Finance, Investment and Growth

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Abstract

This paper examines the relation between the institutional structures of advanced OECD countries and the comparative growth and investment of 27 industries in those countries over the period 1970 to 1995. The paper reports a strong relation between the structure of countries' financial systems, the characteristics of industries and the growth and investment of industries in different countries. There is a particularly strong relation between the structures of countries' financial systems and the growth of industries that are dependent on external equity and skilled labour. As predicted by theory, relations with industries that are dependent on bank finance are more in evidence in countries at earlier stages of development. The relations with investment are much more pronounced for R&D than for fixed capital, suggesting that financial systems in developed economies are primarily associated with patterns of R&D rather than fixed investment.

Key words: financial systems, ownership, growth, investment, R&D

JEL classification: E2, G3, O4

1 Introduction

There is a large literature reporting a relationship between financial development and economic growth. This literature has been concerned with the relation of growth to overall financial development, to the bank or market orientation of financial systems, and to the degree of legal enforcement of minority investor rights. It has also considered whether the link between financial development and growth is particularly significant for firms and industries that are dependent on external finance.[1]

Levine and Zervos (1998) was the benchmark study that used cross-country data to test the hypothesis that bank and stock market development have independent effects on growth. They reported that both the size of the banking sector and the extent of stock market activity (measured by the ratio of value of shares traded to either market capitalization or GDP) are related to future economic growth.

Levine and Zervos used a conventional cross-country growth regression methodology. This is subject to the objection that the unobserved heterogeneity of countries may be correlated with financial development and growth, thereby complicating interpretation of the coefficient on financial development. An alternative approach is to use panel data sets and to employ dynamic techniques to eliminate biases due to country fixed effects. Beck, Levine and Loyaza (2000) confirmed the positive impact of banking sector development on growth in a dynamic panel analysis of data on financial intermediary credits to the private sector (as a percentage of GDP) in 77 countries over the period 1960 to 1995. Rousseau and Wachtel (2000) used dynamic panel techniques on 47 countries over the period 1980 to 1995 and found a positive influence of both stock market activity (per capita value traded) and banking sector development (per capita liquid liabilities (M3)) on growth.[2]

A series of recent papers has addressed the question of whether the balance of financial institutions, i.e. bank or market-based, in an economy affects its aggregate growth or growth in industries particularly dependent on external finance. Levine (2000), Beck and Levine (2001), Demirgüç-Kunt and Maksimovic (2002) and Beck, Demirgüç-Kunt, Levine and Maksimovic (2001) report that overall financial development and the efficiency of the legal system rather than financial structure influence growth.

Rajan and Zingales (1998) examined the channel through which financial development influences growth. They controlled for country (and industry) fixed effects using industry level data and tested whether the growth of industries dependent on external finance is particularly strongly related to financial development. They assessed the influence of accounting standards as well as the size of banking sectors and stock markets. Their results support the view that the quality

[1] For recent surveys, see Levine (1997), Beck, Demirgüç-Kunt, Levine and Maksimovic (2001), and Wachtel (2001).

[2] Demirgüç-Kunt and Maksimovic (1998) report results consistent with these using a sample of large firms from 40 countries.

of financial development, as measured by accounting standards, fosters growth in industries that are dependent on external finance.

Cetorelli and Gambera (2000) performed a similar analysis to Rajan and Zingales with the modification that they tested for the role of the structure, rather than size, of the banking system in providing finance for industries especially dependent on external finance. They found that external finance dependent industries grew faster in the presence of a concentrated banking system.

A common feature of all of these studies is the mixture of developing and developed countries in the sample. Indeed, commenting on studies of advanced economies in his influential survey of the nexus between finance and growth, Ross Levine noted that "comparisons of financial structure and economic development using only these countries will tend to suggest that financial structure is unrelated to the level and growth rate of economic development" (1997, p. 720). Within developed countries, there is a wide variation in the structure of financial systems and governance of companies: some countries have large stock markets, others have large banking systems; some have dispersed share ownership, others have highly concentrated ownership. This raises the question of what, if anything is the relation between the pronounced differences in financial structure of advanced countries and their economic growth and investment. Are all financial institutions equally well suited to all activities, industries and countries? These are the issues addressed in this paper.

Several recent theoretical models point to a relation between types of financial system and types of economic activity. There are three classes of such theories (see Allen and Gale (2000) for a summary). The first emphasizes differences in the way in which financial systems accumulate information. Allen (1993) and Allen and Gale (1999) argue that stock markets allow investors to hold diverse views about investments, whereas banks can exploit economies in acquiring information about firms where there is a high degree of consensus. Securities markets are therefore particularly relevant where investors have diverse views – for example, about new technologies. Banks can exploit economies of scale in collecting information about more traditional investments when technologies are well understood. According to Boyd and Smith (1998), the relative significance of equity markets and debt varies with stages of economic development. In developed economies, monitoring is expensive relative to capital costs so technologies that involve relatively low monitoring costs are preferred. These are associated with equity markets rather than debt so, as economies grow, equity market activity increases relative to debt.

The second set of theories relates to renegotiation. In Dewatripont and Maskin (1995) decentralized financial systems with many small banks impose tighter budget constraints than centralized systems with a small number of banks. Multi-bank systems are therefore better at imposing hard budget constraints on inefficient projects but are too short-term in failing to sustain efficient long-term projects. The Dewatripont-Maskin model suggests that financial systems with many small banks foster industries with short-term projects whereas industries with longer-term

investments fare better in systems with a few large banks. In Huang and Xu (1999), multi-bank/ dispersed creditor systems are associated with R&D intensive industries, particularly when companies are young and uncertainty is high; single bank/ concentrated creditor systems favour industries with lower uncertainty and imitative investments. As in Gerschenkron (1962), there is also an association with stages of development: single bank/ concentrated creditor systems finance early phases of development when investment takes the form of imitation but multi-bank/ dispersed creditor systems finance more advanced stages of development.

The third set of theories concerns corporate governance and commitment. Stiglitz (1985), Shleifer and Vishny (1986) and Huddart (1993) argue that concentrated ownership is required to provide shareholders with adequate incentives to engage in active corporate governance. Corporate governance is therefore more effective under concentrated than dispersed ownership systems. But Allen and Gale (2000) note that active corporate governance by large shareholders may also create interference in activities that are best delegated to managers, and Shleifer and Vishny (1997) and La Porta et al. (1999) argue that they are associated with more conflicts with minority investors. According to Burkhart, Gromb and Panunzi (1997), ownership concentration can be used to determine the commitment of investors to preserving incentives that encourage managerial investment. Dispersed shareholders can more credibly commit than concentrated owners not to interfere in the running of firms. Dispersed ownership is therefore suited to activities that require investments by outside investors, management and other stakeholders, and concentrated ownership to internally funded activities requiring active corporate governance.

In all of the above models, financial and ownership systems are associated with different *types* of corporate activities and investments. Information theories point to the relevance of information flows: securities markets allow for diverse views amongst investors about, for example, new technologies, while more traditional investments benefit from the economies of monitoring banks can provide. The renegotiation literature emphasizes the concentration of credit markets: fragmented banking systems and credit markets are associated with high-risk R&D investments, concentrated credit markets with long-term investments in more mature industries. The governance/commitment literature emphasizes ownership concentration: dispersed ownership systems are associated with activities that require participation by outside investors, managers and other stakeholders, and concentrated ownership with internally funded activities requiring active corporate governance. Both information and renegotiation theories suggest that these relations are sensitive to stages of economic development with bank finance and concentrated banking being more suited to economies at earlier stages of development.

A few examples illustrate these relations. The first is the nature of patenting activity in Germany and the USA. Germany has significantly lower accounting disclosure than the US but much higher levels of ownership concentration. On the basis of the above theories, the German financial system would therefore be predicted

to be more closely associated with mature, internally funded industries and the US with high technology, external-finance dependent industries. When industries are ranked by the intensity of patent registrations, patenting intensity in Germany (relative to a twelve-country average) is almost inversely related to that of the USA. Information technology, semi-conductors and biotechnology, for example, are in the top six (of 30) industries by patent registrations for the USA and in the bottom four for Germany. Germany's patent specialization is highest in civil engineering and transport equipment, which are in the bottom three industries in the USA.[3]

A second example, drawing on data from our study, is the comparative growth of industries in two Scandinavian countries, Denmark and Finland. Denmark has standards of information disclosure below the average of the advanced countries in our study, while Finland's are above average. Bank and ownership concentration are similar in the two countries. On the basis of the above theories, we would therefore predict higher growth of equity dependent industries in Finland than in Denmark. The four industries with the highest equity dependence in our study are instruments, electrical machinery, plastics and non-electrical machinery. In Finland, growth in all of these industries increased during the 1980's and rose again sharply in electrical machinery during the 1990's. In contrast, in Denmark growth declined in these four industries during both the 1980's and 1990's. Therefore, equity dependent industries grew faster through a period of technological shocks in the country with the better accounting disclosure.

Traditional theories of comparative advantage would emphasize the natural resource endowment of Finland relative to Denmark as a source of advantage in resource intensive industries, such as wood products and furniture. In fact, over the period of our study, the relative growth of these industries accelerated markedly in Denmark relative to Finland. Over this period measures of the financial structure of the two countries appear to be more relevant to the comparative performance of their industries than are the underlying resource endowments.

