007) who find that an exogenous measure of growth opportunities predicts faster growth than the endogenous one.

One final issue with our tests so far is that the financial sector is included both in the left-hand side and the right-hand side of the estimation equation. This concern is relatively simple to address: in Column (4) of Table 5, we exclude the sector "Finance, insurance, real estate and business services" and "Financial intermediation" from the main tests using the data disaggregated at the SIC 1-digit and the OECD 2-digit level, respectively. As explained before, our previous results might be biased by the fact that our independent variables of financial development change increase naturally with the share of financial services on the left-hand side. The effect of credit market development, however, survives this procedure, with a largely undiminished magnitude.

Taken together, our robustness checks point to the fact that the endogeneity of the volume measures of finance used so far may be inducing attenuation bias in our estimations, while the inclusion of the financial sector may be biasing the results upwards. In all, our measures of credit markets development continues to affect strongly the speed of convergence to an allocative efficient frontier in all tests.

4.3 "Optimal" vs. "simple" diversification

The virtue of our measure of "optimal" diversification, derived from mean-variance efficiency, is that it accounts simultaneously for sectoral growth, volatility, and cross-correlations. The downside is that while it is the case for investing in high-return industries is intuitive and well-grounded in theory, it is more difficult to make the case for a representative small financier taking into account the covariance structure of sectoral returns when making an investment. In order to test whether investment spurred by more developed financial markets indeed produces these patterns, we contrast our empirical framework with alternative ones in which the importance of cross-sector correlations, or of sectoral growth, volatility, and correlations, is assumed away. In the first case, we estimate a benchmark frontier in which all covariance terms are set to zero. This transforms a mean-variance efficiency argument into one in which finance targets sectors based solely on their individual Sharpe ratios. Such a framework turns out to be unable to explain patterns of convergence of sector weights in country-level value added, with the estimates of α and β being close to 1 and 0, respectively. This implies that the effect of finance on convergence is significant only when the covariance of returns is properly accounted for.

More importantly, we contrast our measure of diversification based on allocative efficiency with one which measures a "mechanical" spreading of output across industrial sectors. The hypothesis is that finance will affect our measure, but not the alternative one, due to the fact our measure incorporates naturally the idea of shifting comparative advantage. One such "mechanical" measure is the Ogive index which is widely used in studies of geographic diversification (see, for example, Conroy (1975)). For a set of $i = 1, ..., n$ individual sectors with corresponding shares s_i, the Ogive index is calculated as $n \sum_{i=1}^{n} \left(s_i - \frac{1}{n}\right)^2$. A second such natural measure is the Herfindahl-Hirschman index defined as $\sum_{i=1}^{n} s_i^2$. Finally, the Gini coefficient is defined as $\frac{1}{2n(n-1)} \sum_{i=1}^{n} \sum_{j=1}^{n} |s_i - s_j|$.[13] All measures are identical in the sense that they ignore any considerations about growth, volatility, and cross-sector correlations.

Table 6 reports the results of a set of tests in which our original measure of distance to allocative efficiency frontier is replaced with each of the mechanical measures of diversification just defined (which can also be understood as distance to an "absolute" diversification benchmark, as all three measures assign a value of 0 to equally spread output, and a value of 1 to output concentrated in one sector). The results largely confirm the intuition: finance has no significant effect on the speed with which the country allocation of output converges to a benchmark in which output is perfectly equally spread across the set of industrial sectors available. And while the coefficient on the measure of diversification implies that diversification increases over time, it does so at a much lower speed than our measure of allocative efficiency, and in the case of the Gini coefficient, for example, convergence is almost nonexistent.

[13] See Imbs and Wacziarg (2006) for details on implementation.

4.4 Finance, allocative efficiency, and economic fragility

We next extend our model to study the combined effect of finance and distance to allocative efficiency frontier on downside risk. In these tests, we lean on the argument in Acemoglu and Zilibotti (1997) that development increases the scope of diversification. By extension, financial development might be acting to decrease the risk of downturns via the channel of sectoral reallocation, regardless of its potentially negative effect via different channels like increased risk-taking, herding, risky financial innovation, etc. Empirical evidence on the finance-downturns nexus has so far been pointedly mixed. For example, Raddatz (2003) shows that financial development decreases the magnitude of industry-level recession for industries that are naturally dependent on external funding. In contrast, Acemoglu et al. (2002) find that measures of financial intermediation, like M2/GDP, exert a statistically insignificant effect on the severity of country-wide crises once institutions are controlled for. And Easterly et al. (2000) find that financial depth, measured as the ratio of private credit to GDP, exerts a positive effect on the probability of a negative per capita GDP growth. The ambiguity in the literature might be stemming from using countries at different stages of financial development in the different studies. By focusing on a sample of industrial countries we hardly aim to resolve it, but rather to study the interaction between finance, distance to frontier, and downside risk at later stages of economic development.

We put this question to the test, and report our results in Table 7. Essentially, we run country-level (Columns (1) and (2)) and industry-level (Columns (3) and (4)) probit regression of the probability of a negative growth event as a function of financial development and distance to allocative efficiency frontier as per the procedure described in equation (8). We do so both for classic recession (Columns (1) and (3)) as well as for "large" recessions (Columns (2) and (4)), namely output drops of more than 5%. We find competing evidence regarding the total effect of finance on economic downturns. On the one hand, larger distance to frontier is associated with a higher probability of an economic downturn, and this effect is significant in several cases. On the other hand, the "direct" effect of finance is also positive and significant in several cases.

Of course, this parsimonious specification is prone to endogeneity problems - in particular, financial development is correlated with the unobservables of the regression and distance to frontier is correlated with the contemporaneous values of finance. We attempt to purge the regressions from these factors by adding country-industry interactions and year dummies. This specification allows us to isolate the simultaneous effect of unobservables on the extent to which countries/sectors experience both more frequent negative growth and lower distance to technological frontier. We can then conclude from our simple set of tests that while the overall effect of finance on economic downturns is somewhat ambiguous, there is some evidence that via the channel of optimal diversification, financial development reduces downside risk.

4.5 Finance, law, and regulation

Another important issue to address is that finance may simply be proxying for other characteristics of the business environment. For example, financially more developed countries tend to have better institutions, less rigid regulation of businesses, and better protection of investors and enforcement of contracts. To the extent that the degree of development tends to be similar across most dimensions of financial, regulatory, and legal development, those could all be capturing similar aspects of an unfavorable business environment. We therefore consider the effects of barriers to entry, investor protection, and contract enforcement on convergence to the allocative efficiency efficiency frontier.

