Finance and the Sources of Growth

Thorsten Beck, Ross Levine, and Norman Loayza

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Abstract: This paper evaluates the empirical relationship between the level of financial intermediary development and (i) economic growth, (ii) total factor productivity growth, (iii) physical capital accumulation, and (iv) private saving rates. We use (a) a pure cross-country instrumental variable estimator to extract the exogenous component of financial intermediary development, and (b) a new panel technique that controls for biases associated to simultaneity and unobserved country-specific effects. After controlling for these potential biases, we find that (1) financial intermediaries exert a large, positive impact on total factor productivity growth, which feeds through to overall GDP growth; and (2) the long-run links between financial intermediary development and both physical capital growth and private saving rates are tenuous.

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I. Introduction

Joseph Schumpeter argued in 1911 that financial intermediaries play a pivotal role in economic development because they choose which firms get to use society's savings. According to this view, the financial intermediary sector alters the path of economic progress by affecting the allocation of savings and not necessarily by altering the saving rate. Thus, the Schumpeterian view of finance and development highlights the impact of financial intermediaries on productivity growth and technological change.[1] Alternatively, a vast development economics literature argues that capital accumulation is the key factor underlying economic growth.[2] According to this view, better financial intermediaries influence growth primarily by raising domestic saving rates and attracting foreign capital. Thus, while many theories note that financial intermediaries arise to ameliorate particular market frictions, models disagree about the fundamental channels via which financial intermediaries are connected to growth. To clarify the relationship between financial intermediation and economic performance, we empirically assess the impact of financial intermediaries on private saving rates, capital accumulation, productivity growth, and overall economic growth.

This paper is further motivated by a rejuvenated movement in macroeconomics to understand cross-country differences in both the level and growth rate of total factor productivity. A long empirical literature successfully shows that "something else" besides physical and human capital accounts for the bulk of cross-country differences in both the level and growth rate of real per capita Gross Domestic Product (GDP). Nevertheless, economists have been relatively unsuccessful at fully characterizing this residual, which is generally termed "total factor productivity." Recent papers by Hall and Jones (1998), Harberger (1998), Klenow (1998), and Prescott (1998) have again focused the profession's attention on the need for improved theories of total factor productivity growth. While we do not advance a new theory, this paper empirically explores one factor underlying cross-country

differences in total factor productivity growth: differences in the level of financial intermediary development.

While past research evaluates the impact of financial intermediary development on growth, we examine the relationship between financial intermediary development and what we term the sources of growth: private saving rates, physical capital accumulation, and total factor productivity growth. King and Levine (1993a,b) show that the level of financial intermediary development is a good predictor of economic growth even after controlling for many other country characteristics. Time-series studies confirm that finance predicts growth [Neusser and Kugler 1998 and Rousseau and Wachtel 1998]. One shortcoming of these papers is that financial intermediary development may be a leading indicator but not an underlying cause of economic growth. Recent industry-level, firm-level, and event-study investigations, however, suggest that the level of financial intermediary development has a large, causal impact on real per capita GDP growth [Rajan and Zingales 1998; Demirgüç-Kunt and Maksimovic 1998; Jayaratne and Strahan 1996]. Using both pure cross-country instrumental variables procedures as well as dynamic panel techniques, Levine, Loayza, and Beck (1999) show that the strong, positive relationship between the level of financial intermediary development and long-run economic growth is not due to simultaneity bias. This paper assesses the relationship between financial intermediary development and (i) private saving rates, (ii) capital accumulation, and (iii) total factor productivity growth. While Levine, Loayza, and Beck (1999) use a very similar data set and identical econometric procedures to study financial development and economic growth, this paper's major contribution is to examine the relationship between financial intermediary development and the *sources* of growth.

Methodologically, this paper uses two econometric procedures to assess the relationship between financial intermediary development and the sources of growth. While King and Levine

(1993a) and Levine and Zervos (1998) examine this relationship, their estimation procedures do not explicitly confront the potential biases induced by simultaneity or omitted variables, including country-specific effects. We use two econometric techniques to control for the simultaneity bias that may arise from the joint determination of financial intermediary development and (i) private saving rates, (ii) capital accumulation, (iii) total factor productivity growth, and (iv) overall real per capita GDP growth.