The purpose of this paper is to provide a first, exploratory analysis of the thesis that there is an association between the institutional structure of a country and the activities undertaken in that country. It differs in three key respects from the existing empirical literature. First, it emphasizes an interrelation between the structure of countries' financial systems, the characteristics of industries and growth and investment of industries in different countries. We do this by performing cross-sectional regressions of growth and investment of industries in particular countries on the institutions of the countries and the characteristics of the industries. The above theories suggest that the institutional structures that are most relevant are information

[3] Patent specialization indices for 30 industries are calculated from patents registered at the European Patent Office. The correlation between the German and US indices is –0.78 (see Hall and Soskice, 2001).

disclosure, the size and concentration of credit markets, and ownership concentration. The relevant institution-related characteristics of industries are their reliance on market and bank sources of finance and inputs from other stakeholders.

The second respect in which the paper differs from the existing empirical literature is in distinguishing between fixed investment and R&D. We examine whether the interaction between country financial institutions and industry characteristics is related to levels of fixed capital formation and R&D expenditure as well as output growth. The theories suggest that some institutions are particularly relevant for intangible investments, and others for tangible ones. Finally, it differs from the existing empirical literature by taking a set of advanced economies as its base-line sample so as to reflect the insights from theory that the financial institutions appropriate for different industries may differ according to stage of development.

The paper reports a strong relation between the structure of countries' financial systems, the characteristics of industries and the growth and investment of industries in different countries. There is a particularly strong relation between the structures of countries' financial systems and the growth of industries that are dependent on external equity and skilled labour. As predicted by theory, relations with industries that are dependent on bank finance are more in evidence in countries at earlier stages in their development. The relations with investment are much more pronounced for R&D than for fixed capital, suggesting that financial systems in developed economies are primarily associated with patterns of R&D rather than fixed investment.

Section 2 describes the hypotheses that the paper tests, section 3 the data that are employed and section 4 the methodology that has been used. Section 5 reports the regression results and section 6 summarizes their implications.

2 Hypotheses

This paper examines how the interaction between the structure of countries' financial systems and the characteristics of industries relates to the growth and investment of different industries in different countries. Since institutional factors may affect the type as well as the scale of investment, we distinguish in the investment equations between fixed investment and research and development (R&D).

The theories discussed in section 1 refer to the relevance of information disclosure, bank concentration and ownership concentration to the provision of market sources of finance, bank finance and investments by other stakeholders. The paper reports the results of estimating equations for growth ($Growth_{ik}$), fixed investment (as a share of value added) (FI_{ik}), and research and development (as a share of value added) ($R\&D_{ik}$) in industry i in country k. In each equation, the dependent variable is regressed on a set of terms that interact country structure variables (proxies for information disclosure ($disclosure_k$), bank concentration ($bankconc_k$) and ownership

concentration ($ownconc_k$) in country k) with industry characteristic variables (proxies for equity-finance dependence ($equity_i$), bank-finance dependence ($bank_i$) and dependence on inputs by other stakeholders ($other_i$) in industry i). In each equation, there is also a full set of country and industry dummies. In the growth equation, there is an additional term – the initial share of industry i in output of country k ($share_{ik}$) – to control for regression to the mean, which is discussed in section 3.

The three equations are as follows:

$$\begin{aligned} Growth_{ik} = {} & \gamma_1(disclosure_k*equity_i) + \gamma_2(disclosure_k*bank_i) + \gamma_3(disclosure_k*other_i) \\ & + \gamma_4(bankconc_k*equity_i) + \gamma_5(bankconc_k*bank_i) + \gamma_6(bankconc_k*other_i) \\ & + \gamma_7(ownconc_k*equity_i) + \gamma_8(ownconc_k*bank_i) + \gamma_9(ownconc_k*other_i) \\ & + \gamma_{10}\, share_{ik} + country\ dummies + industry\ dummies + \varepsilon_{ik} \quad \text{.....(1)} \end{aligned}$$

$$\begin{aligned} FI_{ik} = {} & \varphi_1(disclosure_k*equity_i) + \varphi_2(disclosure_k*bank_i) + \varphi_3(disclosure_k*other_i) \\ & + \varphi_4\,(bankconc_k*equity_i) + \varphi_5\,(bankconc_k*bank_i) + \varphi_6(bankconc_k*other_i) \\ & + \varphi_7\,(ownconc_k*equity_i) + \varphi_8\,(ownconc_k*bank_i) + \varphi_9\,(ownconc_k*other_i) \\ & + country\ dummies + industry\ dummies + \varepsilon_{ik} \quad \text{.....(2)} \end{aligned}$$

$$\begin{aligned} R\&D_{ik} = {} & \rho_1(disclosure_k*equity_i) + \rho_2(disclosure_k*bank_i) + \rho_3(disclosure_k*other_i) \\ & + \rho_4(bankconc_k*equity_i) + \rho_5(bankconc_k*bank_i) + \rho_6(bankconc_k*other_i) \\ & + \rho_7(ownconc_k*equity_i) + \rho_8\,(ownconc_k*\,bank_i) + \rho_9\,(ownconc_k*\,other_i) \\ & + country\ dummies + industry\ dummies + \varepsilon_{ik} \quad \text{.....(3)} \end{aligned}$$

If information disclosure were critical to the provision of market finance then we would expect industries that are dependent on external market sources to grow rapidly in countries with good information disclosure. Furthermore if market sources are associated with the financing of new technology then the interaction of information disclosure and external market dependence should be more evident in the R&D than the fixed investment equation. Since capital is scarce in developing countries, monitoring costs are low relative to the cost of capital (Boyd and Smith (1998)). Therefore in developing countries, forms of finance that are intensive in monitoring (bank finance) are preferred. This suggests that developed and developing countries should not be pooled. We summarize in the following hypotheses how the theoretical predictions would be reflected in the regression coefficients.

H1: The coefficients on the interaction between the proxy for information disclosure (accounting standards) and equity dependence are positive in the growth and investment equations (i.e. $\gamma_1 > 0$, $\varphi_1 > 0$ and $\rho_1 > 0$) and more significant in the R&D than in the fixed investment equation. The coefficients on the interactive terms with bank dependency (γ_2, γ_5, γ_8) will be more significant in developing than developed countries.

If dispersed banking systems facilitate the imposition of hard budget constraints in developed countries then we would expect industries that are dependent on bank finance to grow more rapidly and invest more in countries with dispersed banking systems. This will be more evident in innovative R&D investments than in imitative fixed investment. Bank dependent industries at earlier stages of development benefit from the longer-term investments that concentrated banking systems provide to more imitative industries.

H2: The coefficients on the interaction between bank concentration and bank finance dependence are negative in the growth and investment equations in developed countries (i.e. $\gamma_5 < 0$, $\varphi_5 < 0$ and $\rho_5 < 0$) *and more significant in the R&D than in the fixed investment equation. Conversely, for developing countries, the sign on interaction term between bank concentration and bank dependence is reversed (i.e.* $\gamma_5 > 0$).

If dispersed owners can offer more credible commitments to outside stakeholders and concentrated shareholders provide better governance of internally financed activities then we would expect industries that are dependent on external sources of finance and other stakeholders to grow more rapidly in countries with dispersed ownership.

H3: The coefficients on the interaction terms with ownership concentration are negative in the growth and investment equations (i.e. $\gamma_7 < 0$, $\gamma_8 < 0$, $\gamma_9 < 0$, $\varphi_7 < 0$, $\varphi_8 < 0$, $\varphi_9 < 0$, and $\rho_7 < 0$, $\rho_8 < 0$, $\rho_9 < 0$).

Finally, the first two hypotheses predict a closer association between the type of financial system and R&D than between financial system and fixed investment.

H4: The interaction of country structures and industry characteristics is more closely associated with cross-industry, cross-country variation in R&D than in fixed investment.

3 Data

Output and growth

Data were collected on growth in constant price value added in 27, predominantly 3-digit SIC, manufacturing industries in 18 countries over the period 1970 to 1995. The base sample of countries used for this paper is the 14 OECD countries for which growth, fixed investment and standardized R&D data are available on a consistent cross-country basis from the OECD's STAN data base

(1997).[4] An alternative source of data that has been used in previous work (e.g. Rajan and Zingales (1998) and Cetorelli and Gambera (2000)) is the Industrial Statistics Yearbook of the United Nations Statistical Division. The country coverage of the UN data is greater than that of the OECD, but since this study is focused on developed economies, it is not disadvantaged by the exclusion of developing country data. More significantly, there are fewer measurement problems with the OECD data, and constant price value-added, fixed investment and research and development data are available from the OECD but not the UN. In addition, the OECD data are available for 25 years as compared with a decade for the UN data.

Table 1 records the annual average growth rates of manufacturing industry in the 14 countries over the period from 1970 to 1995. Italy, Japan and Finland have the highest growth rates and Germany, Norway and the UK, the lowest. Since the focus of the paper is on interrelationships between country and industry characteristics, an initial question is the extent to which relative growth rates of manufacturing industry across countries are attributable to initial industrial allocations as against countrywide differences in subsequent growth rates. Table 1 addresses this by decomposing deviations of country growth rates from world averages into three components. The first is a "share effect", the contribution of deviations of initial shares in different industries from world averages in 1970, assuming that industries grew at the world average over the period. If the share effect is important, it means that high growth countries benefited from high initial shares in industries that grew relatively fast (and conversely for low growth countries). The second is a "growth effect". This is the contribution of deviations of growth rates of industries in a particular country from world average growth rates for those industries assuming initial shares are equal to world averages. If the growth effect is important, it means that good performance in manufacturing reflects a superior performance across industries rather than an advantageous initial distribution of industries. The third component captures the possibility that growth in some countries is higher because they do particularly well in the industries in which they have large initial shares: this is an "interactive effect", the interaction of deviations of initial shares and industry growth rates from world averages.