The reason we focus on these three dimensions of the business environment is that they have been found to explain variations in industry growth in previous studies. For example, Klapper et al. (2006) show that entry barriers are associated with lower firm entry in industries characterized by higher business churn. Entry barriers could thus result in slower convergence to the allocative efficiency frontier if the industries with the highest optimal share are the naturally highest-entry ones. Djankov et al. (2008) show that a stricter enforcement of minority shareholders' rights results in a more dynamic economy, as measured by the number of active firms per population. To the degree to which the number of active firms is a proxy for the optimal utilization of growth opportunities, low degree of investment protection may be hampering convergence to the optimal diversification benchmark by constraining industry growth. Finally, insufficient contract enforcement is argued to have been the main culprit in various countries' observed long-term decline (for example, Clague et al. (1999)).[14]

In Table 8, we repeat our previous estimations at the country and country-industry level in a horse race in which interactions of last period's distance to allocative efficiency frontier with the respective characteristic of the business environment have been included in the model. Data on entry barriers (number of days it takes to register a new business), investor protection (composite of transparency of transactions, liability for self-dealing, and shareholders' ability to sue officers and directors for misconduct), and contract enforcement (number of days it takes to resolve a contractual dispute in court) come from the Doing Business Database of the World Bank, and are averaged over the longest available period. We find that industries converge more slowly to their optimal share in countries where it takes longer to register a business. We also find that better investor protection accelerates convergence to frontier. Finally, convergence is slower in countries where it takes longer to resolve contractual disagreements. The sum of these results suggests that legal and regulatory obstacles can slow down convergence to an allocative efficiency frontier - for example, by increasing the marginal cost of investing in opaque high-growth sectors. Importantly, the effect of finance we observed in previous regressions survives this robustness exercise.

4.6 Extention: Finance and distance to allocative efficiency frontier for larger economic zones

One final critical question to our approach is, why is the country a proper unit of observation? The literature on the geographic agglomeration of economic activity, pioneered by Krugman (1991),

[14]Other characteristics of the business environment that have been argued to affect diversification and growth include property rights (for example, Claessens and Laeven (2003)), constraints on the executive (for example, Acemoglu et al. (2002)), and access to finance (for example, Unfortunately, there is too little cross-country variation in those in our sample of the industrialized world. Nevertheless, in unreported regressions show that the above don't matter for the speed of convergence.

points out that demand linkages and costly trade will rather lead to sectoral specialization not within one U.S. state, but between, for example, the East Coast and the U.S. mainland. Kalemli-Ozcan, Papaioannou, and Peydro-Alcalde (2010) also emphasize that the euro zone might be a more appropriate unit of observation to study intersectoral allocation than an individual euro-zone member country. In that respect, that the German region of Bavaria specializes in car production and the German region of Rhineland specializes in wine production might be less important than the fact that Germany has a relatively large automobile industry while Portugal has a relatively large wine industry.

Our framework allows for immediate testing of this hypothesis. In Table 9, we report the estimates from revised versions of previous regressions where we have calculated distance to efficiency frontier using aggregate data for the euro zone starting in 1991[15], and our main measure of credit is now the credit-to-GDP ratio for each year starting in 1991, at the level of the euro zone. Given that we only have 17 years of observations, we only use disaggregation at the 1-digit SIC industry level to calculate the mean-variance efficiency frontier. Across the board of empirical tests, we confirm that deeper credit markets are associated with a faster convergence to an allocative efficiency frontier. As before, we use both OLS and a GMM procedure, we account for "natural" industry characteristics, and we exclude the financial sector from the exercises. We also use the introduction of the euro in 1999 as an instrument for financial development. While the validity restriction is undoubtedly satisfied, the argument can be made that the introduction of the euro in 1999 may have shifted the frontier by allowing faster reallocation along other dimensions, like trade and the reduction of exchange rate risk, which invalidates the exclusion restriction. Therefore, this final test should be interpreted with caution.

[15] The unification in 1991 of the largest economy in the euro zone, Germany, makes it impossible to use pre-1991 data.

5 Conclusion and extensions

In this paper, we explore internationl differences in allocative efficiency and find that financial markets explain a large portion of these differences. In particular, more developed credit credit markets are associated with faster convergence to a time-invariant allocative efficiency benchmark. In general, our results aim to describe a larger picture of how financial markets contribute to optimal diversification. First, we find that overall economic efficiency is improved not just via the increase in size of high-growth sectors, but also via reduced volatility. Second, regulatory and legal institutions contribute to that process too, without diminishing the independent role of finance. Third, while parsimonious, our empirical strategy makes us fairly certain that our findings are not driven by left-out variable bias, the endogeneity of financial development, or global volatility-reducing reallocation effects, like the "Great Moderation". Finally, our allocative efficiency framework differs from mechanical measures of diversification (specialization) which rely on the relative size of any particular sector. Hence, our results do not imply that finance pushes countries to diversify away from their comparative advantage. What they do imply is that finance reallocates investment it in a way which takes into account both comparative advantage in terms of growth and diversification in the sense of an overall volatility-minimizing portfolio. What theories are more relevant in explaining our results, and whether these results will stand the test of dynamic measures of allocative efficiency incorporating the idea of expanding technological frontiers a la Acemoglu et al. (2006) present themselves as exciting avenues of future research.

References

[1] Acemoglu, D., and F. Zilibotti, 1997. Was Prometheus unbound by chance? Risk, diversification, and growth. *Journal of Political Economy* 105, 709-751.

[2] Acemoglu, D., Johnson, S., Robinson, J., and Y. Thaicharoen, 2002. Institutional causes, macroeconomic symptoms: volatility, crises and growth. *Journal of Monetary Economics* 50, 49-123.

[3] Acemoglu, D., Aghion, P., and F. Zilibotti, 2006. Distance to frontier, selection and economic growth. *Journal of the European Economic Association* 4, 37-74.

[4] Acharya, V., Imbs, J., and J. Sturgess, 2007. Finance and efficiency: Do bank branching regulations matter? CEPR Discussion Papers 6202, C.E.P.R. Discussion Papers.

[5] Aghion, P., Fally, T., and S. Scarpetta, 2007. Credit constraints as a barrier to the entry and post-entry growth of firms. *Economic Policy* 22/52, 731-779.

[6] Arellano, M., and S. Bond, 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies* 58, 277-297.

[7] Beck, T., Demirgüç-Kunt, A., and R. Levine, 2000, updated 2008. A New database on financial development and structure. *World Bank Economic Review* 14, 597-605.

[8] Beck, T., Levine, R., and N. Loayza, 2000. Finance and the sources of growth. *Journal of Financial Economics* 58, 261-300.

[9] Beck, T., Demirguc-Kunt, A., Levine, R., and V. Maksimovic, 2001. Financial structure and economic development: Firm, industry, and country evidence, in *Financial Structure and Economic Growth: A Cross-Country Comparison of Banks, Markets, and Development*, eds., Asli Demirguc-Kunt and Ross Levine (MIT Press, Cambridge, MA).