The first technique employs a pure cross-sectional, instrumental variable estimator, where data for 63 countries are averaged over the period 1960-95. The dependent variable is, in turn, real per capita GDP growth, real per capita capital stock growth, productivity growth, or private saving rates. Besides a measure of financial intermediary development, the regressors include a wide array of conditioning information to control for other factors associated with economic development. To control for simultaneity bias, we use the legal origin of each country as an instrumental variable to extract the exogenous component of financial intermediary development. Legal scholars note that many countries can be divided into countries with English, French, German, or Scandinavian legal origins and those countries typically obtained their legal systems through occupation or colonization. Thus, we take legal origin as exogenous. Moreover, LaPorta, Lopez-de-Silanes, Shleifer, and Vishny (1997, 1998; henceforth LLSV) show that legal origin substantively affected (a) creditor rights, (b) systems for enforcing debt contracts, and (c) standards for corporate information disclosure. Each of these features of the contracting environment helps explain cross-country differences in financial intermediary development [Levine 1999]. Thus, after extending the LLSV data on legal origin from 49 to 63 countries, we use the legal origin variables as instruments for financial intermediary development to assess the effect of financial intermediary development on economic growth, capital growth, productivity growth, and private saving rates.

Since these cross-country regression estimates (1) do not exploit the time-series dimension of the data, (2) may be biased by the omission of country-specific effects, and (3) do not control for the endogeneity of all the regressors, we also use a dynamic Generalized-Method-of-Moments (GMM) panel estimator.[3] We construct a panel dataset with data averaged over each of the seven 5-year periods between 1960 and 1995. We then use the GMM panel estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1997) to extract consistent and efficient estimates of the impact of financial intermediary development on growth and the sources of growth. Relative to the cross-sectional estimator, this panel estimator has a number of advantages. Namely, the GMM panel estimator exploits the time-series variation in the data, accounts for unobserved country-specific effects, allows for the inclusion of lagged dependent variables as regressors, and controls for endogeneity of all the explanatory variables (not just financial development). To accomplish this, the panel estimator uses instrumental variables based on previous realizations of the explanatory variables ("internal" instruments). Paradoxically, exploiting the time-series properties of the data also creates one disadvantage with respect to the cross-sectional estimator. By focusing on five-year periods, the panel estimator may not fully isolate long-run growth relationships from business-cycle ones. Thus, taking them as complementary, this paper uses two econometric procedures – a pure cross-sectional instrumental variable estimator and a GMM dynamic panel technique – to evaluate the impact of differences in financial intermediary development on economic growth, capital accumulation, productivity growth, and private saving.

This paper also improves upon existing work by using better measures of saving rates, physical capital, productivity, and financial intermediary development. Private saving rates are notoriously difficult to measure [Masson, Bayoumi, and Samiei 1995]. As detailed below, however, we use the results of a recent World Bank initiative that compiled high-quality statistics on gross private savings

as a share of gross private disposable income over the period 1971-1995 [Loayza, Lopez, Schmidt-Hebbel, and Serven 1998]. We also use more accurate estimates of physical capital stocks. Researchers typically make an initial estimate of the capital stock in 1950 and then use aggregate investment data and a single depreciation rate to compute capital stocks in later years [King and Levine 1994]. The figures reported in the paper use capital stocks computed in this way because of data availability. Recently, however, the Penn-World Tables compiled disaggregated investment data (machinery, transportation equipment, business construction, etc.) and separate estimates of depreciation rates for each component. These data are available for only a subset of countries and years. Nonetheless, we confirm our results using capital stock estimates constructed using these disaggregated figures. To measure TFP growth, researchers typically define TFP growth as a residual: real per capita GDP growth minus real per capita capital growth times capital's share in the national income accounts, which is commonly taken to be between 0.3 and 0.4. Besides this traditional measure, we also control for human capital accumulation in computing TFP growth (using both the Mankiw 1995 and the Bils and Klenow 1998 specifications). Since these alternative productivity growth measures produce similar results, we report only the results with the simple, traditional TFP measure.[4] Finally, this paper also uses an improved measure of financial intermediary development. We measure financial intermediary credits to the private sector relative to GDP. This measure more carefully distinguishes who is conducting the intermediation, to where the funds are flowing, and we more accurately deflate financial stocks than past studies [e.g., King and Levine 1993a,b]. Finally, we check our results using the King and Levine (1993a,b) and Levine and Zervos (1998) measures of financial intermediation after extending their sample periods and deflating correctly.