[Table 1 here]

The table records that variation in country growth is nearly entirely attributable to the growth effect. This is confirmed by an analysis of variance: -9.9% of country growth variation is attributable to the share effect, 118.3% to the growth effect and

[4] See the data appendix.

-8.4% to the interactive effect. The first and last of these imply that there is regression to the mean – high share industries have below average growth rates. These observations justify (i) focusing the subsequent analysis on cross-country variations in industry growth rates rather than initial shares and (ii) inclusion of initial shares of industries in the growth regressions to account for regression to the mean.

Fixed investment and R&D

An advantage of the OECD dataset is that data are available on fixed investment and – for a subset of industries – on research and development expenditure as well as growth. This allows the hypotheses of an influence of financial institutions and governance structures on types of investment to be tested. Data were collected on gross fixed investment for 27 manufacturing industries over the period 1970 to 1990 and on R&D expenditure for 15 manufacturing industries over the period 1973 to 1994.[5]

Table 2 reports the average ratio of fixed investment to value added and R&D to value added for the fourteen countries. The rankings of the two are markedly different. While Spain has the lowest ratio of both, the UK and USA have some of the highest R&D but the lowest fixed investment ratios. Panel B of table 2 records the correlation between growth, R&D and fixed investment across the industries and countries in this study for which data on all three were available. It records that industry growth across countries is more closely correlated with R&D than with fixed investment, a correlation coefficient of 0.508 with R&D as against 0.010 with fixed investment.

[Table 2 here]

Country structures

The paper takes advantage of new datasets on institutions in a large number of countries. We focus on three country structural features that relate most closely to the hypotheses in section 2: information disclosure rules as measured by accounting standards, the concentration of the banking sector as measured by market share data and the concentration of ownership as measured by the control of voting rights.

Financial disclosure is commonly associated with "accounting standards". The Center for International Financial Analysis and Research (CIFAR) creates an index of actual accounting practices and choice of policies regarding disclosure as revealed in the annual reports of individual firms in each of the countries in this study. The first comprehensive survey was undertaken in 1990 and the results, which are reported in

[5] The time periods and industries were dictated by data availability from the OECD. In addition, the petrol refinery industry was excluded throughout because of price index number problems.

Rajan and Zingales (1998) and La Porta, Lopez-de-Silanes, Shleifer and Vishny (1997), have been used in this study.[6] Concentration of the banking system is taken from Cetorelli and Gambera (2000). They construct a measure of bank concentration defined as the sum of the market shares of the three largest banks[7] averaged over the period for which data are available (1989-1996) using the IBCA BankScope 1997 CD as the underlying data source. Our main measure of ownership concentration comes from La Porta et al. (1998) who record the proportion of the 20 largest listed firms in different countries that are "widely held", i.e. have no chain of control by an ultimate owner of greater than 10% of voting rights.

Table 3 records that accounting standards are highest in Sweden and the UK and lowest in Spain. There are substantial variations in accounting standards across developed countries.[8] Several factors contribute to this. Ball, Kothari and Robin (2000) characterize the reporting of accounting income by its "timeliness" (responsiveness of current period accounting to current period economic income) and "conservatism" (extent to which accounting income asymmetrically incorporates economic losses relative to gains). They find that accounting information is both more timely and conservative in common than in civil law systems. This accords with the observation in table 3 that in general accounting standards are higher in common law than civil law countries. They attribute the timeliness of common law systems to their greater reliance on public disclosure of information and their conservatism to the stronger requirement for disclosure of economic losses than in civil law systems.

Table 3 records some variation in accounting standards within common law countries but less than between common and civil law countries. Ball, Kothari and Robin also report variations within common and civil law systems. In particular, they note variations in the degree of regulation of accounting systems: the UK is the least regulated of the common law systems, the US the most regulated, and Australia and Canada somewhere in between. Accounting practice is influenced by enforcement as well as by rules: expected benefits of shareholder litigation are lower in the UK than in Australia, Canada and the US due to smaller punitive damages, the absence of class suits and the allocation of defendant costs in part to plaintiffs. Notwithstanding the greater amount of regulation and litigation in the US, table 3 records that accounting standards are higher in the UK than in the US. This illustrates that good accounting

[6] On the basis of extensive testing, Hope (2001) concludes that "the validity of the CIFAR data is satisfactory" and that the individual firm-level accounting disclosures in the CIFAR sample are positively related to the accuracy of analysts' earnings forecasts of those firms.

[7] They also use a measure of concentration using the five largest banks – our results were very similar using the second measure and we report results using the first measure only.

[8] In a sample of 35 countries, the standard deviation of accounting standards was 0.132. In the 19 developed countries in the sample, the standard deviation was 0.079.

practice may be encouraged by emphasizing form over substance, namely fairness (the presentation of "true and fair" views) rather than detailed rules.[9]

Within civil law systems, accounting income is dictated to varying degrees by taxable income. For example, in Germany, Choi and Mueller (1992) report that "the dominance of tax accounting rules means that there is literally no difference between financial statements prepared for tax purposes and financial statements published in financial reports" (p 96). This implies that German accounting measures are dominated by tax considerations rather than economic performance and is reflected in a low level of accounting standards in Germany in table 3.

Bank concentration is highest in Finland and Sweden and lowest in the US and Japan.[10] [11] Concentration of corporate ownership is much lower in the UK and US than elsewhere. Australia, Canada and Japan have intermediate levels of concentration and Continental Europe has high levels of concentration.

[Table 3 here]

Table 3 reports that the concentration of the banking system is positively correlated with both accounting standards and ownership concentration and that accounting standards are negatively correlated with ownership concentration. There is a *negative* correlation between accounting standards and growth (-0.336) but a positive correlation between accounting standards and both fixed investment and, in particular, R&D share. Bank concentration is also negatively correlated with growth but there is little correlation between ownership concentration and growth. Ownership concentration is positively correlated with investment but the correlation is much lower with R&D. Overall, correlations of growth and investment with country structures are quite low.

In addition to the three institutional structures described above, a set of alternative country structures has been used. Most of these measures have been reported elsewhere and the sources are described in the data appendix.[12]

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[9] See, for example, Nobes and Parker (2000).

[10] In a sample of 41 countries, the standard deviation in 3-bank concentration levels was 0.181. In 18 developed countries, the standard deviation was 0.216, implying that the variation in bank concentration is higher in developed than in developing countries (see Cetorelli and Gambera, 2001).

[11] With growing levels of international capital mobility, it might be thought that national measures of bank concentration would be of little relevance. However, in a sample of nine EU countries, the BIS reports that the share of cross-border loans to non-banks as a percentage of total loans to non-banks ranged from only 1.6% for Spain to 9.9% for the UK in the late 1990s (White, 1998). The same study showed that the arrangers of syndicated loans tend to have the same nationality as the borrowing firm, regardless of the currency in which the loan is being made. In addition, in a detailed analysis of bank deregulation in the USA, Jayaratne and Strahan (1996) found that the impact of deregulation on growth was confined to the states in which deregulation occurred, which suggests that even within the US, bank lending is geographically immobile.

[12] There is one exception: since there was no single source of information on bank ownership of corporate equity, we constructed this measure. Data on the market value of equity held by banks as a

Industry characteristics

As proxies for the dependence of industries on securities markets, banks and investments by other stakeholders, we use industry measures of external equity financing, bank financing and skill levels. We proceed by developing the approach taken by Rajan and Zingales (1998) of using the US as the most highly developed and liberal financial market in the world in which firms are likely to face the least constraints to raising equity finance. New equity funding levels of US industries therefore most closely approximate the underlying requirements of firms operating in those industries. Since Japan has the highest ratio of bank credit to GDP of the OECD countries in this study and an unusually high level of bank financing of industry (see, for example, Corbett and Jenkinson (1997)), we use the dependence of Japanese industries on bank finance to measure this industry characteristic. The same logic leads to the choice of Germany as the source of the third industry characteristic, skill dependence. Germany has an exceptionally high level of investment in skills and training.[13] We therefore measure the dependence on equity finance in the US, on bank loans in Japan and on skills in Germany. As we shall see, this approach has the advantage of both preserving degrees of freedom and allowing potential endogeneity of industry characteristics to be readily corrected.

Using data from Rajan and Zingales (1998), equity financing was measured as the ratio of the net amount of equity issues to capital expenditures by US firms during the 1980s. Although we usually use the equity financing measure, we also refer to external financing - the fraction of US capital expenditure that was not financed with cash flow from operations.[14]

We constructed our own measure of bank dependence using industry data on bank finance in Japan from the Japanese Ministry of Finance. Bank financing ratios were constructed from sources and uses of funds[15] in company accounts of 20,000 listed and unlisted Japanese firms. The main measure that we use is the ratio of bank loans to physical investment (net of depreciation) averaged over the period 1981 to 1990. We also refer to a second measure: the ratio of bank loans to gross external

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proportion of the market value of equity held by the domestic private sector averaged over the period 1980 to 1990 were collected from individual central banks. Where these were not available then OECD Financial Statistics were used to construct this variable. This series is shown in the data appendix.