[10] Beck, T., and R. Levine, 2002. Industry growth and capital allocation: Does having a market- or bank-based system matter? *Journal of Financial Economics* 64, 147-180.

[11] Beck, T., and R. Levine, 2004. Stock markets, banks, and growth: Panel evidence. *Journal of Banking and Finance* 28, 423-442.

[12] Beck, T., Lundberg, M., and G. Majnoni, 2006. Financial intermediary development and growth volatility: Do intermediaries dampen or magnify shocks? *Journal of International Money and Finance* 25, 1146-1167.

[13] Bekaert, G. Harvey, C., and C. Lundblad, 2005. Does financial liberalization spur growth? *Journal of Financial Economics* 77, 3-55.

[14] Bekaert, G. Harvey, C., and C. Lundblad, 2006. Growth volatility and financial liberalization. *Journal of International Money and Finance* 25, 370-403.

[15] Bekaert, G., Harvey, C., Lundblad, C., and S. Siegel, 2007. Global growth opportunities and market integration. *Journal of Finance* 62, 1081-1137.

[16] Blundell, R., and S. Bond, 1998. Initial conditions and model restrictions in dynamic panel data models. *Journal of Econometrics* 87, 115-143.

[17] Bonfiglioli, A., 2008. Financial integration, productivity and capital accumulation. *Journal of International Economics* 76, 337-355.

[18] Bowley, A.L., 1920. Elements of Statistics. Charles Scribner's Sons, New York.

[19] Campbell, J., 1996. Consumption and the stock market: Interpreting international experience. NBER Working Paper 5610.

[20] Carranza, L., and J. Galdon-Sanchez, 2004. Financial intermediation, variability, and the development process. *Journal of Development Economics* 73, 27-54.

[21] Ciccone, A., and Papaioannou, E., 2006. Adjustment to target capital, finance and growth. CEPR Discussion Papers 5969.

[22] Claessens, S., and L. Laeven, 2003. Financial development, property rights, and growth. *Journal of Finance* 58, 2401-2436.

[23] Clague, C., Keefer, P., Knack, S., and M. Olson, 1999. Contract-intensive money: contract enforcement, property rights, and economic performance. *Journal of Economic Growth* 4, 185-211.

[24] Conroy, M., 1975. The concept and measurement of regional industrial diversification. *Southern Economic Journal* 41, 492-505.

[25] Coricelli, F., Masten, A., and & I. Masten, 2008. Non-linear growth effects of financial development: Does financial integration matter? *Journal of International Money and Finance* 27, 295-313.

[26] Deidda, L., and B. Fattouh, 2002. Non-linearity between finance and growth. *Economics Letters* 74, 339-345.

[27] Djankov, S., La Porta, R., Lopez-de-Silanes, F., and A. Shleifer, 2008. The law and economics of self-dealing. *Journal of Financial Economics* 88, 430-465.

[28] Easterly, W., Islam, R., and J., Stiglitz, 2000. Shaken and stirred: Explaining growth volatility. B. Pleskovic and J. E. Stiglitz, Annual Bank Conference on Development Economics. Washington D.C.

[29] Goldsmith, R., 1969. *Financial Structure and Development* (Yale University Press, New Haven, CT).

[30] Imbs, J., 2007. Growth and volatility. *Journal of Monetary Economics* 54, 1848-1862.

[31] Imbs, J., and R. Wacziarg, 2003. Stages of diversification. *American Economic Review* 93, 63-86.

[32] Kalemli-Ozcan, S., Sorensen, B., and O. Yosha, 2003. Risk sharing and industrial specialization: Regional and international evidence. *American Economic Review* 93, 903-918.

[33] Kalemli-Ozcan, S., Papaioannou, E., and J.-L. Peydro-Alcalde, 2010. What lies beneath the euro's effect on financial integration? Currency risk, legal harmonization, or trade. *Journal of International Economics* (forthcoming).

[34] King, R., and R. Levine, 1993. Finance and growth: Schumpeter might be right. *Quarterly Journal of Economics* 108, 717-737.

[35] Klapper, L., Laeven, L., and R. Rajan, 2006. Entry regulation as a barrier to entrepreneurship. *Journal of Financial Economics* 82, 591-629.

[36] Koren, M., and S. Terneyro, 2007. Volatility and development. *Quarterly Journal of Economics* 122, 243-287.

[37] Kose, A., Prasad, E., Rogoff, K., and S. Wei, 2004. Financial globalization, growth and volatility in developing countries. NBER Working Papers 10942.

[38] Lane, P., and G. M. Milesi-Ferretti, 2007. The external wealth of nations mark II: Revised and extended estimates of foreign assets and liabilities, 1970-2004. *Journal of International Economics* 73, 223-250.

[39] Larrain, B., 2006. Do banks affect the level and composition of industrial volatility? *Journal of Finance* 61, 1897-1925.

[40] Levchenko, A., Ranciere, R., and M. Thoenig, 2009. Growth and risk at the industry level: The real effects of financial liberalization. *Journal of Development Economics* 89, 210-222.

[41] Levine, Ross, 2005. Finance and growth: Theory, evidence, and mechanisms, in *The Handbook of Economic Growth,* eds., Philippe Aghion and Steve Durlauf (North-Holland, Amsterdam, Netherlands).

[42] Levine, R., and S. Zervos, 1998. Stock markets, banks, and economic growth. *American Economic Review* 88, 537-558.

[43] Markowitz, H., 1952. Portfolio selection. *Journal of Finance* 7, 77-91.

[44] McKinnon, R., 1973. *Money and Capital in Economic Development* (Brookings Institution, Washington, DC).

[45] Quinn, D., 1997. The correlates of changes in international financial regulation. *American Political Science Review* 91, 531–551.

[46] Raddatz, C., 2006. Liquidity needs and vulnerability to financial underdevelopment. *Journal of Financial Economics* 80, 677-722.

[47] Rajan, R., and L. Zingales, 1998. Financial dependence and growth. *American Economic Review* 88, 559-586.

[48] Ramey, G., and V. Ramey, 1995. Cross-country evidence on the link between volatility and growth. *American Economic Review* 85, 1138-1151.