We find that there is a robust, positive link between financial intermediary development and both real per capita GDP growth and total factor productivity growth. The results indicate that the

strong connections between financial intermediary development and both real per capita GDP growth and total factor productivity growth are not due to biases created by endogeneity or unobserved country-specific effects. Using both the pure cross-sectional instrumental variable estimator and the system dynamic-panel estimator, we find that higher levels of financial intermediary development produce faster rates of economic growth and total factor productivity growth. These results are robust to alterations in the conditioning information set and to changes in the measure of financial intermediary development. Thus, the data are consistent with the Schumpeterian view that the level of financial intermediary development importantly determines the rate of economic growth by affecting the pace of productivity growth and technological change.

Turning to physical capital growth and savings, the results are ambiguous. We frequently find a positive and significant relationship between financial intermediary development and the rate of capital per capita growth. Nonetheless, the results are inconsistent across alternative measures of financial development in the pure cross-sectional regressions. The data do not confidently suggest that higher levels of financial intermediary development promote economic growth by boosting the long-run rate of physical capital accumulation. We find similarly conflicting results on savings. Different measures of financial intermediary development yield different conclusions regarding the link between financial intermediary development and private savings in both pure cross-section and panel regressions. Thus, we do not find a robust relationship between financial intermediary development and either physical capital accumulation or private saving rates. In sum, the results are consistent with the Schumpeterian view of finance and development: financial intermediaries affect economic development primarily by influencing total factor productivity growth.

The rest of the paper is organized as follows. Section II describes the data and presents descriptive statistics. Section III discusses the two econometric methods. Section IV presents the results

for economic growth, capital growth and productivity growth. Section V presents the results for private saving rates. Section VI concludes.

II. Measuring financial development, growth and its sources

This section describes the measures of (1) financial intermediary development, (2) real per capita GDP growth, (3) capital per capita growth, (4) productivity per capita growth, and (5) private saving rates.

A. Indicators of financial development

A large theoretical literature shows that financial intermediaries can reduce the costs of acquiring information about firms and managers and lower the costs of conducting transactions.[5] By providing more accurate information about production technologies and by exerting corporate control, better financial intermediaries can enhance resource allocation and accelerate growth [Boyd and Prescott 1986; Greenwood and Jovanovic 1990; King and Levine 1993b]. Similarly, by facilitating risk management, improving the liquidity of assets available to savers, and reducing trading costs, financial intermediaries can encourage investment in higher-return activities [Obstfeld 1994; Bencivenga and Smith 1991; Greenwood and Smith 1997]. The effect of better financial intermediaries on savings, however, is theoretically ambiguous. Higher returns ambiguously affect saving rates due to well-known income and substitution effects. Also, greater risk diversification opportunities have an ambiguous impact on saving rates as shown by Levhari and Srinivasan (1969). Moreover, in a closed economy, a drop in saving rates may have a negative impact on growth. Indeed, if these saving and externality effects are sufficiently large, an improvement in financial intermediary development could lower growth [Bencivenga and Smith 1991]. Thus, we attempt to shed some empirical light on these debates and ambiguities that emerge from the theoretical literature.

Specifically, we examine whether economies with better-developed financial intermediaries (i) grow faster, (ii) enjoy faster rates of productivity growth, (iii) experience more rapid capital accumulation, and (iv) have higher saving rates.

To evaluate the impact of financial intermediaries on growth and the sources of growth, we seek an indicator of the ability of financial intermediaries to research and identify profitable ventures, monitor and control managers, ease risk management, and facilitate resource mobilization. We do not have a direct measure of these financial services. We do, however, construct a better measure of financial intermediary development than past studies and we check these results with existing measures of financial sector development.