[13] In a comparison of the levels of qualifications of workers in five OECD countries (France, Germany, Japan, US and UK), Germany has the lowest share of workers without qualifications (beyond compulsory schooling) in 13 of 17 manufacturing industries (see Machin and Van Reenen (1998)).

[14] Data were also available on external dependence by industry in Canada. The correlation between external dependence in Canada and the US is 0.76.

[15] Using the methodology set out in Mayer (1988 and 1990). These papers discuss the advantages of using flow rather than stock data for the equity and bank dependence series.

financing (total investment including investment in financial assets minus retentions).[16]

Oulton (1996) reports skill levels of the German workforce in 1987. The proportion of the workforce with high, upper intermediate, lower intermediate and without vocational qualifications is reported for 26 manufacturing sectors.[17] We confirm that the ranking of industries by level of qualifications of workers is very similar across countries using data for the UK and Germany from Oulton (1996) and less disaggregated industry data for five countries from Machin and Van Reenen (1998).[18]

Table 4 shows the three industry variables: equity financing, bank financing and skill levels. Electrical machinery has a high level of equity financing in the US and is skill-intensive in Germany but has only a modest level of bank financing in Japan. Clothing has one of the highest levels of bank financing in Japan but raised no equity in the US and was not skill-intensive in Germany. Skill levels are high in shipbuilding, an industry that raises little equity in the US and reduced outstanding stocks of bank debt in Japan during the 1980s. The correlation between equity and bank finance is 0.073, between skills and bank financing is –0.455 and between skills and equity financing is 0.172. There is a clear positive correlation between equity dependence and both growth and R&D (but not with investment). A similar although less pronounced pattern is apparent for skill dependence. The positive correlation between bank finance and growth is similar to that for skill dependence but there is little correlation between bank finance and either fixed investment or R&D.

[Table 4 here]

The above suggests that (a) a stronger relation of both growth and R&D is observed with industry than country variables, (b) the relation is weaker with bank finance than the other two industry characteristics, and (c) the relation between fixed investment and industry variables is weaker than that of growth and R&D. Table 5 confirms the first two of these observations in an OLS regression of average growth in the 14 OECD countries and 27 industries over the period 1970 to 1995 on the three

[16] There is no other source of data on the dependence of companies on bank finance by industry and it is not therefore possible to check the correlation of industry dependence on bank finance in Japan with other countries.

[17] The four definitions are 'high' = completion of university or technical university (Hochschul-abschluss; Fachhochschulabschluss), 'upper intermediate' = 'master or technician' which is equivalent to completion of technical college (Meister/Techniker gleichwertig Fachschulabschluss), 'lower intermediate' = apprenticeship which is equivalent to completion of vocational college (Lehr-/Anlernausbildung gleichwertig Berufs-Fachschulabschluss; berufliches Praktikum), and 'no qualifications'.

[18] The correlation across the 26 industries for the share of workers with qualifications in the UK and Germany is 0.80. For the five countries, the mean of the pair-wise correlation coefficients between the rankings of industries according to the share of workers with qualifications is 0.83.

country structures and three industry characteristics.[19] Table 5 records that the industry variables are much more important than the country variables. Growth is higher in industries that are skill, equity or bank-finance dependent. There is no systematic relationship between growth and accounting standards or concentration of either the banking system or corporate sector.

[Table 5 here]

When interactive terms between the country structures and industry characteristics are added to the regression in table 5[20], both the country and industry variables become insignificant and the interactive terms are jointly significant (F(9, 351) = 1.66 [0.098]). This provides some initial indication that there is a relation between the growth of different industries in different countries and the interaction of country structures with industry characteristics. The remainder of the paper is devoted to a detailed analysis of this issue.

4 Methodology

We examine the impact of country structures and industry characteristics in separate equations for growth, fixed investment and R&D shares of industries in particular countries. In the growth regression, we also include the initial shares of industries in value added to control for regression to the mean, which table 1 suggested was present. We regress each of the dependent variables on the interaction of country structures and industry characteristics and a full set of industry and country dummies. This specification therefore controls for the large number of factors that affect the average rate of growth and level of investment in different industries and countries, and focuses on the determinants of 'abnormal' growth and investment relative to industry and country averages. The growth, fixed investment and R&D equations are as described in equations 1, 2 and 3 in section 2.

The results reported in this paper are cross-sections relating to average growth and investment over the period 1970 to 1995. They provide evidence on long-run relations between country structures, industry characteristics, growth and investment. While time series of the independent variables are not available, the dependent

[19] The equation is: $Growth_{ik} = \alpha_1 disclosure_k + \alpha_2 bankconc_k + \alpha_3 ownconc_k + \beta_1 equity_i + \beta_2 bank_i + \beta_3 other_i + \gamma share_{ik} + \varepsilon_{ik}$

[20] The equation is: $Growth_{ik} = \alpha_1 disclosure_k + \alpha_2 bankconc_k + \alpha_3 ownconc_k + \beta_1 equity_i + \beta_2 bank_i + \beta_3 other_i + \gamma_1 (disclosure_k * equity_i) + \gamma_2 (disclosure_k * bank_i) + \gamma_3 (disclosure_k * other_i) + \gamma_4 (bankconc_k * equity_i) + \gamma_5 (bankconc_k * bank_i) + \gamma_6 (bankconc_k * other_i) + \gamma_7 (ownconc_k * equity_i) + \gamma_8 (ownconc_k * bank_i) + \gamma_9 (ownconc_k * skill_i) + \gamma_{10} share_{ik} + \varepsilon_{ik}$

variables (growth, fixed investment and R&D) are measured annually and we perform tests of the stability of the results by repeating the regressions on sub-periods.[21]

The absence of time series information on the independent variables means that panel data estimation cannot be undertaken and that lagged values of the country and industry variables are not available for use as instruments. However, we address potential endogeneity issues in two ways. Firstly, if there is feedback from growth and investment to industry characteristics then it will be primarily restricted to the three countries (Germany, Japan and the US) in which these variables are measured. We therefore exclude from the sample the three countries from which the industry variables have been derived. We can have reasonable confidence that the dependence of, for example, industries in the US on equity finance will not have been influenced by the relative growth of industries in *other* countries.

Secondly, we use an instrumental variables approach to address the endogeneity of the country structures. The country variables are the level of accounting standards, the concentration of the banking industry and the concentration of the ownership of non-financial private companies. Following previous literatures, three sets of instruments are used for the country structures – the origin of the legal system (defined by dummy variables for English, French, German and Scandinavian legal origin), the rule of law and population (Rajan & Zingales, 1998, Cetorelli and Gambera, 2000). La Porta et al. (1997) argue that legal systems have a long history and have shaped the development of accompanying institutions. Legal structures (such as the origin of legal systems and the rule of law) can therefore be treated as exogenous variables in analyses of financial systems. In the presence of economies of scale in financial institutions and systems, the size of a country, as measured by its population, will affect its financial structure.

We use the instruments to construct interacted terms with each of the industry characteristics. If the instruments are only weakly correlated with the endogenous variables, the use of instrumental variables estimation may be invalid (Bound, Jaeger and Baker (1997)). We therefore regress each endogenous country variable on the instrument set. We find that population is negatively correlated with the concentration of the banking system, that English and Scandinavian legal origin are positively associated with accounting standards, as is population and the rule of law and that there is a negative correlation between ownership concentration and English legal origin. These results suggest that our instruments are indeed correlated with the endogenous country structures (see table A2 in the appendix).[22]

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[21] We also ran robustness regressions to test for the effect of outliers. The procedure weights observations by their absolute residuals and regresses them again using these weights. It continues to iterate in this way until the maximum change in weights falls below a certain tolerance. The results using these robust regressions were similar to those obtained using OLS.

[22] The regressions of the endogenous variable have been reported since the instruments for the country variables are used to construct interacted terms with the industry variables. The results of the first

Our strategy is to estimate the above regressions with OLS and then with two-stage least squares (2SLS) using the instrument set described above. We implement two diagnostic tests: first, we test to see whether endogeneity is present. The Durbin-Wu-Hausman (DWH) test includes the residuals from the regression of each endogenous variable on the exogenous variables (including the instruments) in an OLS regression. If the included residuals are jointly significant, then endogeneity is present (Davidson and MacKinnon (1993)). Second, we use the Davidson MacKinnon (DM) overidentification test to check the validity of the instruments. This tests the joint hypothesis that the instruments are valid (i.e. uncorrelated with the error) and that the instruments should not themselves have been included in the regression (Davidson and MacKinnon (1993)).

5 Results

In section 5.1 we report the results of the regressions described in the previous section using the country and industry variables discussed in section 3 and the full period for which data are available. In section 5.2, we describe results using alternative country and industry variables. In section 5.3, we discuss the results for two sub-periods and in section 5.4, we consider the relations for a set of four countries that are at an earlier stage of development than the other countries in the sample.

5.1 Estimation of growth, fixed investment and R&D equations

Table 6 reports results of regressions on growth, fixed investment, and research and development. Since the DWH tests suggest that endogeneity is present[23], we report results for these equations using two stage least squares estimation. These pass the DM overidentification test, confirming the validity of the instrument set. We describe the three sets of regressions in turn.

Growth

Column 1 of table 6 confirms the decomposition of growth analysis in table 1 since the coefficient on the initial share of each industry in a country is strongly significant and negative in the growth regression. This implies regression to the mean in the sense that industries with high initial shares of total output in particular countries have below average growth (relative to the country in question and the world average for that industry). The size of the effect is large. A 1% higher initial share of an industry in a country is associated with a 0.239% lower annual average growth rate of that industry.