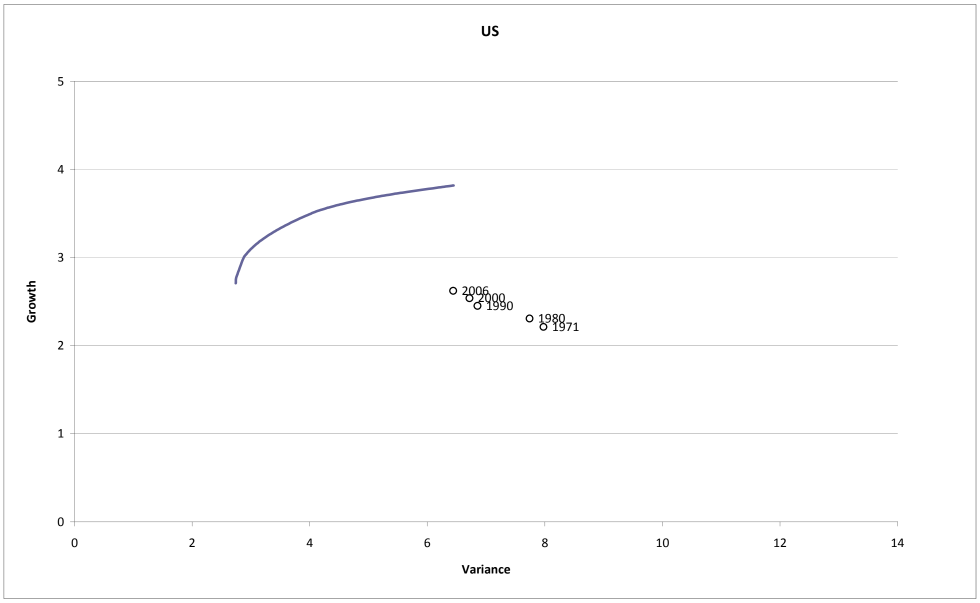
[49] Rancière, R., Tornell, A., and F. Westermann, 2008. Systemic crises and growth. *Quarterly Journal of Economics* 123, 359-406.

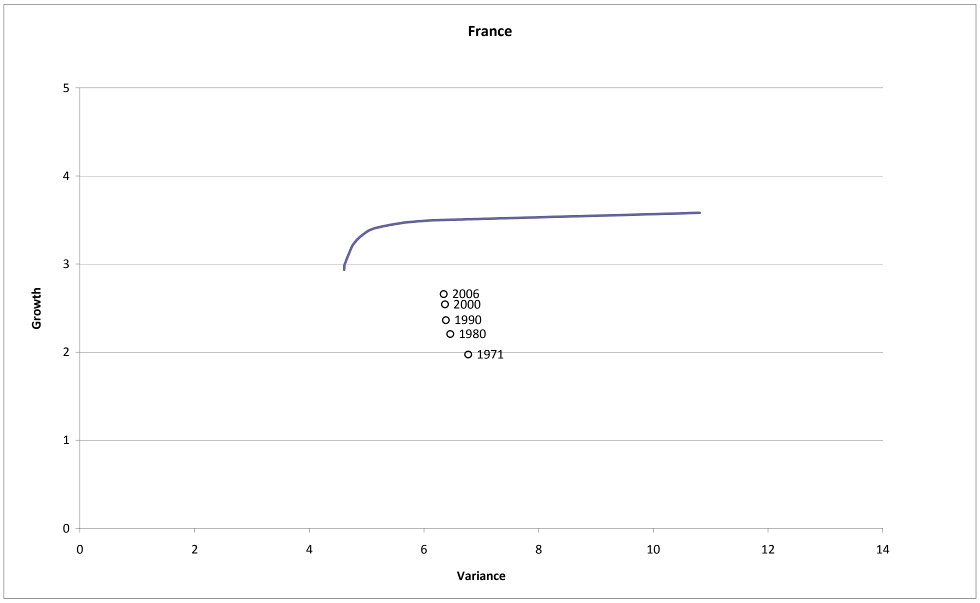
[50] Schumpeter, J., 1912. *The Theory of Economic Development*, published in 1934 (Harvard University Press, Cambridge, MA).

[51] Wachtel, Paul, 2001. Growth and finance: What do we know and how do we know it?, *International Finance*, 4(3), 335-362.

[52] Wurgler, J., 2000. Financial markets and the allocation of capital. *Journal of Financial Economics* 58,187-214.

Figure 1. Distance to frontier and actual industrial composition over time





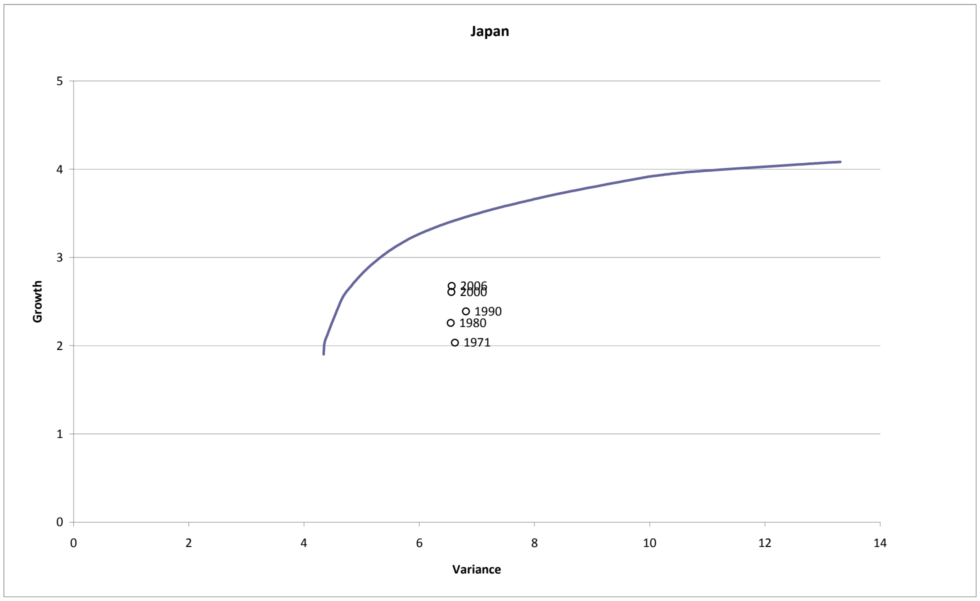


Figure 2. Distance between optimal and actual industrial allocation and finance: Country averages for 1970-2006

