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Financial Architecture and Economic Performance: International Evidence

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The paper examines the relation between the architecture of an economy's financial system—its degree of market orientation—and economic performance in the real sector. I find that while market-based systems outperform bank-based systems among countries with developed financial sectors, bank-based systems fare better among countries with underdeveloped financial sectors. Countries dominated by small firms grow faster in bank-based systems and those dominated by larger firms in market-based systems. The findings suggest that recent trends in financial development policies that indiscriminately prescribe market-oriented financial-system architecture to emerging and transition economies might be misguided because suitable financial architecture, in and of itself, could be a source of value. *Journal of Economic Literature* Classification Numbers: G1, G21, O1, 04.

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An important long-standing issue in corporate finance has been the relative merits of banks and financial markets as providers of capital. A macroeconomic version of this question is whether the financial architecture of an economy—i.e., the degree to which its financial system is bank-oriented or market-based—has any impact on economic performance in the real sector. Does a financial architecture anchored on markets work better than one centered on banks, and if so, under what conditions? I confront this question empirically using international data.

The theoretical literature is sparse in its predictions whereby, lacking a unified approach, different theories emphasize specific features of banks and markets.

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Opinions range from the position that financial architecture has no real consequences to arguments emphasizing the inherent superiority of either market-based system (e.g., Macey, 1998) or bank-based systems (e.g., Gilson and Roe, 1993). A middle ground position is to argue that the effectiveness of a particular architecture depends on a host of country-specific factors. These may include the contractual environment of the country (e.g., Rajan and Zingales, 1998b), the informational structure of participating firms (e.g., Boot and Thakor, 1997), or the technological characteristics of the economy (Allen and Gale, 1999b; Rajan and Zingales, 1998b).

Financial markets and banks perform vital functions in an economy that may include capital formation, facilitation of risk sharing, information production, and monitoring. The case for bank-based or market-oriented systems is made based on the relative effectiveness with which banks or markets execute these common functions. Some argue that financial architecture is inconsequential to the real sector of the economy with the belief that banks and markets are complementary in providing financial services, and that neither has a natural advantage in the provision of all services. According to this view, it is the quantity and quality of these financial services in an economy that matter, not the venue by which they are provided (see Levine, 2002, in this issue).

Recent theoretical discussion on the issue takes a middle ground position by suggesting that financial system architecture (i.e., whether bank-oriented or market-based) may matter in that markets or banks may have a comparative advantage in delivering particular financial services depending on the economic and contractual environments of the country. This perspective relies on distinct differences, rather than the similarities, in the types of services provided by markets and banks. In particular, a key attribute of financial markets—a feature that distinguishes them from banks—is that equilibrium prices formed in markets provide valuable information (about the prospect of investment opportunities) to real decisions of firms. This is what is called the 'information feedback' function of markets. The relative importance of a given financial architecture (market-based vs bank-based) therefore depends on how effectively markets perform this information feedback function (supply side argument) and the value of market information to decision making in the firm (demand side argument).

On the supply side, the relative merits of markets versus banks depend on the effectiveness with which markets can perform their information feedback function. Well-functioning markets rely on contracts and their legal enforceability. Weak legal systems and poor institutional infrastructure impede the functioning of markets, reducing the supply of information feedback as a market function. Rajan and Zingales (1998b) argue that bank-based architecture survives and is more effective in these situations, because banks can use their power, in the absence of effective legal provision, to protect their interest. Hence, market-based systems work better where stronger contractual environments are in place and bank-based systems fare well where such is lacking.

On the demand side, one would expect a prevalence of market-based systems in situations where information feedback is especially valued. However, market-generated information is not always considered useful for various reasons. For example, the prevalence and severity of moral hazard attenuates the value of information feedback by financial markets. Boot and Thakor (1997), for instance, argue that banks provide a superior resolution of post-lending moral hazard resulting from potential distortions in firms' investment choices while markets provide improvements in real decisions through the information feedback function. However, the greater the moral hazard problem in the economy, the lower the information acquisition in the financial markets, and the smaller the value of market information in affecting real decisions. The value of market information is therefore lower in economies dominated by firms that are prone to moral hazard problems, implying that a bank-based system might be better for such economies.

The foregoing suggests that the real consequences of financial architecture should depend on a host of country-specific factors, including the contractual, legal, and institutional environment of the country and the associated degree of agency and informational problems in the economy. These factors systematically vary across groups of countries. For example, weak legal systems, poor property rights, and fragile regulatory institutions characterize less developed countries (LaPorta *et al.*, 1998), leading to financial underdevelopment (LaPorta *et al.*, 1997). This diversity in contractual and informational environment across countries leads one to expect a systematic pattern in the effectiveness of different financial architectures. Given the weak legal and institutional structure in financially underdeveloped countries, it appears more likely for bank-based financial architecture to prevail and be more effective in these economies. Similarly, one is more likely to find effective bank-based architectures in countries that are dominated by small firms, which have a greater need for flexible financing. In Bolton and Freixas (2000), for example, the value of financing flexibility is such that, in equilibrium, less mature and riskier firms would prefer bank financing even when costly, while mature and safer firms tap into securities markets. Hence, the distribution of firms across risk class may dictate the dominance of bank versus market financing. There are also substantial fixed costs, partly reflecting the underlying agency and informational problems, in issuing securities, making it a viable financing option mostly to large and stable firms.

Based on industry-level data from a panel of 36 countries, this paper explores how a country's financial architecture affects performance in the real sector of the economy. My goal is to examine whether real economic performance varies across countries of differing financial architecture. In particular, does the relative performance of bank-based vis-à-vis market-based systems vary between financially developed and financially underdeveloped economies and among countries of differing size distribution of firms?

I find that financial architecture is not a matter of indifference in that real economic performance varies systematically across economies with differing financial

system architecture. Across countries with underdeveloped financial sectors, industries from bank-based economies grow faster than industries from market-based systems, while industries in market-based systems grow faster across countries with developed financial systems. That is, the degree of market orientation of the financial system is significantly positively related to economic performance in countries with developed financial sectors, whereas this relation is significantly negative in countries with underdeveloped financial sectors.

I find that bank-based financial architecture outperforms market-based systems across countries dominated by small firms while market-based architecture fares well across countries populated with larger firms. As a result, the size distribution of firms appears to be a key determinant of the composition of financing. This is also consistent with previous findings. Even in advanced countries, small firms rely on bank financing more so than on markets (Petersen and Rajan, 1995).

The findings indicate that financial architecture, in and of itself, could be a source of value. A lack of fit between the country's financial architecture and its legal institutions could retard economic performance. The results also suggest that the recent trend in policy-making circles of prescribing market-based systems indiscriminately across emerging and transition economies might be misguided. Markets require requisite institutional and legal infrastructure. Moreover, in countries where most firms are small, as in many emerging and transition economies, there is more economic value in strengthening the banking sector. A potential major weakness of relationship-based financial systems is the relative lack of competition and transparency. On the other hand, relationship-based finance has an important advantage of being flexible in accommodating firms with short-term difficulties but long-term potential. Established relationships enable creditors to benefit from future successes, as well as 'dynamically cross-subsidize' younger, potentially profitable firms with short-term financial difficulty using cash flows from mature firms that have the ability to pay.

The paper is related to Levine (2002) and Beck and Levine (2000). In a cross-country study, Levine (2002) examines the impact of financial architecture on per capita GDP growth. Beck and Levine (2000) examine whether growth rates of industries that differ in external financial dependence depend on countries' financial architecture. Both Levine (2002) and Beck and Levine (2000) identify overall financial development and not financial system architecture as the key determinant of growth.