The primary measure of financial intermediary development is PRIVATE CREDIT, which equals the value of credits by financial intermediaries to the private sector divided by GDP. Unlike many past measures [King and Levine 1993a,b], this measure excludes credits issued by the central bank and development banks. Furthermore, it excludes credit to the public sector and cross claims of one group of intermediaries on another. PRIVATE CREDIT is also a broader measure of financial intermediary development than that used by Levine and Zervos (1998) since it includes all financial institutions, not only deposit money banks.[6] PRIVATE CREDIT is a comparatively comprehensive measure of credit issuing intermediaries since it includes the credits of financial intermediaries that are not considered deposit money banks.[7] Finally, unlike past studies, we carefully deflate the financial intermediary statistics. Specifically, financial stock items are measured at the end of the period, while GDP is measured over the period. Simply dividing financial stock items by GDP, therefore, can produce misleading measures of financial development, especially in highly inflationary environments.[8] Thus, PRIVATE CREDIT improves significantly on other measures of financial development.[9]

To assess the robustness of our results, we use two additional measures of financial development. One traditional measure of financial development, LIQUID LIABILITIES, equals the liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of financial intermediaries and nonbank financial intermediaries) divided by GDP.[10] The correlation between PRIVATE CREDIT and LIQUID LIABILITIES is 0.77 and is significant at the one- percent level. Unlike PRIVATE CREDIT, LIQUID LIABILITIES is just an indicator of size. A second measure is COMMERCIAL-CENTRAL BANK, which equals the ratio of commercial bank domestic assets divided by commercial bank plus central bank domestic assets. COMMERCIAL-CENTRAL BANK measures the degree to which commercial banks or the central bank allocate society's savings. The correlation with PRIVATE CREDIT is 0.64 and is significant at the one- percent level. The intuition underlying this measure is that commercial financial intermediaries are more likely to identify profitable investments, monitor managers, facilitate risk management, and mobilize savings than central banks.[11]

B. Economic growth and its sources

To assess the impact of financial intermediary development on the sources of growth, this paper uses new and better data on capital accumulation, productivity growth and private saving rates. This subsection describes our data on economic growth, capital per capita growth and productivity growth.[12] The next subsection describes the saving data.

GROWTH equals the rate of real per capita GDP growth, where the underlying data are from the national accounts. For the pure cross-sectional data (where there is one observation per country for the period 1960-1995), we compute *GROWTH* for each country by running a least-squares regression of the logarithm of real per capita GDP on a constant and a time trend. We use the estimated

coefficient on the time trend as the growth rate. This procedure is more robust to differences in the serial correlation properties of the data than simply using the geometric rate of growth [Watson 1992].[13] We do not use least squares growth rates for the panel data because the data are only over five-year periods. Instead, we calculate real per capita GDP growth as the geometric rate of growth for each of the seven five-year periods in the panel data.

CAPGROWTH equals the growth rate of the per capita physical capital stock. To compute physical capital growth figures for a broad cross-section of 63 countries over the 1960-95 period, we follow King and Levine (1994). Specifically, we first use Harberger's (1978) suggestion for deriving an initial estimate of the capital stock in 1950, which assumes that each country was at its steady-state capital-output ratio in 1950. While this assumption is surely wrong, it is better than assuming an initial capital stock of zero, which many researchers use.[14] Then, we use the aggregate real investment series from the Penn-World Tables (5.6, henceforth PWT) and the perpetual inventory method with a depreciation rate of seven percent to compute capital stocks in later years. To check our results, we also used disaggregated investment data from the PWT. Specifically, we consider four components of the investment series independently (and exclude the fifth component, residential construction): machinery, transportation equipment, business construction, and other (non-residential) construction. The capital stock number for each component, *i,* is then computed using the following formula: $K_{i,t+1} = K_{i,t} + I_{i,t} - \delta_{i,} K_{i,t}$, where individual depreciation rates are used for the different categories and we again use Harberger's (1978) method for getting an initial capital stock estimate. We were only able to compute this alternative capital stock measure for 42 countries. Nonetheless, using this alternative measure does not alter any of the conclusions that follow.[15]