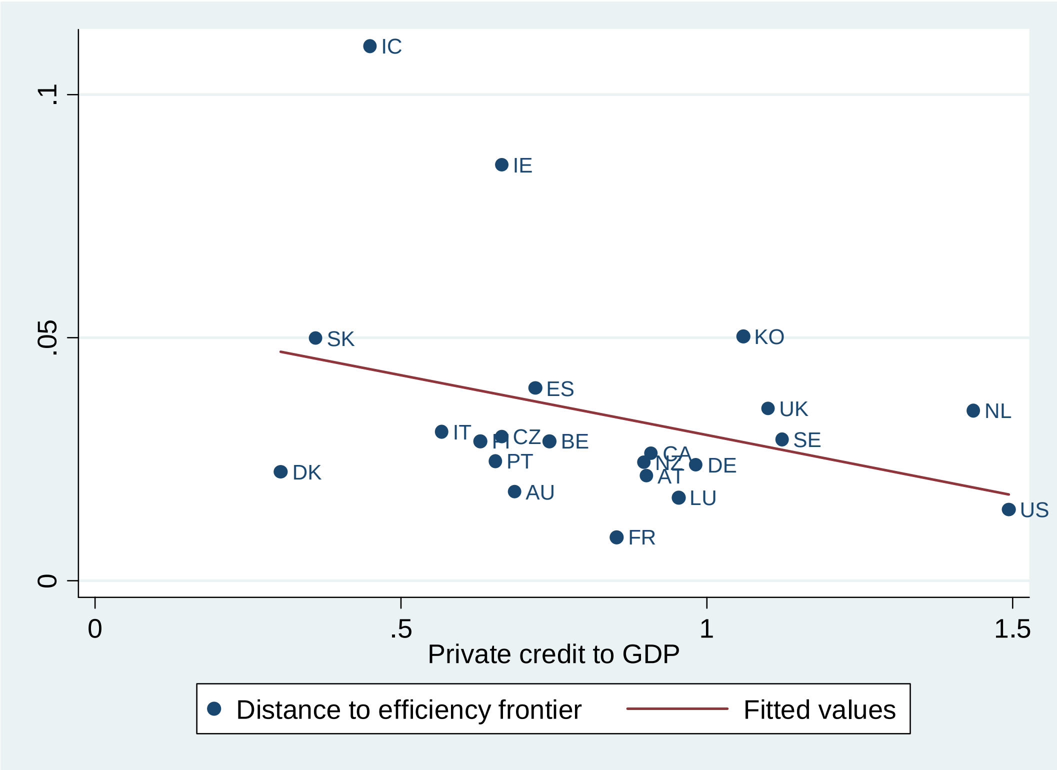


Table 1. Value added growth, volatility, and distance to frontier

Country	Average growth	Average volatility	Initial distance	Final distance	Data starts	Initial distance	Final distance	Data starts
			SIC 1-digit industries			OECD 2-digit industries		
Australia	0.032	0.036	4.64	2.98	1970	5.66	3.11	1982
Austria	0.021	0.018	1.26	0.86	1976	1.97	1.18	1976
Belgium	0.022	0.026	4.35	2.23	1970	4.84	2.87	1970
Canada	0.030	0.035	8.00	7.17	1970	8.21	8.10	1970
Czech Republic	0.020	0.039	10.2	8.75	1993	12.8	12.2	1993
Denmark	0.018	0.024	3.02	2.16	1970	3.55	2.76	1970
Finland	0.029	0.052	18.4	14.3	1970	18.5	15.0	1975
France	0.023	0.025	2.37	1.76	1970	3.08	2.38	1970
Germany	0.006	0.013	1.37	0.89	1991	1.54	1.13	1991
Greece	0.026	0.051	11.4	9.04	1970	11.0	7.45	1970
Hungary	0.004	0.056	17.5	12.2	1991	21.0	17.6	1991
Iceland	0.028	0.087	10.9	12.0	1973	27.8	35.0	1973
Ireland	0.065	0.039	8.97	9.98	1986	9.05	8.12	1986
Italy	0.027	0.037	8.12	5.19	1970	9.16	6.19	1970
Japan	0.023	0.024	2.73	2.34	1970	3.88	2.71	1970
Korea	0.077	0.068	22.6	17.4	1970	35.1	29.0	1970
Luxembourg	0.054	0.035	6.64	13.5	1985	9.92	19.1	1985
Netherlands	0.023	0.025	2.06	2.00	1970	3.08	2.57	1970
New Zealand	0.032	0.036	6.57	5.28	1971	8.47	7.04	1971
Norway	0.034	0.045	4.67	37.6	1970	5.47	36.2	1970
Poland	0.029	0.032	12.2	9.62	1994	11.8	9.41	1994
Portugal	0.022	0.034	5.29	6.68	1977	7.86	8.39	1977
Slovakia	0.023	0.042	12.5	12.3	1993	14.2	16.8	1993
Spain	0.026	0.025	2.88	3.69	1980	3.89	4.39	1980
Sweden	0.021	0.036	8.55	4.90	1970	10.7	5.99	1970
Switzerland	0.006	0.017	2.09	1.58	1990	2.32	1.75	1990
UK	0.007	0.012	2.06	2.38	1970	3.79	1.76	1985
US	0.024	0.026	5.26	3.70	1970	5.62	4.01	1970

Note: The data describes the STAN database for structural analysis (2008). The underlying industry data is at the SIC 1-digit level and OECD 2-digit level (See Appendix B for details). Column (2) lists the average country-level value added growth rate over the period that the country is observed, which is a simple average of the sectoral level growth rates. Column (3) lists long-term standard deviations of growth for each country, again averages across sectors. Columns (4)-(5) and (7)-(8) list our estimates of initial and final distance to the allocative efficiency frontier for each country, in a mean-variance efficiency metric, for SIC 1-digit and OECD 2-digit data, respectively. Columns (6) and (9) give the initial year for which data is available for each country. All data is avalable until 2007.

Table 2. Credit markets, equity markets, and financial integration

Country	Credit markets	
	Private credit / GDP	Liberalization date
Australia	0.513	1994
Austria	0.841	<1970
Belgium	0.433	<1970
Canada	0.783	<1970
Czech Republic	0.507	1994
Denmark	0.501	1994
Finland	0.571	<1970
France	0.713	<1970
Germany	1.077	<1970
Greece	0.371	1987
Hungary	0.299	1994
Iceland	0.541	<1970
Ireland	0.821	<1970
Italy	0.618	<1970
Japan	1.452	1985
Korea	0.827	1998
Luxembourg	1.054	<1970
Netherlands	1.069	<1970
New Zealand	0.558	1987
Norway	0.869	1985
Poland	0.236	1994
Portugal	0.856	1986
Slovakia	0.504	1994
Spain	0.811	<1970
Sweden	0.956	1985
Switzerland	1.601	<1970
UK	0.653	<1970
US	1.306	1985

Note: The data describes our main financial variable used in the text, private credit over GDP. Column (2) lists the country-level ratio of private credit by all financial institutions, excluding central banks, to GDP, averaged over the sample period. Column (3) lists the year in which the respective country liberalized its banking sector; '<1970' means that those countries' credit markets are open throughout the period. Data on private credit come from Beck et al. (2000, updated 2008). Data on banking sector liberalization come from Bekaert et al. (2005).