The paper differs from Levine (2002) and Beck and Levine (2000) in a number of ways. First, Levine (2002) and Beck and Levine (2000) take a view that the strength of the legal system, which determines the overall level of financial services, is more important for economic performance than distinguishing the financial system as bank-based or market-based. While not discounting the role of the legal system, I argue that financial architecture complements the underlying legal and institutional environment in promoting growth. Accordingly, Levine (2002) makes a comparison of overall financial development and financial architecture in terms of their

impacts on growth. I, on the other hand, examine whether a particular financial architecture is more suitable for a country's level of financial development. I argue that bank-based architecture suitably complements weak legal and institutional environments, as markets require stronger legal and institutional structure to flourish. I report a significant positive relation between financial architecture and performance among financially developed countries and a significant inverse relation in financially underdeveloped countries.

Second, this paper is the first to explore differences across countries in size distribution of firms as a determinant of the effectiveness of financial architecture, making a case that distinguishing financial systems as bank-based or market-based may be important to economic performance. Recognizing small firms' need for financial flexibility and their relative lack of access to securities markets, I argue that bank-based architectures could be relatively more effective in countries that are dominated by small and less mature firms. I examine the relation between financial architecture and economic performance across countries of differing distribution of firm size. I find that this correlation is significantly negative in the lowest quartile of countries on the average firm-size scale and significantly positive in the highest quartile of countries.

In so doing, I emphasize the structural differences, in terms of firm-size distribution and overall development, across countries to identify the comparative advantages of financial system architectures. Bank-based systems appear to be more effective than market-based systems in financially underdeveloped countries and in countries dominated by smaller firms, whereas market-based systems are more effective in financially developed countries and countries dominated by larger firms.

Finally, I use industry-level data for 10 industries in a cross-section of 36 countries over the period 1980 through 1995. Because I attempt to explain average performance over this period, I deal with an unbalanced panel with a maximum of 360 data points. I effectively control for unobservable country- and industry-related determinants of growth through random effects. Levine (2002) uses country-level data with a sample size of 48 data points, using explicit controls. Levine and Beck (2000) use industry-level data as ours to see if growth rates of industries that differ in external financial dependence depend on countries' financial architecture. They do not examine differences in the role of financial architecture across countries that differ in overall development and the size distribution of firms the way I do.

The balance of the paper is as follows. Section 1 introduces the data and the empirical methodology, Section 2 reports the main results, and Section 3 concludes.

1. DATA AND METHODOLOGY

My database combines international data on financial architecture and on financial development, industry-level data on economic performance, and various

measures of the legal and institutional environments of countries. I have complete data on these sets of variables for 36 countries. I have data on financial architecture and financial development for a large cross section of countries, but industry performance data only for a matching 36 countries, thus limiting the size of the sample.

1.1. Financial Architecture

There is no uniformly accepted empirical definition of whether a given country's financial system is market-based or bank-based. Previous studies use stylized facts based on a handful of countries, such as Germany, as representative of a bank-based system and the United States as the prototypical market-based system. I use a variety of financial architecture indicators based on aggregate cross-country data recently compiled at the World Bank. The data set described in Beck *et al.* (2000) contains measures of the relative size, activity, and efficiency of the banking and market subsectors of the financial system for a broad cross section of countries over the period 1980 to 1995, which also coincides with the period for which we have data on economic performance. For this study, I use two measures of financial architecture as described in Demirguc-Kunt and Levine (1999): ARCHITECTURE, a continuous variable, and MARKET, a dummy variable that distinguishes market-based countries from bank-based systems. The definitions of these variables as described in Demirguc-Kunt and Levine (1999) are as follows:

Architecture: an index of the degree of stock market orientation of a financial system and is based on three indices of financial architecture based on measures of relative size, activity, and efficiency of the stock market in a given country vis-à-vis those of the banking sector. Higher values of this index indicate a more market-oriented financial system. The variable ARCHITECTURE reflects the means-removed averages of three variables: architecture size, architecture activity and architecture efficiency.

Architecture size: measures the relative size of stock markets to that of banks in the financial system. The size of domestic stock market is measured by market capitalization of domestic stocks to GDP ratio. The size of the banking sector is measured by the bank credit ratio defined as the claims of the banking sector against the private sector as a percentage of GDP. This excludes claims of non-bank intermediaries, and credit to the public sector. Architecture size combines the two size measures as a ratio of the capitalization ratio to bank credit ratio. Larger values indicate more market orientation.

Architecture activity: measures the activity of stock markets relative to that of banks and is denoted by the ratio of total value of stocks traded to bank credit ratio. Total value traded as a share of GDP measures stock market activity relative to economic activity, and bank credit ratio (defined above) also indicate the importance of banks in the economic activities of the private sector.

Architecture efficiency: measures the relative efficiency of a country's stock markets vis-à-vis that of its banks. Efficiency of stock markets is measured by the total value traded ratio defined to be the share of total value of shares traded to GDP. Efficiency of banking is measured by overhead costs defined to be the ratio of banking overhead costs to banking assets. Architecture efficiency is the product of total value traded ratio and overhead costs. Demirguc-Kunt and Levine (1999) also present measures using turnover ratio (instead of value traded) and find no different rankings.

ARCHITECTURE, the conglomerate measure, takes, after the means of each series are removed, the average of capitalization to bank credit ratio, value traded to bank credit ratio, and the product of value traded and overhead costs. For robustness, I also develop an alternative aggregation of the architecture variables. I generate a conglomerate measure as a principal component of the three architecture variables.

Market: *MARKET*, my alternative measure, is a dummy variable and classifies countries as market-based if they fall above the mean of the ARCHITECTURE, the conglomerate index, and as bank-based if they score below the mean of the index.

Table 1 presents country classifications based on financial architecture and financial development (discussed below). The top two panels list countries with market-based financial architecture and the bottom two provide a list of bank-based systems. The average of the ARCHITECTURE variable for the market-based countries is 0.866 and that for bank-based countries is -0.38141. The difference is statistically significant at 1%. This is true comparing market-based economies and bank-based economies across underdeveloped countries (0.5300 against -0.40889), as well as across developed economies (1.09 against -0.3608).

1.2. Financial Development

To control for the overall development of the financial systems, I classify countries into *financially developed* and *financially underdeveloped* based on two indices. Following Demirguc-Kunt and Levine (1999), I define a country as having underdeveloped financial system if it scores below the mean on both bank development and stock market development. Specifically, an underdeveloped financial system will have (1) lower than the mean for bank credit ratio and (2) lower than the mean for value traded ratio (i.e., value traded to GDP ratio).

Table 1 provides the classification of countries by financial development. Countries on the left two panels are countries with underdeveloped financial sectors, and those on the right two panels are countries with developed financial systems. In this classification, Denmark is considered financially underdeveloped because it registers below the average on bank development and stock market development.[2]

[2] The forgoing analysis is robust to classifying Denmark as financially developed or removing it altogether.