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stage regression in the two-stage least squares estimation are not therefore informative about the correlation between instruments and country variables.

[23] While the DWH test is passed for the fixed investment equation, for consistency, we report the two stage least squares results for all three equations.

Five of the interaction terms between country structures and industry characteristics are significant at better than the 10% level in the growth regression. The set of interaction terms is highly significant (see table 6). Two of the three variables that interact with accounting standards are significant. Greater disclosure is associated with faster growth of skill intensive and equity financed industries. These variables are economically as well as statistically significant. For example, the interactive term between accounting standards and skills (disclosure*other) has a range of 0.035 from Spain (the country with the lowest accounting standards) to Sweden (the country with the highest accounting standards) in non-electrical machinery (the industry with the second highest skill level in Germany). Shifting from the country with the lowest to the highest accounting standards is therefore associated with an increase in annual growth in non-electrical machinery of $0.439 \times 0.035 = 1.54$ per cent.

Conversely, the share of skilled workers in Germany is at its lowest level in leather products and footwear. The range of the interactive variable in these industries is 0.038. An increase in accounting standards from Spain to Sweden is therefore associated with a decline in the growth rate in these industries of $0.439 \times 0.038 = 1.67$ percent (relative to the country and industry means). The range of the interactive variable is much lower in industries close to mean skill levels in Germany, e.g. iron and steel, where this variable therefore has little relation to growth rates. This variable illustrates the nature of the interactive relation between country structures and industry characteristics on 'abnormal' growth rates in different industries; a similar effect applies to all the variables.

In addition to information disclosure, column 1 of table 5 records that concentration of ownership is also related to the growth of equity dependent and skill intensive industries. Higher ownership concentration is associated with faster growth of both types of industry. In contrast, higher levels of bank concentration are associated with lower growth of equity dependent industries.

We return to an interpretation of these results in the context of the hypotheses of section 2 below. Before that, we report the equivalent regression results for fixed investment and R&D.

[Table 6 here]

Fixed investment

In marked contrast to the growth equation reported above and the R&D equation reported below, column 2 of table 6 records that there is no relation of fixed investment with the interaction of country structures and industry characteristics. The nine interaction terms are jointly insignificant and their inclusion raises the equation

R-squared by less than 1% in relation to a regression with just country and industry dummies (R-squared = .6021).

Research and development

Column 3 of table 6 records that the results of the R&D regression are similar to those of the growth regression.[24] The interaction terms are jointly significant at the 1% level. There is a positive relationship between R&D and the interaction of accounting standards with both equity and skills dependence. There is a positive relationship between R&D and the interaction of ownership concentration with equity dependence and, as in the growth regression, there is a negative relation of R&D with the interaction of bank concentration and equity dependence. Unlike growth, there is also a negative relationship between R&D and the interaction of bank concentration with skill dependence.

We examined the relationship between growth, R&D and fixed investment further by regressing growth on the predicted values from the fixed investment and R&D equations. While the predicted values from the fixed investment equation are insignificant, those from the R&D regression are highly significant (compare rows (1) and (2) in table 7). When the predicted values from both the fixed investment and R&D regressions are included (row (3) of table 7), the coefficient on R&D remains virtually unchanged.

[Table 7 here]

5.2 Alternative country and industry variables

We evaluated a large number of alternative country and industry variables that are described in the data appendix.

Country structure variables

We examined the effect of replacing accounting standards with (a) the size of stock markets – the ratio of market capitalization to GDP ratios, (b) the liquidity of stock markets – the value of shares traded divided by market capitalization, (c) the number of initial public offerings (IPOs) in different countries and (d) two measures of the legal rights of investors – "anti-director" rights and "creditor rights". There was no evidence of a significant relationship between growth or R&D and interactive terms involving the size or liquidity of stock markets or the measure of creditor rights. However, there was evidence of a positive relation between growth and the number of IPOs in equity dependent industries. In the R&D regression, the number of IPOs and

[24] Since R&D data are only available for 15 as compared with 27 industries for output and fixed investment, we report results using the 14 as against the 11-country sample. The results are similar for the 11-country sample but the estimates are less precise.

the measure of anti-director rights were important for both equity- and skill-dependent industries.

We replaced concentration of the banking sector with (a) the size of banking systems – measured both by bank credit to the private sector and total bank credit to GDP ratios, (b) bank ownership of corporate equity and (c) government ownership of banks. In the growth regression, the interaction between bank ownership of corporate equity and equity dependence was negative (mirroring the result for the interaction of bank concentration with equity dependence). In the R&D regression, bank ownership of corporate equity was not significant but there was a positive relation of the size of the banking system to R&D in skill dependent industries, indicating the relevance of banking systems to the financing of skill intensive R&D. Government ownership of banks was never significant for R&D but weakly positive when interacted with equity dependence in the growth regression.

We replaced the ownership concentration variable (as measured by voting control) by a second measure of the structure of ownership - the median ownership of the three largest privately owned non-financial domestic firms. We also examined the role of pyramidal ownership (where a publicly traded company lies in the chain of control between the firm and its ultimate owner). The median structure and pyramidal ownership measures gave similar results in the growth regressions to the voting control measure reported above. Using the voting control measure, there is a positive interaction with both equity and skill dependent industries. The interaction is stronger with equity dependence for the median measure of ownership structure and with skill dependence for the pyramid measure. The weak positive relationship of R&D with the interaction between ownership concentration and equity dependence is not found with the median or pyramid measures of ownership concentration.

Industry characteristics

Results are little affected by the precise definition of market finance. Replacing new equity by external finance in the US, we still find positive interactions with accounting standards and ownership concentration and a negative interaction with bank concentration in the growth and R&D equations.

To date, bank finance in Japan has been measured as the ratio of bank finance to net physical investment. Since retained earnings are the dominant source of finance in most industries, bank finance measured relative to external rather than total finance might be thought more appropriate. Results are little affected by this change.

The definition of skills used above is the proportion of the work force with any skills (i.e. one minus the proportion without qualifications). If this is replaced with the proportion of the workforce with the highest level of skills, then the interaction between both accounting standards and skills is similar but somewhat weaker than

with the broader skills measure. The interaction with accounting standards is highly significant in the R&D regression when the highest skill level is used.

To summarize, the results reported in section 5.1 are robust to alternative definitions of industry characteristics. The results are sensitive to the definitions of country structures but the variables that theory suggests are most relevant (namely information disclosure, bank concentration and ownership concentration) are the ones that appear most significant in practice. Only IPOs and anti-director rights appear to be as important as accounting standards for R&D in skill and equity dependent industries.

5.3 Time-varying effects

As noted above, while time series are not available for most of the independent variables, they are for the dependent variables. We perform tests of stability of the coefficients by splitting the sample into two periods, 1970-1980 and 1980-1995, and allowing the second period coefficients (including the constant) to differ from the first. Most of the coefficients in the second period are not significantly different from the first, suggesting that a majority of the relations are stable. The two exceptions are the interaction of skill dependence with ownership concentration, which declines in magnitude in the second period, and the interaction of skill dependence with accounting standards, which increases in magnitude in the second period. This suggests that the relevance of ownership concentration to skill-dependent industries declined from the 1970s to the 1990s in relation to that of information disclosure. Splitting the sample into finer sub-periods of five yearly intervals confirms the declining significance of the interaction of skill dependence with ownership concentration in later periods.

5.4 Stages of economic development

It was suggested in the introduction and in the hypotheses that relations between growth and financial institutions differ between developing and developed countries and in particular, the significance of bank dependence of industries is greater in developing countries. Although a study of developing countries cannot be readily undertaken within the context of an OECD dataset, data are available in OECD STAN for four countries at an earlier stage of development. These four countries (Korea, Mexico, Portugal and Greece) had GDP per capita in 1970 in the range $2,200 to $6,300 as compared with a range of $7,300 to $15,000 for the countries in the base sample in 1970. The four countries are referred to as low GDP per capita countries.

The correlations between the country and industry variables and growth for the four low GDP p.c. countries are interesting. In contrast to the advanced OECD

countries, there is a *positive* correlation between accounting standards and growth (0.476) and a very high *negative* correlation between ownership concentration and growth (-0.954). Bank concentration is also negatively correlated with growth (-0.854). For the low GDP p.c. countries, the correlation between growth and bank dependence is higher (0.557) than for the other industry characteristics (0.272 for equity dependence and –0.062 for skill dependence) and higher than in the advanced countries (see table 4).

Table 8 reports the results of an OLS regression on the four low GDP per capita countries.[25] The results are quite different from the main sample results. Both bank concentration and accounting standards are associated with higher growth of bank dependent industries and lower growth of skill dependent industries in the low GDP but not the main sample. A Chow test confirms the hypothesis of a significant difference between the regression coefficients in the two samples ($F(12, 329) = 4.60$ [0.000]). This test confirms that we cannot pool the two samples of low and high GDP per capita countries from the OECD dataset.

The most striking result is that financial institutions are more important for bank-dependent industries in the lower GDP p.c. countries than in the advanced OECD countries. Support for this came from looking at alternative measures of financial development of both stock markets and banking systems. These were interacted with the industry variables. In developed countries, neither the size (or liquidity) of the stock market, nor the number of IPOs is relevant for bank-dependent industries. In contrast, in the low GDP per capita countries, there is a negative relationship of growth in bank-dependent industries with these stock market variables and a positive relation with the size and concentration of banking systems.