Table 3. Finance and convergence to allocative efficiency frontier: OLS estimation

	Full sample	Complete data	"Clean frontier"
	Panel A. Country distances: SIC 1-digit data		
$D_{c,t-1} \cdot$ Credit	-0.0564	-0.0590	-0.1172
	(0.0274)**	(0.0287)**	(0.0506)**
$D_{c,t-1}$	0.9045	0.9099	0.9467
	(0.0333)***	(0.0349)***	(0.0552)***
Credit	0.0211	0.0225	0.0415
	(0.0123)*	(0.0130)*	(0.0231)***
Observations	731	670	424
	Panel B. Country distances: OECD 2-digit data		
$D_{c,t-1} \cdot$ Credit	-0.0309	-0.0325	-0.0538
	(0.0108)***	(0.0111)***	(0.0215)**
$D_{c,t-1}$	0.9109	0.9149	0.8666
	(0.0175)***	(0.0180)***	(0.0358)***
Credit	0.0066	0.0073	0.0132
	(0.0045)	(0.0046)	(0.0083)
Observations	607	553	359
	Panel C. Country-industry distances: SIC 1-digit industries		
$D_{c,s,t-1} \cdot$ Credit	-0.0224	-0.0236	-0.0416
	(0.0067)***	(0.0069)***	(0.0120)***
$D_{c,s,t-1}$	0.8804	0.8839	0.8819
	(0.0083)***	(0.0036)***	(0.0131)***
Credit	0.0024	0.0026	0.0049
	(0.0012)**	(0.0012)**	(0.0022)**
Observations	6,687	6,138	3,924
	Panel D. Country-industry distances: OECD 2-digit industries		
$D_{c,s,t-1} \cdot$ Credit	-0.0259	-0.0271	-0.0246
	(0.0040)***	(0.0042)***	(0.0072)***
$D_{c,s,t-1}$	0.9500	0.9079	0.8840
	(0.0051)***	(0.0053)***	(0.0082)***
Credit	0.0005	0.0006	0.0001
	(0.0004)	(0.0005)	(0.0008)
Observations	12,840	11,760	7,880

Note: The dependant variable is $D_{c,t}$ (Panels A and B) and $D_{c,s,t}$ (Panels C and D), both calculated according to equation (5). 'Credit' is the ratio of private credit to GDP. Column 1 reports the regression estimates from the full unbalanced panel covering the period 1970-2006; Column 2 reports the regression estimates after excluding countries for which data is only available after 1990; Column 3 reports the regression estimates after excluding countries which liberalized their credit markets during the sample period. All estimates are from an OLS regression. Country and year fixed effects (Panels A and B) and country fixed effects interactions with industry fixed effects, as well as year fixed effects (Panels C and D) included in all regressions. White (1980) standard errors appear below each coefficient in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 4. Finance and convergence to allocative efficiency frontier: GMM estimation

	Full sample	Complete data	"Clean frontier"
	Panel A. Country distances: SIC 1-digit data		
$D_{c,t-1}\cdot$Credit	-0.0911	-0.0858	-0.1443
	(0.0290)***	(0.0302)***	(0.0495)***
$D_{c,t-1}$	0.9025	0.9012	0.9515
	(0.0319)***	(0.0334)***	(0.0518)***
Credit	0.0347	0.0322	0.0566
	(0.0132)***	(0.0137)**	(0.0226)***
Observations	697	641	402
	Panel B. Country distances: OECD 2-digit data		
$D_{c,t-1}\cdot$Credit	-0.1859	-0.1898	-0.2388
	(0.0219)***	(0.0217)***	(0.0257)***
$D_{c,t-1}$	0.9420	0.9717	0.9653
	(0.0281)***	(0.0283)***	(0.0344)***
Credit	0.0024	0.0026	0.0025
	(0.0008)***	(0.0008)***	(0.0011)**
Observations	575	526	339
	Panel C. Country-industry distances: SIC 1-digit industries		
$D_{c,s,t-1}\cdot$Credit	-0.2005	-0.1918	-0.2091
	(0.0139)***	(0.0143)***	(0.0246)***
$D_{c,s,t-1}$	0.8225	0.8193	0.8661
	(0.0152)***	(0.0156)***	(0.0245)***
Credit	0.0230	0.0217	0.0232
	(0.0025)***	(0.0026)***	(0.0044)***
Observations	6,273	5,769	3,618
	Panel D. Country-industry distances: OECD 2-digit industries		
$D_{c,s,t-1}\cdot$Credit	-0.1271	-0.1246	-0.1011
	(0.0071)***	(0.0083)***	(0.0149)***
$D_{c,s,t-1}$	0.7897	0.7921	0.7579
	(0.0095)***	(0.0098)***	(0.0149)***
Credit	0.0052	0.0051	0.0021
	(0.0010)***	(0.0010)***	(0.0017)
Observations	12,180	11,200	7,460

Note: The dependant variable is $D_{c,t}$ (Panels A and B) and $D_{c,s,t}$ (Panels C and D), both calculated according to equation (5). 'Credit' is the ratio of private credit to GDP. Column 1 reports the regression estimates from the full unbalanced panel covering the period 1970-2006; Column 2 reports the regression estimates after excluding countries for which data is only available after 1990; Column 3 reports the regression estimates after excluding countries which liberalized their credit markets during the sample period. All estimates are from a GMM procedure which implements the Arrelano-Bond estimator to account for the presence of a lagged dependent variable in a dynamic panel model. White (1980) standard errors appear below each coefficient in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 5. Finance and convergence to allocative efficiency frontier: Endogeneity

	Benchmark = US industry Sharpe ratio	Benchmark = US industry share young firms	Credit = Bank liberalization date	Financial sector excluded
	Panel A. Country-industry distances: SIC 1-digit industries			
$D_{c,s,t-1}\cdot$ Credit·Benchmark	-0.0181	-0.2001		
	(0.0053)***	(0.0654)***		
$D_{c,s,t-1}\cdot$ Credit			-0.0330	-0.0141
			(0.0053)***	(0.0050)***
$D_{c,s,t-1}$	0.8794	0.8799	0.8902	0.8669
	(0.0086)***	(0.0092)***	(0.0069)***	(0.0076)***
Credit	0.0014	0.0024	0.0034	0.0019
	(0.0011)	(0.0013)*	(0.0009)***	(0.0009)***
Benchmark	0.0071	0.0110		
	(0.0022)***	(0.0061)*		
Observations	6,273	6,273	6,930	5,848
	Panel B. Country-industry distances: OECD 2-digit industries			
$D_{c,s,t-1}\cdot$ Credit·Benchmark	-0.0119	-0.2079		
	(0.0045)***	(0.349)***		
$D_{c,s,t-1}\cdot$ Credit			-0.0376	-0.0260
			(0.0033)***	(0.0040)***
$D_{c,s,t-1}$	0.9069	0.9051	0.9702	0.9042
	(0.0050)***	(0.0055)***	(0.0042)***	(0.0051)***
Credit	0.0002	0.0003	0.0019	0.0006
	(0.0004)	(0.0005)	(0.0004)***	(0.0004)
Benchmark	0.0067	0.0122		
	(0.0009)***	(0.0067)*		
Observations	12,160	12,160	13,540	12,198