TABLE 1

Financial Architecture, Capital Market Functions, and Industry Performance across Countries during the Period 1980–1995

Country	Architecture	Value traded	Bank ratio	Growth in value added	Growth in productivity	Growth in production efficiency	Growth in economic efficiency	Average mfg. firm size
Financially underdeveloped—Market-based systems								
Chile	0.25	0.09	0.45	0.053	0.038	0.002	0.089	11.655
Denmark	0.15	0.16	0.38	0.029	0.018	0.0002	−0.018	10.915
Mexico	0.68	0.13	0.22	0.021	0.009	−0.0006	−0.154	10.137
Peru	0.16	0.04	0.09	−0.119	−0.036	−0.009	−1.103	9.944
Philippines	0.71	0.15	0.28	0.018	0.031	0.002	0.036	9.828
Turkey	1.23	0.16	0.13	0.054	0.016	0.001	0.190	11.639
Average	**0.530**	**0.122**	**0.258**	**0.009**	**0.013**	**−0.0006**	**−0.159**	**10.686**
Financially underdeveloped—Bank-based systems								
Egypt	−0.82	0.02	0.23	0.029	0.010	−0.0006	−0.509	10.475
Columbia	−0.47	0.01	0.16	0.039	0.011	0.001	0.089	10.089
Greece	−0.34	0.06	0.18	0.022	0.038	0.002	0.218	10.335
India	−0.14	0.08	0.24	0.089	0.027	0.004	0.398	9.239
Indonesia	−0.50	0.08	0.46	0.171	0.030	0.005	0.331	9.975
Pakistan	−0.38	0.06	0.23	0.075	−0.004	0.0005	−0.2253	10.136
Sri Lanka	−0.54	0.02	0.21	0.155	0.054	0.012	0.476	8.989
Venezuela	−0.15	0.03	0.12	−0.005	−0.005	−0.004	−0.532	10.082
Zimbabwe	−0.34	0.01	0.16	0.027	−0.029	−0.002	−0.281	9.475
Portugal	−0.38	0.05	0.54	0.075	−0.004	0.0005	−0.253	9.825
Average	**−0.409**	**0.042**	**0.253**	**0.067**	**0.015**	**0.002**	**−0.007**	**9.863**

Country	Architecture	Value traded	Bank ratio	Growth in value added	Growth in productivity	Growth in production efficiency	Growth in economic efficiency	Average mfg. firm size
Financially developed—Market-based systems								
Australia	0.50	0.33	0.70	0.008	0.020	0.000	0.028	10.523
Canada	0.41	0.29	0.57	0.030	0.019	−0.000	−0.012	11.259
South Korea	0.89	0.44	0.53	0.113	0.049	0.005	0.926	10.362
Malaysia	2.93	1.14	0.75	0.108	0.019	0.002	0.002	10.591
Netherlands	0.11	0.43	0.90	0.017	0.016	−0.0002	0.017	12.256
Singapore	1.18	0.70	0.83	0.040	0.008	0.0003	0.080	11.366
Sweden	0.91	0.33	0.46	0.008	0.018	0.0001	0.007	11.754
United Kingdom	0.92	0.55	1.14	0.002	0.021	0.0002	0.101	10.588
United States	1.96	0.62	0.64	0.034	0.032	0.0004	0.112	11.070
Average	**1.090**	**0.537**	**0.724**	**0.040**	**0.022**	**0.0009**	**0.140**	**11.085**
Financially developed—Bank-based systems								
Austria	−0.73	0.08	0.93	0.019	0.028	0.0007	0.174	11.427
Belgium	−0.66	0.05	0.56	−0.001	0.002	−0.001	−0.084	10.848
Finland	−0.53	0.12	0.77	0.0003	0.021	0.0005	0.157	11.564
Germany	−0.10	0.28	0.94	0.025	0.022	−0.0002	0.025	12.352
Israel	−0.06	0.19	0.60	−0.019	−0.013	−0.003	−0.380	10.375
Italy	−0.57	0.08	0.52	−0.015	−0.018	−0.003	−0.311	11.930
Japan	−0.19	0.28	1.07	0.042	0.018	−0.0003	0.016	10.688
Jordan	−0.14	0.12	0.62	0.008	−0.021	−0.004	−0.494	7.680
New Zealand	−0.29	0.14	0.78	−0.016	0.009	−0.0008	−0.038	9.537
Norway	−0.33	0.14	0.57	−0.002	0.025	0.000	0.108	11.201
Spain	0.02	0.23	0.68	0.011	0.013	−0.0003	0.023	9.64
Average	**−0.361**	**0.155**	**0.731**	**0.005**	**0.009**	**−0.0009**	**−0.047**	**11.652**

Measures of bank and stock market development are significantly higher in financially developed countries than in underdeveloped countries. The average bank ratio for developed countries is 0.728 versus 0.255 for underdeveloped countries; stock value traded to GDP ratio is 0.327 in developed countries versus 0.072 in underdeveloped countries.

1.3. Economic Performance

I use industry-level data obtained from the United Nations Industrial Database to construct economic performance measures. The database contains data on the production and cost structure of manufacturing industries for the sample of countries. I use data on 10 representative manufacturing industries. The economic performance measures include annual growth in industry real value added, growth in productivity, and growth in production and economic efficiency. Real value added is gross output less intermediate inputs, all stated in real terms.

Growth in value added could be a result of growth in factors of production and improvements in productivity. Productivity improvements, in turn, can be decomposed into growth in the efficiency with which resources are utilized given the technology of the firm, and technological change which reflects improvements in products and processes. Efficiency improvements are measured in reference to cross-country production (and cost) functions as representations of the best-practice technology. Production efficiency is a measure of *how close* an industry becomes to the best-practice production frontier in its production structure. Economic efficiency is *how close* an industry gets to the best-practice cost frontier in its cost structure. These measures are obtained from Tadesse (2000), and Appendix 1 presents details on their construction.

Table 1 provides a summary of these performance measures for each country in the sample and summaries for the subsample of countries. Table 2 provides a simple comparison of performance between market-based and bank-based systems without distinguishing based on financial development or firm size. For the full sample, there is no discernable difference in economic performance (for any of the performance measures) between bank-based countries and market-based economies. The same is true between financially developed countries and financially underdeveloped countries (see Table 2). Notice in Table 1, however, the differences in economic performance between market-based (top two panels) and bank-based economies (bottom two panels) for the developed (right two panels) and underdeveloped (left two panels) subsample, respectively. On each performance measure, the average economic performance of bank-based systems is significantly higher than that of market-based systems across financially underdeveloped countries: for example, growth in value added (0.067 against 0.009), growth in production efficiency (0.002 versus −0.0006), and growth in economic efficiency (−0.007 versus −0.1597). The reverse is true (i.e., economic performance is better in market-based economies than in bank-based economies) among the countries that have developed financial systems.

TABLE 2
Economic Performance Comparison of Bank-Based and Market-Based Countries

	Growth in value added	Growth in production efficiency	Growth in economic efficiency	Growth in productivity
Financial architecture				
Bottom 25%	0.037	0.001	0.0005	0.016
Top 25%	0.039	0.001	0.0013	0.023
t test	−0.16	0.12	−0.46	−0.69
Bank vs market				
Bank-based	0.030	0.0004	0.0001	0.014
Market-based	0.023	0.0001	−0.0001	0.018
t test	0.98	0.61	0.19	−0.73
Financial System Development				
Developed	0.037	0.0005	−0.0009	0.013
Underdeveloped	0.020	0.0001	0.0007	0.017
t test	2.23**	0.59	−1.23	−0.52

Note. Industry growth in real value added is the average annual compounded growth rate in real value added for each of the 10 industries in each of the 36 countries over the period 1980 to 1995. Productivity and efficiency are computed based on parameter estimates of cross-country stochastic production and cost frontiers on the panel of industry production and cost data. Production efficiency measures the degree to which an industry diverges from the efficient production frontier. Economic efficiency measures the degree to which an industry diverges from the best-practice cost frontier. Financial architecture is a continuous variable that measures the degree of market orientation of a financial system and is an average of the means-removed values of size, activity, and efficiency measures. Market-based dummy is a variable that takes 1 if the financial system is classified as market-based and 0 if it is bank-based. Developed financial systems are countries with above average stock market liquidity and the ratio of bank credit to private sector to GDP.