[Table 8 here]

6 Implications for the hypotheses on financial systems and governance arrangements

Table 9 summarizes the results reported in table 6 for the estimated coefficients of the matrix of interaction terms between country structures and industry characteristics in the growth and R&D equations. None of the coefficients in the fixed investment equation were significant.

[25] There are an insufficient number of countries to perform instrumental variable regressions.

Table 9 – Summary of Signs of Regression Coefficients: Advanced OECD Countries

		Industry characteristic		
Growth		Equity dependence	Bank finance dependence	Skill dependence
Country structure	Accounting standards	+	0	+
	Bank concentration	-	0	0
	Ownership concentration	+	0	+
R&D				
Country structure	Accounting standards	+	0	+
	Bank concentration	-	0	-
	Ownership concentration	+	0	0

A clear relationship between both growth and R&D and the interaction of country structures and industry characteristics emerges. Accounting disclosure is associated with faster growth of industries that are equity and skill dependent. A larger share of output is devoted to R&D in these types of industries in countries with more information disclosure. There is a more pronounced relation of growth and R&D to information disclosure than to the size of financial markets measured in relation to either stock markets or banking systems. This points to the importance of information theories in explaining the link between finance and growth and to their relevance in R&D rather than fixed investment.

Concentration of the banking system is associated with slower growth and lower R&D shares in equity dependent industries and of R&D shares in skill dependent industries. Ownership concentration is associated with higher growth and R&D in equity dependent industries and faster growth of skill dependent industries. There was evidence that the relation between ownership concentration and growth of skill dependent industries is declining over time whereas accounting standards appear to be becoming more important in skill-dependent industries.

We have also found preliminary evidence that the above results are sensitive to stages of economic development. In particular, the role of institutions appears to be different for industries dependent on bank finance in developing and developed countries. In countries at earlier stages of economic development, information disclosure and bank concentration are positively related to growth of bank dependent industries.

The results are consistent with the first hypothesis of section 2. The coefficient on the interaction between accounting standards and equity dependence is

positive in the growth and R&D equation and it is insignificant in the fixed investment equation. The results are also consistent with the second hypothesis: lower bank concentration is associated with faster growth of externally financed industries in advanced countries. Lower bank concentration is also associated with higher R&D shares but not higher fixed investment shares of externally (equity) financed industries. As predicted by hypothesis 2, the converse result is found for countries at earlier stages of development: high bank concentration is associated with faster growth of bank dependent industries for such countries.

In contrast, the third hypothesis, which is based on external governance and intervention of concentrated shareholders, is rejected. Dispersed ownership is associated with slower not faster growth of equity and skill dependent industries, and dispersed ownership is associated with lower not higher R&D shares of equity dependent industries. The evidence is therefore consistent with concentrated rather than dispersed shareholders providing commitments to external investors and stakeholders.

This result can be illustrated by the cases of Sweden and the UK. Both countries have high levels of accounting disclosure and high levels of bank concentration but levels of concentration of ownership are much higher in Sweden than in the UK. On the basis of the third hypothesis, we would expect this to be reflected in differences in relative growth of equity and skill dependent industries. Plastic products and electrical machinery both have high equity dependence but plastic products has lower levels of skill dependence than electrical machinery. Contrary to theoretical predictions but consistent with the above positive coefficients on the interactive terms of equity and skill dependent industries with ownership concentration, the growth of electrical products relative to plastics was higher in Sweden than in the UK. Our interpretation is that unlike concentrated shareholders in Sweden, the dispersed anonymous shareholders in the UK may be unable to commit to other stakeholders – in this case, to skilled workers. This hinders the relative growth of skill-dependent industries in the UK as compared with Sweden.

Hypothesis 4 receives strong confirmation. The interaction between country financial and ownership structures and industry characteristics is important for R&D but not for fixed investment. In general, there is a close correspondence between the determinants of R&D and of growth.

Rajan and Zingales (2001) attempt to provide a theoretical explanation for our results. They argue that the key difference between fixed investment and R&D is that the former is collateralizable whereas the latter frequently is not. Furthermore, "typically, equity-financed industries tend to have few hard assets, and substantial intangible assets such as growth opportunities. In economies with underdeveloped financial markets and institutions, collateral is essential to obtain outside financing.

Thus we would expect industries that would optimally use few hard assets if financing was easy to come by, to use more of them in countries with underdeveloped financial systems. Thus the finding that as accounting standards and credit markets develop, equity-financed industries tend to use less fixed capital. In other words, the intangible assets that they typically possess in abundance become easier to finance, and they do not have to distort asset holdings towards fixed capital." (Rajan and Zingales (2001), p 471).

In sum, there is a strong relationship of financial systems with growth and R&D, which differs by characteristics of industries and stages of economic development. No such relationship is found for fixed investment. In advanced countries, information disclosure is associated with higher growth and R&D of equity financed and skill-intensive industries. There is also faster growth of equity financed and skill-intensive industries in the presence of high ownership concentration. In advanced countries there is higher growth and R&D of equity financed industries in the presence of dispersed banking systems. By contrast with the advanced countries, there appears to be a relation between financial systems and the bank dependency of industries in lower GDP per capita countries – in particular, a more concentrated banking system is positively related with growth in bank-dependent industries.

7 Conclusions

The starting point of the paper was the observation that, in the literature to date, relations between financial systems and economic performance identified in cross-country studies have come from datasets that include both developed and developing countries. The relevance of the pronounced differences that exist in the structure of financial systems in advanced countries is less clear-cut. The paper has used a dataset well suited to the investigation of this question for advanced countries.

We examine the proposition that there is an association between the structure of financial systems and the types of activities undertaken in different countries. The paper has provided some initial evidence that such a relationship exists. Theory points to the significance of three features of financial systems: information disclosure, the concentration of banking systems and the concentration of ownership of corporate sectors. We have found evidence of the relevance of all three. They are associated with the relative growth of industries that are dependent on external equity and bank sources of finance and on inputs of skilled labour. There is a strong relation of information disclosure, concentration of ownership and fragmentation of banking systems with growth of equity financed and skill-intensive industries in advanced countries.

Institutional structure is related not only to growth of different industries but also to the composition of their investment. While we can explain a significant amount of cross-industry and country variation in R&D expenditure, there is virtually no relation with fixed investment. This suggests that the link between institutional structure and cross-industry growth for advanced countries is more closely associated with investment in R&D than in fixed investment.

The relationships between institutional structure and industrial activity appear sensitive to stages of economic development. They are quite different for countries at earlier stages of development where, in particular we find more evidence, as predicted by theory, of a role for banking concentration in promoting the growth of bank dependent industries.

The paper provides some first exploratory evidence of a link between financial systems and types of activities in advanced economies. Future work should focus on extending the number of developing countries and finding alternative measures of industry characteristics, in particular in relation to bank borrowing. If our findings are borne out by future work, they suggest that policies concerning the structure of financial and corporate systems may need to be sensitive to countries' industrial composition and stages of economic development. For example, the relevance of ownership concentration and the concentration of banking systems may be quite different for countries in early and late stages of development. Even within advanced economies, information disclosure, dispersed banking systems and concentrated ownership may be of benefit to the industries in which some but not necessarily all such economies are specialized.

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Table 1: Average and Decomposition of Annual Growth Rates of Manufacturing Industry of 14 OECD Countries, 1970 to 1995

The table reports the annual average compound growth rates of manufacturing industry in column 1. In column 2 the difference between the country growth rate and the average of the 14 countries is shown, and in columns 3, 4 and 5 this is decomposed into "share", "growth" and "interactive"effects. These are the first, second and third terms respectively of the right hand side of the equation:

$$\Sigma_i\{a_{ik}g_{ik} - a_{i-}g_{i-}\} = \Sigma_i\{a_{ik} - a_{i-}\}g_{i-} + \Sigma_i a_{i-}\{g_{ik} - g_{i-}\} + \Sigma_i\{a_{ik} - a_{i-}\}\{g_{ik} - g_{i-}\}$$

where a_{ik} is the share of industry i in country k's total manufacturing in 1970, g_{ik} is the growth rate of industry i in country k over the period 1970 to 1995 and subscript – denotes the average across all countries. *Source*: OECD, Structural Analysis Industrial (STAN) Database and own calculations.