Note: The dependant variable in all cases is $D_{c,s,t}$ calculated according to equation (5). 'Credit' is the ratio of private credit to GDP. 'US industry Sharpe ratio' is the ratio of long-term growth divided by long-term standard deviation of growth for US industries at the SIC 1-digit (panel A) or OECD 2-digit (Panel B) level. 'Share of young firms' is the share of firms younger than 2 years out of the full population of firms for US industries at the SIC 1-digit (panel A) or OECD 2-digit (Panel B) level. Both industry benchmarks are instrumented in all regressions by the predicted sample Sharpe ratio/share of young firms in a regression on country and industry dummies, interacted with the respective US measure of financial development. The US is excluded from all regressions in Columns 2 and 3. 'Bank liberalization date' equals 1 for the years after the country liberalized its domestic credit market, and 0 otheriwise. Data on those come from Bekaert et al. (2005). Financial sector (SIC industry #8, OECD industry #65-67) is excluded from the regressions in Column 5. The analysis is performed on a panel covering the period 1970-2006. Country fixed effects interactions with industry fixed effects, as well as year fixed effects, are included in all regressions. White (1980) standard errors appear below each coefficient in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 6. Finance and "simple" diversification

	Ogive index	HHI	Gini coefficient
	Panel A. Country distances: SIC 1-digit data		
$D_{c,t-1}\cdot$Credit	0.0248	0.0036	-0.0029
	(0.0164)	(0.0036)	(0.0021)
$D_{c,t-1}$	0.9091	0.1032	0.0499
	(0.0283)***	(0.0063)***	(0.0037)***
Credit	-0.0023	-0.0001	0.0013
	(0.0099)	(0.0021)	(0.0013)
Observations	731	731	731
	Panel B. Country distances: OECD 2-digit data		
$D_{c,t-1}\cdot$Credit	0.0168	0.0018	0.0033
	(0.0137)	(0.0015)	(0.0032)
$D_{c,t-1}$	0.9035	0.1005	0.0169
	(0.0186)***	(0.0021)***	(0.0009)***
Credit	-0.0112	-0.0012	-0.0019
	(0.0094)	(0.0011)	(0.0005)***
Observations	642	642	642

Note: The dependant variable in all cases is the actual share of output industry at time *t* out of the country's total output at time *t*. 'Credit' is the ratio of private credit to GDP. 'US industry Sharpe ratio' is the ratio of long-term growth divided by long-term standard deviation of growth for US industries at the SIC 1-digit (panel A) or OECD 2-digit (Panel B) level. 'Share of young firms' is the share of firms younger than 2 years out of the full population of firms for US industries at the SIC 1-digit (panel A) or OECD 2-digit (Panel B) level. Both industry benchmarks are instrumented in all regressions by the predicted sample Sharpe ratio/share of young firms in a regression on country and industry dummies, interacted with the respective US measure of financial development. 'Bank liberalization date' equals 1 for the years after the country liberalized its domestic credit market, and 0 otherwise. Data on those come from Bekaert et al. (2005). The US is excluded from all regressions. The analysis is performed on a panel covering the period 1970-2006. Country fixed effects interactions with industry fixed effects, as well as year fixed effects, are included in all regressions. White (1980) standard errors appear below each coefficient in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 7. Finance and convergence to allocative efficiency frontier: Downside risk

	Country-level recessions		Industry-level recessions	
	Recession	Large recession	Recession	Large recession
	Panel A. SIC 1-digit industries			
$D_{c,s,t-1}\cdot$ Credit	1.6166	0.6503	-0.6369	2.0045
	(3.1081)	(0.3507)*	(0.8382)	(1.4128)
$D_{c,t-1}$	3.1047	0.1673	2.0321	4.4233
	(3.4055)	(0.5481)	(1.1559)**	(1.9471)**
Credit	0.3617	-0.2397	0.2068	0.3533
	(1.3742)	(0.2033)	(0.1270)*	(0.1666)**
Observations	567	731	6,085	4,705
	Panel B. OECD 2-digit industries			
$D_{c,s,t-1}\cdot$ Credit	1.4126	-0.2141	-2.3315	3.4109
	(3.5066)	(0.2099)	(1.2957)*	(2.0557)*
$D_{c,t-1}$	0.6559	-0.0904	3.1532	1.1114
	(4.4672)	(0.3089)	(1.7833)*	(2.5386)
Credit	0.0858	0.0991	0.1366	0.0157
	(1.4277)	(0.0950)	(0.0922)	(0.1217)
Observations	427	642	10,606	7,659

Note: The dependant variable is a dummy equal to 1 in the year in which the country (Columns 2 and 3) or the country-industry (Columns 4 and 5) is experiencing a recession. In columns 2 and 4, 'Recession' is defined as a negative-growth event, in columns 3 and 5, 'Large recession' is defined as an at least 5% drop in output. 'Credit' is the ratio of private credit to GDP. $D_{c,t}$ and $D_{c,s,t}$ are the distances to allocative efficiency frontier from equation (5). The analysis is performed on a panel covering the period 1970-2006. Country fixed effects interactions with industry fixed effects, as well as year fixed effects (Columns 2 and 3), and country and year fixed effects (Columns 4 and 5) included in all regressions. White (1980) standard errors appear below each coefficient in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 8. Finance, law, and regulation

	Full sample	Complete data	"Clean frontier"	Full sample	Complete data	"Clean frontier"
			Panel A. SIC 1-digit data			
		Country level			Country-industry level	
$D_{c,(s,)t-1}$ · Credit	-0.0607	-0.0613	-0.1278	-0.0184	-0.0190	-0.0337
	(0.0304)**	(0.0317)**	(0.0550)**	(0.0074)**	(0.0077)**	(0.0128)***
$D_{c,(s,)t-1}$ · Entry time	0.0016	0.0020	0.0026	0.0020	0.0025	0.0024
	(0.0025)	(0.0026)	(0.0040)	(0.0009)**	(0.0009)***	(0.0016)
$D_{c,(s,)t-1}$ · Investor	-0.0176	-0.0202	-0.0231	-0.0210	-0.0260	-0.0211
protection	(0.0246)	(0.0260)	(0.0392)	(0.0082)***	(0.0086)***	(0.0123)*
$D_{c,(s,)t-1}$ · Contract	0.0003	0.0003	0.0003	0.0001	0.0001	0.0002
enforcement	(0.0001)***	(0.0001)***	(0.0001)**	(0.0001)	(0.0001)*	(0.0001)***
$D_{c,(s,)t-1}$	0.8818	0.8998	0.9490	0.9610	0.9864	0.9273
	(0.1803)***	(0.1903)***	(0.2717)***	(0.0502)***	(0.0622)***	(0.0897)***
Observations	680	619	405	6,120	5,571	3,645
			Panel B. OECD 2-digit data			
		Country level			Country-industry level	
$D_{c,(s,)t-1}$ · Credit	-0.0362	-0.0367	-0.0425	-0.0240	-0.0251	-0.0220
	(0.0117)***	(0.0121)***	(0.0205)**	(0.0042)***	(0.0044)***	(0.0074)***
$D_{c,(s,)t-1}$ · Entry time	-0.0004	0.0005	0.0042	0.0019	0.0022	0.0016
	(0.0016)	(0.0016)	(0.0020)**	(0.0005)***	(0.0005)***	(0.0011)
$D_{c,(s,)t-1}$ · Investor	-0.0089	-0.0121	0.0199	-0.0368	-0.0419	-0.0284
protection	(0.0125)	(0.0129)	(0.0132)	(0.0053)***	(0.0055)***	(0.0016)***
$D_{c,(s,)t-1}$ · Contract	0.0001	0.0001	0.0003	0.0001	0.0002	0.0003
enforcement	(0.0001)	(0.0001)	(0.0001)***	(0.0001)	(0.0001)*	(0.0001)***
$D_{c,(s,)t-1}$	0.9279	0.9332	0.6507	0.9671	0.9212	0.9855
	(0.0821)***	(0.0845)***	(0.1069)***	(0.0360)***	(0.0376)***	(0.0554)***
Observations	556	502	340	11,820	10,740	7,500