** Significant at 5%.

2. RESULTS

2.1. Financial Architecture, Financial Development, and Economic Performance

As a preliminary step to gauge the relations between financial architecture and performance, we begin with a difference in means test of economic performance between market-based systems and bank-based systems. Table 3 groups countries into those with underdeveloped and those with developed financial systems. Within each group, we then compare economic performance measures between countries of market-based architecture and those with bank-based systems.

Across countries with developed financial systems, economic performance is significantly larger in countries with market-based financial architecture than in those with bank-based architecture. Conversely, across countries with underdeveloped financial systems, economic performance is significantly larger in countries with bank-based systems than in those with market-based architecture. This is true nearly for all measures of economic performance. For example, the average realized

TABLE 3
Economic Performance Comparison of Bank-Based and Market-Based Systems in Financially Developed and Financially Underdeveloped Countries

Performance measure	Overall financial development	Bank-based	Market-based	*t* test
Growth in value added	Developed	0.008	0.037	−4.93*
	Underdeveloped	0.063	0.005	4.12*
	t test	−5.87*	2.69*	
Growth in production efficiency	Developed	−0.0004	0.0008	−2.72*
	Underdeveloped	0.0017	−0.0008	1.66***
	t test	−2.14**	1.40	
Growth in economic efficiency	Developed	0.0003	0.014	−2.22**
	Underdeveloped	−0.00004	−0.0019	0.91
	t test	0.25	2.26**	
Growth in productivity	Developed	0.013	0.022	−1.91***
	Underdeveloped	0.014	0.012	0.14
	t test	−0.16	0.90	

Note. Industry growth in real value added is the average annual compounded growth rate in real value added for each of the 10 industries in each of the 36 countries over the period 1980 to 1995. Productivity and efficiency are computed based on parameter estimates of cross-country stochastic production and cost frontiers on the panel of industry production and cost data. Production efficiency measures the degree to which an industry diverges from the efficient production frontier. Economic efficiency measures the degree to which an industry diverges from the best-practice cost frontier. Financial architecture is a continuous variable that measures the degree of market orientation of a financial system and is an average of the means-removed values of size, activity, and efficiency measures. Market-based dummy is a variable that takes 1 if the financial system is classified as market-based and 0 if it is bank-based. Developed financial systems are countries with above average stock market liquidity and the ratio of bank credit to private sector to GDP.

* Significant at 1%.

** Significant at 5%.

*** Significant at 10%.

real growth rate in value added for market-based, financially well-developed countries, 3.7%, is statistically larger than that for bank-based financially well-developed countries (0.8%). On the other hand, growth rate in value added for bank-based, financially underdeveloped countries, 6.3%, statistically dominates that for bank-based, financially underdeveloped countries, 0.5%. Across developed financial systems, the average growth rate in production efficiency for market-based economies (0.0008) is significantly larger than that for bank-based economies (−0.0004). For financially developed countries, the average growth rate in production efficiency for bank-based economies (0.002) is significantly larger than that for market-based economies (−0.0008).

To further explore the patterns of relations that are emerging in the data, while controlling for potential country and industry heterogeneity that may drive the preliminary findings, I estimate empirical models in which I attempt to explain cross-country variations in growth in real value added based on variations in financial

architecture. I first estimate a regression model in which I include country and industry characteristics explicitly to control for these potential country and industry heterogeneity. Among the country characteristics, I include initial per capita GDP to control for the well-known convergence effect. As an industry characteristic, I include the output share of an industry to the total manufacturing output of the country to control for the relative importance of the industry in the country.

Finally, I estimate a random-effects specification of the following form where, besides the explicit controls, the latent country-related and industry-related sources of variations on growth are effectively accounted for:

$$G_{ci} = \alpha + \beta FA_c + \sum\nolimits_{ci} \gamma Z_{ci} + \phi FD_c + \delta(FA_c * FD_c) + \varepsilon_{ci}$$

where

$$\varepsilon_{ci} = \lambda_c + \eta_i + e_{ci}.$$

The model is a three-way error component specification with random country and industry effects to explicitly account for the cross-correlation between error terms for observations in the same country and the same industry respectively. *FA* is either of the financial architecture variables: *ARCHITECTURE*, the conglomerate measure of the market orientation of the financial system, or *MARKET*, the dummy variable that takes 1 if the financial system is classified as market-oriented and 0 if not. FD is an indicator of financial development in a given country. Specifically, I use the dummy variable UNDER, which takes the value 1 for financially underdeveloped systems, to indicate financial development. Z represents a host of explicit control variables. In all the specifications, I include initial per capita GDP of countries to control for the impact of initial conditions on economic growth. I also include the output share of an industry to the total manufacturing output of the country. λ and η are random country and industry effects intended to capture the latent country-related and industry-related sources of variations on growth. The dependent variable G is the average annual growth rate in value added of industry i, in country c over the period 1980 through 1995. (Summary statistics for the variables are provided in Appendix 2.) I expect a positive relation between growth and financial architecture in financially developed economies and a negative relation in financially underdeveloped ones.

Table 4 presents the results of the regressions across 10 industries in 36 countries around the world. I use the dummy variable UNDER, which takes the value 1 for financially underdeveloped systems, to indicate financial development. For measuring financial systems architecture, I use the dummy variable MARKET, which takes 1 for market-based systems, and, alternatively, the continuous variable ARCHITECTURE. The focal variables for testing the hypotheses are the interaction variables: UNDER × MARKET and UNDER × ARCHITECTURE.

From the OLS regressions, in column I, the coefficient on the interaction between UNDER and MARKET is negative and statistically significant, implying

TABLE 4
Economic Performance Comparison of Bank-Based and Market-Based Systems in Financially Developed and Financially Underdeveloped Countries—Regression Results

	OLS				Random effects			
	I	II	III	IV	I	II	III	IV
Intercept	0.162*	0.174*	0.111**	0.140*	0.164**	0.175**	0.124	0.150***
	(0.044)	(0.043)	(0.044)	(0.043)	(0.086)	(0.084)	(0.085)	(0.084)
Under	0.011	−0.015	0.049*	0.011	0.013	−0.011	0.043	0.008
	(0.016)	(0.012)	(0.017)	(0.014)	(0.031)	(0.025)	(0.033)	(0.028)
Market	0.022***		0.024**		0.026		0.027	
	(0.010)		(0.010)		(0.020)		(0.019)	
Architecture		0.017*		0.014*		0.018***		0.016
		(0.005)		(0.005)		(0.011)		(0.011)
Market × Under	**−0.065***		**−0.073***		**−0.066****		**−0.072****	
	(0.016)		**(0.016)**		**(0.033)**		**(0.031)**	
Architecture × Under		**−0.046***		**−0.047***		**−0.044*****		**−0.044*****
		(0.013)		**(0.018)**		**(0.026)**		**(0.025)**
Turnover			0.028	0.031			0.019	0.020
			(0.020)	(0.021)			(0.034)	(0.037)
Bank ratio			0.094*	0.076*			0.074***	0.056
			(0.024)	(0.023)			(0.044)	(0.045)
Per capita GDP	−0.016*	−0.017*	−0.018*	−0.019*	−0.017**	−0.017**	−0.018**	−0.019**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.017)	(0.009)	(0.008)	(0.009)
Industry share in manufacturing	0.035	0.043	0.050	0.053	0.060	0.060	0.060	0.060
	(0.089)	(0.089)	(0.086)	(0.087)	(0.072)	(0.072)	(0.073)	(0.073)