	(1)	(2)	(3)	(4)	(5)
Country	**Growth Rate**	**Difference from Average**	**Share Effect**	**Growth Effect**	**Interactive Effect**
Italy	0.030	0.010	-0.005	0.015	-0.001
Japan	0.027	0.006	0.000	0.011	-0.005
Finland	0.027	0.006	-0.001	0.011	-0.003
Spain	0.026	0.005	-0.001	0.010	-0.004
USA	0.023	0.003	0.002	0.005	-0.004
Canada	0.023	0.002	0.001	0.007	-0.005
Australia	0.017	-0.003	0.000	-0.001	-0.002
Netherlands	0.017	-0.004	0.002	-0.006	0.000
France	0.016	-0.004	-0.001	-0.002	-0.001
Denmark	0.015	-0.005	0.000	-0.003	-0.002
Sweden	0.012	-0.009	0.000	-0.008	-0.001
Germany	0.010	-0.011	0.003	-0.012	-0.002
Norway	0.006	-0.014	-0.001	-0.011	-0.002
UK	0.004	-0.017	0.001	-0.016	-0.002

Table 2: Average Ratio of Fixed Investment to Value Added, 1970-1990 and R&D to Value Added, 1973 to 1994

This table reports the average ratio of investment (gross domestic fixed investment) to value added in manufacturing industries in column 1 and the average ratio of R&D to value added in manufacturing in column 2. Countries are ranked from highest to lowest.
Source: OECD Structural Analysis Industrial (STAN) Database for fixed investment and value added, and OECD Analytical BERD (ANBERD) Database for R&D

Fixed Investment / Value Added 1970-90		**R&D/ Value Added 1973-94**	
	(1)		(2)
Finland	0.198	USA	0.079
Japan	0.194	Sweden	0.071
Norway	0.189	UK	0.055
Italy	0.174	Japan	0.054
Netherlands	0.169	Germany	0.052
Canada	0.162	Netherlands	0.051
Sweden	0.159	France	0.051
Denmark	0.153	Norway	0.038
France	0.148	Finland	0.033
Australia	0.131	Denmark	0.031
UK	0.124	Canada	0.027
Germany	0.121	Italy	0.021
USA	0.113	Australia	0.020
Spain	0.077	Spain	0.010
Correlation matrix (156 observations)			
	Growth	Fixed Investment	R&D
Growth	1	0.0996	0.5080
Fixed Investment		1	-0.0065

Table 3: Country Structures

Column 1 is the number of accounting standards on a scale from 0 to 90 reported in Rajan and Zingales (1998) from a survey conducted by the Center for International Financial Analysis and Research normalized to lie in the range 0 to 1 by dividing by 90. Column 2 is the average over the period 1989-1996 of the market share of the three largest banks, reported in Cetorelli and Gambera (2000). Column 3, shows 1 minus percentage of widely held firms of the 20 largest publicly traded firms in 1995, reported in La Porta et al (1998).

	(1)	**(2)**	**(3)**
Country	**Accounting Standards**	**Bank Concentration**	**Ownership Concentration**
Australia	0.833	0.60	0.45
Canada	0.822	0.57	0.50
Denmark	0.689	0.74	0.90
Finland	0.856	0.85	0.85
France	0.767	0.28	0.70
Germany	0.689	0.27	0.65
Italy	0.689	0.24	0.85
Japan	0.722	0.21	0.50
Netherlands	0.711	0.77	0.70
Norway	0.822	0.60	0.95
Spain	0.567	0.34	0.85
Sweden	0.922	0.71	1.00
UK	0.867	0.50	0.10
USA	0.789	0.15	0.20
Mean	0.768	0.488	0.657

Correlation matrix (14 countries)

	Accounting standards	Bank concentration	Growth	Fixed Investment	R&D
Accounting standards	1		-0.3360	0.2446	0.4900
Bank concentration	0.4752	1	-0.2425	0.1428	0.0278
Ownership concentration	-0.2032	0.3450	0.0769	0.3870	0.1089

Table 4: Industry Characteristics

This table records three industry variables used in the regression analyses. Column 1 is the fraction of capital expenditure financed with net equity by US firms during the 1980s as reported in Rajan and Zingales (1998). Column 2 is the average proportion of net physical investment financed by bank loans in Japan over the period 1981 to 1990. The source of these data is the Japanese Ministry of Finance (N/A = not available). Column 3 is one minus the proportion of employees reported by Oulton (1996) as having no skill qualifications in different German industries in 1987.

	(1)	(2)	(3)
Industry	**Equity Dependence (US)**	**Bank Dependence (Japan)**	**Skill Levels (Germany)**
Food	0	0.52	0.658
Beverages	0	0.52	0.745
Tobacco	-0.08	0.52	0.619
Textiles	0.01	0.86	0.593
Clothing	0	1.49	0.646
Leather &Products	0	N/A	0.586
Footwear	0.04	N/A	0.586
Wood Products	0.04	1.78	0.724
Furniture & Fixtures	0.01	N/A	0.724
Paper & Products	0.02	0.68	0.628
Printing & Publishing	0.03	0.80	0.771
Industrial Chemicals	0.07	0.04	0.758
Other Chemicals	0.02	0.04	0.758
Petroleum & Coal Products	0.06	N/A	0.769
Rubber Products	0.11	N/A	0.641
Plastic Products, nec	0.26	N/A	0.641
Pottery, China etc	0.11	0.63	0.623
Glass & Products	0.02	0.63	0.623
Non-Metallic Products, nec	0.01	0.63	0.707
Iron & Steel	0.01	-1.01	0.691
Non-Ferrous Metals	0.02	0.11	0.655
Metal Products	0.02	1.03	0.703
Non-Electrical Machinery	0.11	0.81	0.791
Electrical Machinery	0.36	0.37	0.732
Shipbuilding & Repairing	0.02	-3.41	0.843
Motor Vehicles	0.01	0.39	0.723
Instruments	0.62	0.72	0.737
Mean	0.07	0.39	0.692

Correlation matrix (27 industries; 21 industries for correlations with bank finance; 15 industries for correlations with R and D; 14 industries for correlations with R&D and bank finance; correlations for growth, fixed investment and R&D relate to the 14 OECD countries)

	Equity dependence	Bank finance	Growth	Fixed Investment	R&D
Equity dependence	1		0.5577	-0.0451	0.6214
Bank finance	0.0734	1	0.2914	-0.1874	0.0034
Skills	0.1717	-0.4551	0.2813	0.1384	0.3472

Table 5: Growth Regression with Country and Industry Variables	
This table reports an OLS regression of annual average growth over the period 1970 to 1995 in 14 OECD countries and 27 industries on initial value added shares of industries at the start of the period (initial shares), three country structures (accounting standards (disclosure), bank concentration (bankconc) and ownership concentration (ownconc)) and three industry characteristics (equity dependence (equity), bank dependence (bank) and skill dependence (other)). A constant and zero-one dummy variables relating to industries and countries with missing independent variables have been included but are not reported. Huber-corrected t-statistics are shown in brackets. * = significant at 10% level, ** = significant at 5% level, and *** = significant at 1% level. The p-values of the F-tests are shown in square brackets.	
Initial shares	-0.0350 (1.04)
Country variables:	
Accounting standards (disclosure)	-0.0244 (1.25)
Bank concentration (bankconc)	-0.0066 (0.98)
Ownership concentration (ownconc)	0.0041 (0.69)
Industry variables:	
Equity dependence (equity)	0.0707 (6.16) ***
Bank finance dependence (bank)	0.0059 (2.26) **
Skill dependence (other)	0.0905 (4.47) ***
Country and industry dummies	NO
Number of observations	369
F-test on equation	12.20 [0.000]
R^2	0.2476

Table 6: Growth, Fixed Investment and R&D Regressions

The table reports the results of two-stage least square regressions of annual average growth rates in column 2, of the share of fixed investment in value added in column 3 and of the share of research and development in value added in column 3. The country and industry pools are defined in the data appendix. There are ten independent variables: initial value added shares of industries at the start of the period (share) and nine interactive terms between three country structure variables (accounting standards (disclosure), bank concentration (bankconc) and concentration of ownership (ownconc)) and three industry characteristics (external equity finance in the US (equity)), external bank finance in Japan (bank), and the proportion of workers with any skill training in Germany (other)). A constant and a zero-one dummy variable relating to industries and countries with missing independent variables have been included but are not reported below. Huber-corrected t-statistics are shown in brackets. * = significant at 10% level, ** = significant at 5% level, and *** = significant at 1% level. The instruments for all country variables used to construct the interactive terms are population, rule of law and dummy variables for legal origin.

	(1)	(2)	(3)
Dependent variable:	Growth	Fixed Investment	R&D
Initial shares	-0.2388 (4.53)***	-	-
Disclosure*equity	0.3465 (3.68)***	-0.1448 (0.35)	1.4767 (2.43)**
Disclosure*bank	-0.0105 (0.34)	0.0171 (0.31)	-0.0550 (1.33)
Disclosure*other	0.4387 (1.74)*	0.8248 (0.79)	0.4797 (2.04)**
Bankconc*equity	-0.1277 (2.60)***	-0.2546 (1.27)	-0.2402 (1.91)*
Bankconc*bank	-0.0104 (1.06)	-0.0352 (0.91)	0.0069 (0.58)
Bankconc*other	0.1129 (0.92)	0.3702 (0.65)	-0.3712 (1.77)*
Ownconc*equity	0.1013 (3.19) ***	-0.0805 (0.94)	0.2781 (1.81)*
Ownconc*bank	-0.0007 (0.09)	0.0194 (1.43)	-0.0083 (1.33)
Ownconc*other	0.1656 (2.04) **	0.2317 (0.68)	0.0095 (0.08)
Country and industry dummies	YES	YES	YES
Number of obs.	290	250	171
F-test on equation	14.73 [.000]	16.93 [.000]	19.12 [.000]
R^2	0.6836	0.6111	0.7280
F-test on sign. Of interaction terms	F(9, 243)= 4.14 [0.0001]	F(9, 204)= 1.26 [0.2590]	F(9, 136) = 2.91 [.0035]
DWH test	1.97 [.0435]	1.29 [.2448]	3.05 [.0025]
Davidson-MacKinnon test	χ^2 (3) = 5.404 [.1445]	χ^2 (3) = 5.857 [.1188]	χ^2 (6)= 1.891 [.9294]

Table 7: Regression of Growth on Predicted Values of Fixed Investment and R&D

The table reports the results of a regression of annual average growth on the predicted values from the fixed investment and R&D regressions. The predicted values come from the regression of the average fixed investment and R&D shares on the nine interaction terms plus country and industry dummies, estimated by 2SLS. The equations in this table are estimated by OLS on the sample that is common to the two regressions. * = significant at 10% level, ** = significant at 5% level, and *** = significant at 1% level.