Note: The dependant variable is $D_{c,t}$ in Columns (2)-(4), and $D_{c,s,t}$ in Columns (5)-(7), both calculated according to equation (5). Entry time is the number of days necessary to start a business in the respective country. Investor protection is an average of three indices of degree of protecting private investors. Contract enforcement is the number of days necessary to settle a contractual dispute in court. Columns 2 and 5 report the regression estimates from the full unbalanced panel covering the period 1970-2006; Columns 3 and 6 report the regression estimates after excluding countries for which data is only available after 1990; Columns 4 and 7 report the regression estimates after excluding countries which liberalized their credit markets during the sample period. Country and year fixed effects are included in all regressions (Columns (2)-(4)). Country fixed effects interactions with industry fixed effects, as well as year fixed effects, are included in all regressions (Columns (5)-(7)). White (1980) standard errors appear below each coefficient in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 9. Finance and convergence to allocative efficiency frontier in larger economic zones

	OLS	Arellano - Bond	Benchmark= US industry Sharpe ratio	Benchmark= US industry share young firms	Financial sector excluded	2SLS
			SIC 1-digit data			
$D_{c,t-1} \cdot$ Credit	-0.1147	-0.1729			-0.0966	-0.1619
	(0.0239)***	(0.0247)***			(0.0239)***	(0.0359)***
$D_{c,s,t-1} \cdot$ Credit			-0.0966	-0.7495		
$\cdot$ Benchmark			(0.0230)***	(0.1816)***		
$D_{c,t-1}$	0.9121	0.8694	0.8899	0.9214	0.9021	0.8989
	(0.0228)***	(0.0219)***	(0.0257)***	(0.0229)***	(0.0308)***	(0.0243)***
Benchmark			0.0390	-0.0009		
			(0.0086)***	(0.0005)*		
Observations	135	126	135	135	120	135

Note: The dependant variable is $D_{c,t}$, calculated according to equation (5), using aggregated data for the 12 original eurzone countries. 'Credit' is the ratio of private credit to GDP for the 12 original eurozone countries. Column 1 reports the OLS regression estimates from the full unbalanced panel covering the period 1991-2006. Column 2 reports the estimates from a GMM procedure which implements the Arrelano-Bond estimator to account for the presence of a lagged dependent variable in a dynamic panel model. 'US industry Sharpe ratio' is the ratio of long-term growth divided by long-term standard deviation of growth for US industries at the SIC 1-digit level. 'Share of young firms' is the share of firms younger than 2 years out of the full population of firms for US industries at the SIC 1-digit level. Financial sector (SIC industry #8) is excluded from the regression in Column 5. In column 6, the credit variable has been instrumented using an indicator variable equal to 1 if the year is at least 1999. Industry and year fixed effects included in all regressions. White (1980) standard errors appear below each coefficient in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Appendix A. Variables and sources

Value added	Country-industry estimate of real annual growth of value added. Available until 2007 for 9 SIC 1-digit and 20 OECD 2-digit industries for 28 OECD countries, at best staring in 1970. Constructed by deflating nominal growth rates. Source: STAN Database for Structural Analysis.
Share young firms	Share of firms younger than 2 years out of the total population of firms, for US corporations. Calculated for 1-digit SIC industries. Average for the years 1985-95. Source: Dun & Bradstreet.
Private credit / GDP	The value of total credits by financial intermediaries to the private sector in each country, available with annual frequency. Excludes credit by central banks. Calculated using the following deflation method: {(0.5)*[Ft/P_et + Ft-1/P_et-1]}/[GDP_t/P_at] where F is credit to the private sector, P_e is end-of period CPI, and P_a is average annual CPISource: Beck et al. (2000, updated 2008).
Bank liberalization	Dummy variable equal to 1 after the year in which domestic credit markets were open to foreign participation. Source: Bekaert et al. (2005).
Entry time	The time (in days) it takes to register a new business entity in the respective country. Data aggregated over the time period. Source: Doing Business Database.
Investor protection	Average of three indices of protection of investors: trasparency of transactions, liability for self-dealing, and shareholders' ability to sue officers and directors for misconduct. Data aggregated over the time period. Source: Doing Business Database.
Contract enforcement	The time (in days) it takes to resolve a contractual dispute in the respective country. Data aggregated over the time period. Source: Doing Business Database

Appendix B. Sectoral coverage

1. SIC 1-digit Classification (9 sectors)

1. Agriculture, Hunting, Forestry, and Fishing
2. Mining and Quarrying
3. Manufacturing
4. Electricity, gas, and water supply
5. Construction
6. Wholesale and retail trade - restaurants and hotels
7. Transport, storage and communications
8. Finance, insurance, real estate, and business services
9. Community, social, and personal services.

2. OECD 2-digit Classification (20 sectors)

01-05. Agriculture, Hunting, Forestry, and Fishing
10-14. Mining and Quarrying
15-16. Food Products, Beverages, and Tobacco
17-19. Textiles, Textile Products, Leather, and Footwear
20. Wood and Products of Wood and Cork
21-22. Pulp, Paper, Paper Products, Printing, and Publishing
23-25. Chemical, Rubber, Plastics, and Fuel Products
26. Other Non-Metallic Mineral Products
27-28. Basic Metals and Fabricated Metal Products
29-33. Machinery and Equipment
34-35. Transport Equipment
36-37. Manufacturing Not Elsewhere Specified and Recycling
40-41. Electricity, Gas, and Water Supply
45. Construction
50-52. Wholesale and Retail Trade
55. Hotels and Restaurants
60-64. Transport, Storage and Communications
65-67. Financial Intermediation
70-74. Real Estate, Renting, and Business Activities
75-99. Community, Social, and Personal Services