Note. The dependent variable is average annual growth in real value added. The parameter estimates are maximum likelihood estimates of regression equations containing random country and industry effects. The OLS equations do not contain random effects. Architecture is a continuous variable that measures the degree of market orientation of a financial system and is a means-removed average of the size, activity, and efficiency dimensions of financial architecture. Market is a dummy variable that takes 1 if the financial system is classified as market-based and 0 if it is bank-based. UNDER is an indicator variable that takes 1 for countries classified as financially underdeveloped and 0 otherwise. Stock market turnover is total value of shares traded divided by market capitalization. Bank credit ratio is claims of deposit money banks against the private sector divided by GDP. All regressions also contain log of initial per capita income and industry share in manufacturing (not reported). Industry share in manufacturing is calculated by dividing the real output of the industry in the country by the total real output of the manufacturing sector of the country. Coefficients of the country and industry effects are not reported. Asymptotic standard errors are given in parentheses.

* Significant at 1%.

** Significant at 5%.

*** Significant at 10%.

that, other things being equal, market orientation of the financial system is inversely related to growth in real output in financially underdeveloped countries. The MARKET variable enters with positive sign, implying a positive relation between market orientation and growth in financially developed countries, though this relation is somehow weaker than that for financially underdeveloped countries. Column II reports similar results based on the continuous variable ARCHITECTURE. The coefficient on the variable ARCHITECTURE is positive and highly statistically significant, implying that, among countries that are financially developed, market orientation of the financial system is positively associated with growth. The interaction variable between ARCHITECTURE and UNDER is negative and statistically significant at 1% significance level. The absolute value of this coefficient (0.046) is very large compared to the coefficient for ARCHITECTURE (0.017). This implies that, other things being equal, across countries that are financially underdeveloped, relatively market-based systems tend to achieve lower output growth.

As would be expected, per capita GDP has significant negative coefficients. Poorer countries grow faster, other things being equal. The magnitude of the implied rate of convergence is comparable to what is found in the growth literature. Industry effects appear to be less important as the industry's share in total manufacturing output has no relationship with industry growth.

The OLS regressions include explicit controls of a country factor in the form of per capita GDP and an industry factor in terms of industry's share in total manufacturing. As there are a host of other country- and industry-related factors that could derive the cross-sectional variations in output growth, we introduce a random-effects specification where, besides the explicit controls, the latent, unobservable country-related and industry-related sources of variations in growth are properly accounted for. The random-effects regressions provide similar results. In column I, the interaction between UNDER and MARKET is negative and statistically significant, implying that, other things being equal, across countries that are financially underdeveloped, industries grow faster in those countries with bank-based financial systems. In column II, the coefficient for ARCHITECTURE is positive and significant, indicating that in financially developed countries, market orientation is positively related to industry growth. On the other hand, the interaction term is negative and significant. The magnitude of this coefficient (0.044) is larger than the coefficient on ARCHITECTURE (0.018). Financial architecture, the relative market orientation of financial system, is inversely related to industry growth in financially underdeveloped economies. Increasing market orientation slows growth in financially underdeveloped countries; yet it increases growth in financially developed countries. For example, a one standard deviation (0.654) increase in ARCHITECTURE slows industry growth by an average rate of 1.7% in financially underdeveloped economies, while the same change in the variable increases industry growth in value added by about 1.2% in financially developed countries.

Markets and banks provide vital financial services. A growing literature documents the positive impact of these services on economic performance. Levine

and Zervos (1998) find that both bank development (measured by bank ratio) and stock market development (particularly in terms of market liquidity) positively impact growth in per capita GDP. Tadesse (2000) finds that stock market liquidity has a positive impact on measures of efficiency, productivity, and growth in value added.

For robustness, I would like to gauge the marginal impact of financial systems architecture, controlling for the effects of bank and stock market development. Columns III and IV of Table 4 present the results of regressions in which I include market turnover ratio and bank credit ratio to control for capital market functions. As would be expected, both turnover and bank ratio have positive and significant impacts on industry growth. The variables have the same order of magnitude as found in the literature. More importantly, the impacts of financial architecture on growth are the same after controlling for turnover and bank ratio. From the random-effects estimations, the interaction of MARKET and UNDER (column III) and the interaction of ARCHITECTURE and UNDER (column IV) are significantly negative, indicating inverse relations between market orientation and industry growth.

The evidence underscores bank-based systems as superior venues for financially underdeveloped economies and market-based systems as fitting financially developed economies. Rajan and Zingales (1998b) argue that bank-based systems have a comparative advantage in economies with weak legal systems and poor institutional infrastructure. Well-functioning markets rely on contracts and their legal enforceability. In an environment of weak legal systems and institutions, investors rely on hierarchies and relationships as powers to prevent expropriation (solution to corporate governance), implying that institutions would be more effective and fitting than markets. One would therefore expect relationship-based systems to perform well in financially underdeveloped environments.

2.2. Financial Architecture, Firm Size, and Economic Performance

The agency perspective on financial architecture advanced by Boot and Thakor (1997) suggests that the relative merits of the bank-based and market-based financial architectures depend on the informational environment of the economy. Noting the comparative advantages of banks in monitoring post-lending moral hazard, and of markets in aggregating information for real decisions, they conjecture that bank-based systems would fare better in economies where agency problems predominate. The greater the agency problem in the economy, the less incentive investors have to acquire information in the financial markets. As a result, the lower the usefulness of market information in affecting real decisions, while the more valuable bank monitoring in mitigating the prevalent moral hazard. This implies that, other things held constant, a bank-based system might fit better to economies dominated by firms observationally more prone to agency problems.

It is a stylized fact that small and large firms have different patterns of financing. Peterson and Rajan (1995) report that bank finance is a preferred means of funding

small and start-up ventures, while large and stable firms tend to opt for securities markets. There are substantial fixed costs in issuing securities, making it a viable financing option mostly to large and stable firms. Furthermore, young and riskier firms value the financial flexibility associated with bank loans which could help them during financial difficulties. Bolton and Freixas (2000) argue that the trade-off between this need for flexible financing and the cost of intermediation is such that less mature and riskier firms, in equilibrium, opt for bank financing while mature firms prefer securities. This segmentation in patterns of financing between less mature and large and stable firms suggests that the size distribution of firms may explain the prevalence and effectiveness of different financial architectures. One is more likely to find effective bank-based architectures in countries that are dominated by small firms, which, among others, have a greater need for flexible financing.

Table 5 presents a difference in means test of economic performance for countries classified by the size of the average (or typical) firm in the manufacturing

TABLE 5
Economic Performance Comparison of Bank-Based and Market-Based Systems across Countries That Differ in Average Firm Size

Performance measures	Country ranking based on size of average manufacturing firm	Bank-based	Market-based	*t* test
Growth in value added	Bottom 25%	0.065	−0.046	4.41*
	Top 25%	0.008	0.030	−2.19**
	t test	5.42*	−3.05*	
Growth in production efficiency	Bottom 25%	0.003	−0.003	2.15**
	Top 25%	−0.0003	0.0005	−1.14
	t test	2.58**	−1.42	
Growth in economic efficiency	Bottom 25%	0.002	−0.005	2.01**
	Top 25%	0.0003	0.0002	0.10
	t test	1.27	−1.94***	
Growth in productivity	Bottom 25%	0.022	−0.0005	0.93
	Top 25%	0.015	0.020	−0.54
	t test	0.74	−0.85	

Note. Industry growth rate in value added is average annual growth rate over 1980 through 1995. Productivity and efficiency are computed based on parameter estimates of cross-country stochastic production and cost frontiers on the panel of industry production and cost data. Production efficiency measures the degree to which an industry diverges from the efficient production frontier. Economic efficiency measures the degree to which an industry diverges from the best-practice cost frontier. Architecture is a continuous variable that measures the degree of market orientation of a financial system and is a means-removed average of the size, activity, and efficiency dimensions of financial architecture. Firm size is total real output of the manufacturing sector of the country divided by the number of firms in the manufacturing sector.