	Initial share	Predicted value of fixed investment	Predicted value of R&D	Number of obs.	R^2	F [p-value]
(1)	-0.0981 (-3.26)***	0.0229 (0.64)	-	156	0.0675	6.68 [.002]
(2)	-0.0393 (1.65)	-	0.2832 (5.79)***	156	0.2935	21.51 [.000]
(3)	-0.0312 (1.29)	0.0445 (1.50)	0.2876 (5.81)***	156	0.3009	14.49 [.000]

Table 8: Growth Regression: Low GDP p.c. Sample of OECD countries

This table reports the results of an OLS regression of annual average growth over the period 1970 to 1995 in four low GDP per capita countries on the independent variables described in table 6. A constant and a zero-one dummy variable relating to industries and countries with missing independent variables have been included but are not reported. Huber-corrected t-statistics are shown in brackets. * = significant at 10% level, ** = significant at 5% level, and *** = significant at 1% level.

Initial share	-0.3679 (3.14)***
Disclosure*equity	-0.2966 (0.22)
Disclosure*bank	0.4757 (1.80)*
Disclosure*other	-5.925 (2.14)**
Bankconc*equity	-0.4137 (1.12)
Bankconc*bank	0.1350 (1.92)*
Bankconc*other	-1.3903 (1.90)*
Ownconc*equity	0.0349 (0.15)
Ownconc*bank	-0.0353 (0.76)
Ownconc*other	0.3605 (0.80)
Country and industry dummies	YES
Number of observations	101
F-test on equation	133.84 [.0000]
R^2	0.8979
F-test on significance of interaction terms	3.40 [.0019]

Appendix 1: Data[26]

In all OECD data used in this study, Germany refers to West Germany, even for the years after reunification.

1. Activity Measures

Growth rates:

Calculated using constant price value added data by country and industry from OECD, DSTI(STAN) 1997.

Fixed investment share:

Calculated using gross fixed investment (GFI) and value added data by country and industry from OECD, DSTI(STAN) 1997.

R&D share:

Calculated using R&D expenditure from OECD, DSTI(ANBERD), 1998 and value added from OECD, DSTI(STAN) 1997, both by country and industry.

For Germany data stops in 1993; averages refer to 1973-1993.

2. Industry Variables

(1) Equity finance and external finance in the USA in the 1980s*:*

Table 1, Rajan and Zingales (1998). The series for equity dependence was reported in earlier versions of Rajan and Zingales (1998), but not in the published version.

(2) Bank finance in Japan by industry:

Japan, Ministry of Finance 1981-1990 (Unpublished data provided by Jenny Corbett, Nissan Institute, Oxford University.) Our measures are flow measures derived from the sources and uses of funds constructed from the aggregate balance sheet data compiled by the Ministry of Finance.

Banknpi = bank loans / net physical investment

Bankinv = bank loans / (net investment - net retentions)

To correct for fluctuations in and possible time discrepancies between investment and loans received, the 1981-1990 sum of each term in the above equation was determined before the division.

(3) Employment broken down by category of skill and by industry in Germany:

Oulton (1996). Total employment in the industry is broken down into four skill categories: workers with no skills, low skilled, medium, and highly skilled.

3. Country Variables:

(1) Ownership concentration:

1. Ownership concentration

This is a measure of voting control defined as one minus the mean of the percentage of the 20 largest listed firms widely held (i.e. in which there is not a chain of control from an ultimate owner of at least 10% of voting rights), Table 3B , La Porta et al. (1999). Affiliates of foreign-owned firms with at least 50% of votes directly controlled by a single foreign owner are excluded. Data is from 1995-6.

2. Median ownership concentration

Median ownership of the three largest shareholders in the 10 largest non-financial privately-owned domestic firms; Table 10, La Porta et al. (1998)

3. Pyramid

Mean of percentage of pyramids and not widely held 20 largest listed firms, Table 4, La Porta et al. (1999). We changed the missing value for the UK into a zero.

(2) Bank concentration:

The measure of bank concentration is the sum of the market shares of the three largest banks averaged over the period for which data are available (1989-1996) and uses the IBCA BankScope 1997 CD as the underlying data source (Cetorelli and Gambera (2000)).

(3) Accounting standards:

Table 2, Rajan and Zingales (1998) and Laporta et al (1997).

[26] Detailed information on data cleaning and adjustments to the data is available in a data appendix from the authors.

(4) Origin of Legal System, Creditor Rights, Anti-director Rights:
Table 2, La Porta et al.(1997).
(5) Bank ownership of equity:[27]

$$\text{Percentage of equity held by banks} = \frac{\text{Market value of equity held by banks}}{\text{Market value of equity held by the private domestic sector}}$$

Details of sources used to construct this variable are available in the detailed data appendix from the authors.

Equity owned by banks	
This shows the proportion of total equity market capitalization in different countries held by banks. (N/A = not available).	
Country	**Equity Owned by Banks**
Australia	0.042
Canada	0.080
Denmark	n.a.
Finland	0.150
France	0.064
Germany	0.136
Italy	0.057
Japan	0.232
Netherlands	0.053
Norway	0.082
Spain	0.095
Sweden	0.000
UK	0.017
USA	0.004
Mean	0.078

(6*) Credit / GDP*
IMF, International Financial Statistics, lines 32d and 99b. 1980-1990 average.
(7) Private credit/GDP
Value of credits by financial intermediaries to the private sector / GDP, 1960s average; 1970s average. Beck, Demirgüç-Kunt and Levine (1999).
(8) Government-owned banks (before privatisation waves)
Share of assets of top 10 banks owned by government, 1985. La Porta, Lopez-de-Silanes, Shleifer (2002, forthcoming).
(9) Market capitalization / GDP
Market capitalization in US$ is from Emerging Stock Markets Factbook 1992, IFC, p. 52-53. Exchange rate and GDP are from International Financial Statistics, lines ae and 99b. 1982-1991 average.
(10) Value traded / Market capitalization
Market capitalization and Value traded in US$ for 1980-1990 is from Emerging Stock Markets Factbook, IFC, 1990 and 1995 editions.
(11) Initial public offerings (IPO)
The number of domestic IPOs in 1996 is from the Federation Internationale des Bourses de Valeurs website: http://www.fibv.com/stata.htm, 1997 Annual Statistics, 1.1 Equity market: Number of newly listed companies.
(12) Population
Population in 1973 is from Maddison, A., 1995, "Monitoring the World Economy 1820-1992", OECD Development Center Studies, OECD: Paris.

[27] We are grateful to the staff of the many central banks who helped us collect these data.

4. Definition of Pools used in Regressions

	Period	No. of countries	No. of industries
Growth	1970-95	14, 11, 4 OECD countries	27
Fixed investment	1970-90	14, 11 OECD countries	27
R&D	1973-94	14,11 OECD countries	15

Industry pool for growth and investment regressions		Industry pool for research and development regressions	
Industry	ISIC	Industry	ISIC
Food	3110+3120	Food, Beverages and Tobacco	3100
Beverages	3130		
Tobacco	3140		
Textiles	3210	Textiles, Clothing , Leather & Footwear	3200
Clothing	3220		
Leather &Products	3230		
Footwear	3240		
Wood Products	3310	Wood Products, Furnitures & Fixtures	3300
Furnitures & Fixtures	3320		
Paper & Products	3410	Paper & Products, Printing & Publish	3400
Printing & Publishing	3420		
Industrial Chemicals	3510	Chemicals	3510+3520
Other Chemicals	3520		
Petroleum & Coal Products	3540		
Rubber Products	3550	Rubber Products and Plastic Products	3550+3560
Plastic Products, nec	3560		
Pottery, China etc	3610	Non-Metallic Products	3600
Glass & Products	3620		
Non-Metal Products, nec	3690		
Iron & Steel	3710	Iron & Steel	3710
Non-Ferrous Metals	3720	Non-Ferrous Metals	3720
Metal Products	3810	Metal Products	3810
Non-Electrical Machinery	3820	Non-Electrical Machinery	3820
Electrical Machinery	3830	Electrical Machinery	3830
Shipbuilding & Repairing	3841	Shipbuilding & Repairing	3841
Motor Vehicles	3843	Motor Vehicles	3843
Instruments	3850	Instruments	3850

Appendix 2: Regressions on Instrumental Variables

Table A2: Regression of Endogenous Variables on the Instruments

This table reports three OLS regressions of the endogenous variables on the instrument set. The omitted category in the legal origin dummies is 'French'. In the 11-country sample, there are no instances of German legal origin. Huber-corrected t-statistics are shown in brackets. * = significant at 10% level, ** = significant at 5% level, and *** = significant at 1% level

	(1)	(2)	(3)
	Accounting standards	Bank concentration	Ownership concentration
English legal origin	0.1148 (6.69) ***	0.1129 (1.14)	-0.4289 (-2.88) **
Scandinavian legal origin	0.1577 (2.69) **	0.0536 (0.41)	0.0415 (0.24)
Rule of law	1.054 (11.99) ***	0.7923 (1.84)	-0.5039 (-1.01)
Population	0.000004 (8.73) ***	-0.000005 (-2.13) *	-0.000005 (-1.74)
Number of observations	11	11	11
F-test on equation	54.30 [0.0001]	20.17 [0.0013]	7.85 [0.0145]
R^2	0.7348	0.8249	0.8619