* Significant at 1%.
** Significant at 5%.
*** Significant at 10%.

sector. I have data on the total number of firms and total real gross output in the manufacturing sector of each country. The size of the average firm is calculated as total manufacturing-sector gross output divided by total number of firms in the manufacturing sector. The (log of) size of the average firm ranges from 7.68 in Jordan to 12.352 in Germany. The size distribution appears to correlate with the level of development of countries. If we divide the sample into two, small-firm countries generally include emerging economies such as Sri Lanka, India, Indonesia, Jordan, and Peru, and large-firm countries include such developed economies as Germany, Finland, Austria, Canada, and the U.S.

I categorize countries into quartiles by the size of the typical firm in each country. Table 5 presents a comparison of countries in the bottom quartile and in the top quartile. The results indicate that market-based systems outperform bank-based systems in economies dominated by large firms (i.e., the top quartile) and that bank-based systems outperform market-based systems in countries dominated by small firms (i.e., bottom quartile). The differences between the means of the corresponding performance measures are statistically significant. Across countries that are the lowest quartile in firm size, industries in bank-based systems register annual growth rate in value added of 6.5% while those in market-based systems register a rate of −4.6%. In countries with the top firm-size quartile, those industries in market-based economies achieve annual growth rate of 3%, while their counterparts in bank-based systems register a 0.8%.

Table 6 presents results of growth regressions where firm-size classification is a variable. SIZE is a dummy variable that takes 1 if a country scores in the lower third in average manufacturing firm-size ranking and 0 if it ranks in the top third. MARKET is a dummy variable that takes 1 for market-based financial systems and 0 otherwise. ARCHITECTURE is a continuous variable denoting the relative market orientation of the financial system. The focal variables of interest are the interaction between financial architecture and firm size: MARKET × SIZE and ARCHITECTURE × SIZE. I expect the coefficients of the interaction terms to be significantly negative.

Column I and column II report the results using the MARKET variable and the ARCHITECTURE variables, respectively. From the OLS results, the coefficient on the size variable is negative and significant, implying that countries dominated by smaller firms tend to grow slower. The coefficient on the interaction term is negative and statistically significant at 1%. The interpretation is that in countries that are dominated by smaller firms, market-based financial systems retard growth (inversely bank-based systems promote growth). This is also true in column II, where I use the continuous ARCHITECTURE variable. The interaction term is significantly negative, implying that market-orientation is inversely related to growth in countries dominated by smaller firms. In column II, furthermore, the coefficient on SIZE is negative and significant, indicating that, other things constant, countries with small firms grow slower on average. Similar results obtain in the random-effects specification. In column I, the interaction MARKET × SIZE is negative and highly significant, indicating that market-based systems retard

TABLE 6
Economic Performance Comparison of Bank-Based and Market-Based Systems across Countries That Differ in Average Firm Size—Regression Results

	OLS				Random effects			
	I	II	III	IV	I	II	III	IV
Intercept	0.313*	0.271*	0.323*	0.289*	0.295*	0.255**	0.302*	0.262*
	(0.047)	(0.046)	(0.050)	(0.047)	(0.079)	(0.086)	(0.085)	(0.079)
Size	−0.030***	−0.057*	−0.026	−0.046*	−0.026	−0.054***	−0.024	−0.046
	(0.016)	(0.015)	(0.018)	(0.015)	(0.029)	(0.028)	(0.032)	(0.029)
Market	−0.013		−0.010		−0.011		−0.008	
	(0.014)		(0.014)		(0.038)		(0.025)	
Architecture		−0.001		0.004		0.001		0.005
		(0.011)		(0.011)		(0.021)		(0.021)
Market × Size	**−0.106***		**−0.101***		**−0.108***		**−0.105***	
	(0.021)		**(0.021)**		**(0.038)**		**(0.039)**	
Architecture × Size		**−0.086***		**−0.088***		**−0.096****		**−0.099****
		(0.021)		**(0.020)**		**(0.041)**		**(0.041)**
Turnover			0.004	0.021			0.008	0.009
			(0.030)	(0.032)			(0.049)	(0.053)
Bank ratio			0.063**	0.091*			0.036	0.058
			(0.026)	(0.028)			(0.046)	(0.051)
Per capita GDP	−0.031*	−0.027*	−0.036*	−0.035*	−0.029*	−0.026*	−0.032*	−0.030*
	(0.005)	(0.005)	(0.005)	(0.005)	(0.008)	(0.009)	(0.009)	(0.009)
Industry share manufacturing	0.067	0.074	0.079	0.085	0.095	0.103	0.094	0.099
	(0.109)	(0.117)	(0.108)	(0.114)	(0.114)	(0.114)	(0.114)	(0.114)

Note. The dependent variable is average annual growth in value added over 1980–1995. The parameter estimates are maximum likelihood estimates of regression equations containing random country and industry effects. The OLS equations do not contain random effects. Architecture is a continuous variable that measures the degree of market orientation of a financial system and is a means-removed average of the size, activity, and efficiency dimensions of financial architecture. Market is a dummy variable that takes 1 if the financial system is classified as market-based and 0 if it is bank-based. Under is an indicator variable that takes 1 for countries classified as financially underdeveloped and 0 otherwise. Size is an indicator variable that takes 1 for countries with smaller average manufacturing firm size and 0 otherwise. Stock market turnover is total value of shares traded divided by market capitalization. Bank credit ratio is claims of deposit money banks against the private sector divided by GDP. All regressions also contain log of initial per capita income and industry share in manufacturing (not reported). Industry share in manufacturing is calculated by dividing the real output of the industry in the country by the total real output of the manufacturing sector of the country. Coefficients of the country and industry effects are not reported. Asymptotic standard errors are given in parentheses.

* Significant at 1%.
** Significant at 5%.
*** Significant at 10%.

growth in countries dominated by smaller firms. The size variable has a negative coefficient, but is statistically not significant; hence, other things being equal, being a country with predominantly small firms or predominantly large firms has no impact on growth. In column II, the interaction term has a significant negative coefficient, again indicating an inverse relation between market orientation and industry growth in countries with smaller firms. Columns III and IV report results controlling for market turnover ratio and bank ratio as proxies for capital market functions. The evidence that market orientation adversely impacts industry growth in countries with small firms is robust in both

the OLS and random-effects specifications. The coefficients of the interaction terms are significantly negative.

The distributional difference in firm size across countries may dictate a systematic pattern in firm financing. Traditionally, small firms tend to access capital from banks even in developed countries. There are significant fixed costs associated with securities issues, making it a viable option mostly to large and stable firms. Small firms also value the financial flexibility associated with bank finance, which could help them during financial difficulties. It might be more likely therefore to observe striving and more effective bank-based financial systems in countries that are populated by small and emerging firms.

The results from firm-size classification also complement my results from the financial development classification. There appears to be a partial endogeniety between firm-size and financial development classifications. The size and financial development classifications have a correlation of 0.467, which is statistically significant. Kumar *et al.* (1999) find that financial development is a key determinant of firm size across countries. Because of this endogeniety, an alternative way of interpreting the firm-size results might be that it is a confirmation of the results based on financial development classification. For example, the evidence that countries with small firms fare better in bank-based architecture might suggest that bank-based systems complement weak legal and institutional environment because low financial development, among others, tends to foster smaller firm size.

To summarize the results so far, (1) while bank-based systems produce higher growth in financially underdeveloped economies, market-based systems generate higher growth in financially developed countries; and (2) while bank-based systems produce higher growth in economies dominated by smaller firms, market-based systems generate higher growth in countries dominated by larger firms.

Not all financially underdeveloped countries pursue a bank-based system—e.g., Turkey, Philippines, and Peru. Similarly, not all financially developed countries follow a market-based path (e.g., Germany and Japan). How would one then explain why some financially underdeveloped economies could follow a market-based path? The results might suggest that among the financially underdeveloped economies, those that follow a market-based path are those that have larger and stable firms. To see this, I classify the countries categorized as financially underdeveloped into those market-based and those that are bank-based. I then compute (a) the average firm size and (b) the firm-size class designation (0 or 1) of each group. The average firm size of the financially underdeveloped countries with market-based architecture is statistically significantly larger than that of the countries with bank-based architecture. The firm-size designation of market-based countries (0.52) is significantly larger than that of the bank-based countries (0). This pattern is reversed in developed economies. The average firm size of the financially developed countries that pursue bank-based systems is significantly smaller (at 5%) than that of the countries that pursue market-based architecture. Hence,

the size distribution of firms in a country combined with the level of financial development explains much of the patterns in the prevalence of bank-based and market-based architectures.

2.3. Robustness

In this section, I briefly describe the results of some of the robustness checks of my findings. One major concern is the difficulty of classifying countries as market-based or bank-oriented and whether the results are shaped by the particular classification scheme adopted in the paper. In the analysis, I classify countries based on the means-removed average of the size, activity, and efficiency measures of countries' financial architecture. For robustness, I generate a different ranking of countries based on the principal components of the size, activity, and efficiency of financial architecture. In the new classification, Denmark qualifies as bank-based, and Belgium, Israel, Jordan and New Zealand become market-based. Furthermore, the continuous variable (ARCHITECTURE) takes new values. I repeat the analysis using these new variables, and apply the random-effects version of my model. The results are robust in both direction and magnitude. In Table 7, in columns I, the interaction term between the architecture variable MARKET and UNDER is significantly negative and of the same order of magnitude. Market-oriented financial systems retard growth (or conversely, bank-oriented systems promote growth) in financially underdeveloped economies. The same is true in column II, where the interaction term between the continuous architecture variable—ARCHITECTURE—and the financial development variable—UNDER—is found to be significantly negative. Columns III and IV report results on the impact of firm size using the new measures of financial architecture. The coefficients of the interaction terms between SIZE and the financial architecture variables are negative and statistically significant, implying that market-oriented systems retard growth (and conversely, bank-oriented systems promote growth) in countries dominated by smaller firms.

Still, the classification of some of the countries into the financial development–financial architecture quadrants could be controversial. For example, while Jordan is commonly recognized as underdeveloped, some consider the Scandinavian countries of Denmark and Sweden as bank-based, financially developed systems. To check the sensitivity of the results to such concerns, I consider a classification scheme in which I reclassify Denmark, South Korea, Netherlands, and Sweden as financially developed, bank-based systems and Jordan as a financially underdeveloped, bank-based country. This is an ad-hoc classification in the sense that it is not generated by the data. The results (not reported) are robust to this classification. The interaction between the architecture variable MARKET and UNDER is negative and statistically significant at 10% and is of equivalent magnitude (-0.057). Market-oriented financial systems retard growth (or conversely, bank-oriented systems promote growth) in financially underdeveloped economies. The coefficient of the interaction term between SIZE and the

TABLE 7
Robustness

	(a) Alternative definition of financial architecture				(b) Modified size groupings		(c) Size groupings as quartile	
Intercept	0.204*	−0.172**	0.221**	0.209**	0.293*	0.250*	0.389*	0.335*
	(0.066)	(0.067)	(0.087)	(0.088)	(0.075)	(0.080)	(0.084)	0.104
Under	0.002	−0.026						
	(0.026)	(0.010)						
Size			0.001	−0.042	−0.028	−0.053**	−0.029	−0.059***
			(0.033)	(0.027)	(0.027)	(0.027)	(0.030)	(0.033)
Market	0.011		−0.001		−0.011		−0.032	
	(0.023)		(0.026)		(0.021)		(0.027)	
Architecture		0.009		0.002		0.003		−0.014
		(0.010)		(0.018)		(0.015)		(0.028)
Market × Under	**−0.060****							
	(0.030)							
Architecture × Under		**−0.037****						
		(0.016)						
Market × Size			**−0.092****		**−0.108***		**−0.108***	
			(0.039)		**(0.036)**		**(0.039)**	
Architecture × Size				**−0.032*****		**−0.100***		**−0.094****
				(0.020)		**(0.037)**		**(0.048)**
Per capita GDP	−0.020**	−0.016**	−0.022**	−0.021**	−0.028*	0.025*	−0.038*	−0.034*
	(0.007)	(0.007)	(0.008)	(0.009)	(0.007)	(0.008)	(0.008)	(0.011)
Industry share in manufacturing	0.057	0.064	0.098	0.094	0.071	0.076	0.011	0.021
	(0.072)	(0.072)	(0.098)	(0.098)	(0.088)	(0.088)	(0.114)	(0.114)

Note. The dependent variable is average annual growth in value added. The parameter estimates are maximum likelihood estimates of regression equations containing random country and industry effects. Architecture is a continuous variable that measures the degree of market orientation of a financial system and is a principal component of the size, activity, and efficiency dimensions of financial architecture. Market is a dummy variable that takes 1 if the financial system is classified as market-based and 0 if it is bank-based. Under is an indicator variable that takes 1 for countries classified as financially underdeveloped and 0 otherwise. Size is an indicator variable that takes 1 for countries with smaller average manufacturing firm size, and 0 otherwise. Industry share in manufacturing is calculated by dividing the real output of the industry in the country by the total real output of the manufacturing sector of the country. Coefficients of the country and industry effects are not reported. Asymptotic standard errors are given in parentheses. In panel (a), financial architecture is defined as the principal component (highest R^2) of financial architecture size, activity, and efficiency measures. Under panel (b), the large firm-size groups include the UK and Japan. Under panel (c), small and large firm-size groups are defined to be bottom and top quartiles of country firm-size rankings.

* Significant at 1%.
** Significant at 5%.
*** Significant at 10%.

financial architecture variable MARKET is negative (−0.11) and statistically significant at 1%, implying that market-oriented systems retard growth (and conversely, bank-oriented systems promote growth) in countries dominated by smaller firms.

In the original regressions where I classify countries by typical firm size, I categorize countries into three size categories, and I compare the top and bottom third as large-firm and small-firm countries respectively. This classification results in the UK and Japan in the middle category. I include the two countries in the large category to check for the sensitivity of the findings. The results are in columns VI

and V. The interaction variables are negative, are statistically significant, and are of similar magnitude. To further check the sensitivity of the results to changes in the size classification scheme, I categorize the countries into size quartiles and compare the bottom and top quartiles as small- versus large-firm countries. The results are not sensitive to such changes as can be seen under columns VI and VII. The coefficients are significant and are of comparable magnitude. The findings that bank-based systems promote growth in countries of relatively small firms appear to be robust to variations in country classifications into size groupings as well as to how I classify countries into bank-based or market-based financial architectures.

3. CONCLUSION

Countries differ in the way their financial sector is configured, ranging from the market-based systems typical of the Anglo-Saxon traditions to bank-centered systems characteristic of Continental Europe and Japan. An important issue in corporate finance is the question of whether this diversity in financial system architecture has any consequence to economic performance in the real sector. Does a financial architecture anchored on markets work better than one centered on banks, and if so, under what conditions?

Based on industry-level data from a panel of 36 countries, the paper examines how a country's financial architecture affects performance in the real sector of the economy. I examine whether real economic performance varies across countries of differing financial architecture.

I find that financial architecture is not a matter of indifference in that real economic performance varies systematically across economies with differing financial system architecture. Across countries with developed financial sectors, industries supported by market-based financial systems grow faster than industries with bank-based systems. Conversely, bank-based financial systems significantly outperform market-based systems across countries with underdeveloped financial sectors. Furthermore, I find that market-oriented systems retard economic growth, and conversely, bank-oriented systems promote growth in countries dominated by smaller firms.

The evidence suggests that financial architecture, in and of itself, could be a source of value. A lack of fit between the legal and institutional preconditions and the financial architecture retards economic performance. A market-oriented financial system does not fit well with an environment of weak contractability and lack of respect to the law. On the other hand, a synergic fit between the financial architecture and the contractual environment fosters economic growth. In view of the evidence, recent directions in capital-market-development policy that prescribe market-oriented financial systems indiscriminately, particularly in emerging and transition economies, might be misguided. It suggests that in situations where the

requisite legal and institutional preconditions are lacking, economies fare much better through strengthening their banking sector instead.

APPENDIX 1

Estimation of Production and Economic Efficiency Measures

I assume that there exists an unobservable function, a production frontier, representing the maximum attainable output level for a given combination of inputs. I represent these ***best-practice*** production technologies by a translog production function of the form[3]

$$\begin{aligned}\ln y_{ci}(t) = {} & \beta_0 + \sum\nolimits_j \beta_j \ln x_{ci}^j(t) + \beta_t t \\ & + \frac{1}{2}\left(\sum\nolimits_j \sum\nolimits_k \beta_{jk} \ln x_{ci}^j(t) \ln x_{ci}^k(t) + \beta_{tt} t^2 \right) \\ & + \sum\nolimits_j \beta_{jt} \ln x_{ci}^j(t) t + \mu_{ci}(t) + \varepsilon_{ci}(t) \end{aligned} \tag{2A}$$

where

$$\varepsilon_{ci}(t) = \alpha_c + \eta_i + \nu_{ci}(t),$$

$x_{ci}^j(t)$ and $x_{ci}^k(t)$ are production inputs j and k used in industry i of country c during period t. The production inputs are capital (K) and labor (L). The variable t, an index of time, represents the level of technology. $\mu_{ci}(t)$ is a one-sided random variable and measures the degree of ***inefficiency*** of industry i of country c in period t. The specification is a random-effects model in which latent country and industry effects are specified as random variables. α_c and η_i are the random unobservable country-specific and industry-specific effects, respectively, and $\nu_{ci}(t)$ is the usual white noise. The distributional assumptions on the error components are

$$\begin{aligned} \alpha_c &\approx iidN\left(0, \sigma_\alpha^2\right) \\ \eta_i &\approx iidN\left(0, \sigma_\eta^2\right) \\ \mu_{ci}(t) &\approx iid - halfNormal\left(0, \sigma_\mu^2\right), and, \mu_{ci}(t) \leq 0 \\ \nu_{ci}(t) &\approx iidN\left(0, \sigma_\nu^2\right) \end{aligned}$$

[3] My choice of this particular functional form is dictated by its flexibility reducing the chance of inferring inefficiency when in fact the problem is a poor fit to the data of a more restrictive form. Moreover, there is evidence that manufacturing production is non-homothetic and exhibits scale economies, both of which are accommodated in the translog form.

From Eq. (2A), the level of production efficiency of industry i of country c during period t is

$$PRODEFF_{cit} = e^{-\mu_{ci}(t)}. \tag{2B}$$

PRODEFF represents the ratio of actual output to the maximum attainable output if the industry were efficient holding the technology (i.e., the production frontier) and the level of input usage constant. Its value ranges from 0 to 1 (i.e., 100% efficient). Improvements in efficiency for industry i in country c over period (t) is then given by

$$\Delta PRODEFF = \frac{\partial \ln PRODEFF_{cit}}{\partial t}. \tag{2C}$$

The efficiency estimate using the production function framework measures only technical (production) efficiency. It does not account for the possible error of the firm in choosing an appropriate input mix given relative prices (i.e., price inefficiency). I estimate an economic efficiency score based on the dual cost function,[4] which reflects both technical and price efficiencies. After estimating a translog cost function analogous to Eq. (2A) above, the level of economic efficiency for country c, industry i, in period t is

$$ECONEFF_{ci}(t) = e^{-\theta_{ci}(t)}, \tag{2D}$$

where $\theta_{ci}(t)$ is a one-sided random variable denoting the degree of economic ***inefficiency***. Equation (2D) is the ratio of the minimum cost on the frontier to actual cost incurred and ranges in value from 0 (inefficient) to 100% (efficient). Improvements in economic efficiency are then given by

$$\Lambda ECONEFF_{ci}(t) = \frac{\partial \ln ECONEFF_{ci}(t)}{\partial t}. \tag{2E}$$

[4] Duality theory suggests that under certain regularity conditions, if producers pursue cost minimizing objective, the production function can be uniquely represented by a dual cost function.

APPENDIX 2

Summary Statistics

Variable	*N*	Mean	Std. Dev.	Minimum	Maximum
UNDER	281	0.352	0.479	0	1
MARKET	281	0.399	0.490	0	1
ARCHITECTURE	281	0.059	0.654	−0.820	1.960
Log of average firm size	281	10.806	0.883	7.680	12.352
SIZE	206	0.252	0.435	0	1
Stock market turnover ratio	277	0.270	0.197	0.010	0.897
Bank ratio	280	0.469	0.241	0.102	1.046
Log per capita GDP	281	8.833	1.355	5.780	10.179
Share of industry's value added to total manufacturing	280	0.053	0.047	0.004	0.238
Growth in real value added	251	0.020	0.047	−0.268	0.200

Note. UNDER is an indicator variable that takes 1 for countries classified as financially underdeveloped and 0 otherwise. MARKET is a dummy variable that takes 1 if the financial system is classified as market-based and 0 if it is bank-based. ARCHITECTURE is a continuous variable that measures the degree of market orientation of a financial system and is a means-removed average of the size, activity, and efficiency dimensions of financial architecture. Average firm size is calculated as total real output of the manufacturing sector of the country divided by the number of firms in the manufacturing sector. SIZE is an indicator variable that takes 1 for countries with smaller average manufacturing firm size and 0 otherwise. Stock market turnover is total value of shares traded divided by market capitalization. Bank credit ratio is claims of deposit money banks against the private sector divided by GDP. Industry share in manufacturing is calculated by dividing the real output of the industry in the country by the total real output of the manufacturing sector of the country. Industry growth rate in value added is average annual growth rate over 1980 through 1995.

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