Our measure of productivity growth (*PROD*) builds on the neoclassical production function with physical capital *K*, labor *L* and the level of total factor productivity *A*. We assume that this

aggregate production function is common across countries and time, such that aggregate output in country i, Y_i, is given as follows:

$$Y_i = A_i K_i^{\alpha} L_i^{1-\alpha} \tag{1}$$

To solve for the growth rate of productivity, we first divide by L to get per capita production. We then take logs and the time derivative. Finally, assuming a capital share $a=0.3$ and solving for the growth rate of productivity per capita, we have

$$PROD = GROWTH - 0.3 * CAPGROWTH \tag{2}$$

C. Private Saving Rates

The data on private saving rates draw on a new savings database recently constructed at the World Bank, and described in detail in Loayza, Lopez, Schmidt-Hebbel and Serven (1998). This database improves significantly on previous data sets on saving in terms of country- and year-coverage and, particularly, accuracy and consistency. For example, Levine and Zervos (1998) have only 29 observations in their regressions analyzing the impact of financial development on savings. Here, we have 61 countries in the cross-section regressions. Furthermore, these new data on saving rates represent the largest and most systematic collection to date of annual time series on country saving and saving-related variables, spanning a maximum of 35 years (from 1960 to 1994) and 112 developing and 22 industrialized countries. These data draw on national-accounts information and are checked for consistency using international and individual-country sources. Arguably, however, the main merits of the new World Saving Database are, first, the consistent definition of private and, thus, public sectors both across countries and over time and, second, the adjustment of private (and public) saving to account for the value erosion of private assets due to inflation. Therefore, the World Saving Database presents four measures of private saving (and their corresponding measures of public saving) according

to whether the public sector is defined as either central government or consolidated state sector[16] and whether saving figures are adjusted or not for inflation-related capital gains and losses.

The private saving rate is calculated as the ratio of gross private saving to gross private disposable income. Gross private saving is measured as the difference between gross national saving (gross national disposable income minus consumption expenditures, both measured at current prices) and gross public saving (in this paper the public sector is defined as the consolidated central government).[17] Gross private disposable income is measured as the difference between gross national disposable income and gross public disposable income (sum of public saving and consumption).

Due to data availability, the sample for the private saving rate regression is slightly different from the sample used in the analysis of real per capita GDP growth, capital per capita growth and productivity per capita growth. Specifically, we have data available from 1971 – 1995, so that we have five non-overlapping five-year periods for the panel data set and 25 years for the cross-country estimations.

D. Descriptive Statistics and Correlations

Table 1 presents descriptive statistics and correlations between financial development and the different dependent variables. There is a considerable variation in PRIVATE CREDIT across countries, ranging from a low of 4% in Zaire to a high of 141% Switzerland. GDP per capita growth and capital per capita growth also show significant variation. Korea has the highest growth rates, both for real per capita GDP and for capital per capita, with 7% and 11%, respectively. Zaire has the lowest GDP per capita growth rate with –3%, whereas Zimbabwe has the lowest capital per capita growth rate with –2%. Private saving rates also show considerable cross-country variation. Sierra Leone has a private

saving rate of 1%, whereas Japan's rate is 34%. Notably, *PRIVATE* CREDIT is significantly correlated with all of our dependent variables. .

III. Methodology

This section describes the two econometric methods that we use to control for the endogenous determination of financial intermediary development with growth and the sources of growth. We first use a traditional cross-sectional, instrumental variable estimator. As instruments, we use the legal origin of each country to extract the exogenous component of financial intermediary development in the pure cross-sectional regressions. We also use a cross-country, time-series panel of data and employ dynamic panel techniques to estimate the relationship between financial development and growth, capital accumulation, productivity growth, and saving rates. We describe each procedure below.

A. Cross-country regressions with instrumental variables

1. Legal origin and financial development

To control for potential simultaneity bias, we first use instrumental variables developed by LLSV (1998). Legal systems with European origins can be classified into four major legal families [Reynolds and Flores 1996]: the English common law, and the French, German, and Scandinavian civil law countries. [18] All four families descend from the Roman law as compiled by Byzantine Emperor Justinian in the sixth century and from interpretations and applications of this law in subsequent centuries by Glossators, Commentators, and in Canon Law. The four legal families developed distinct characteristics during the last four centuries. In the 17th and 18th centuries the Scandinavian countries formed their own legal codes. The Scandinavian legal systems have remained relatively unaffected from the far reaching influences of the German and especially the French Civil Codes.

The French Civil Code was written in 1804, under the directions of Napoleon. Through occupation, it was adopted in other European countries, such as Italy and Poland. Through its influence on the Spanish and Portuguese legal systems, the legal French tradition spread to Latin America. Finally, through colonization, the Napoleonic code was adopted in many African countries, Indochina, French Guyana and the Caribbean.

The German Civil Code *(Bürgerliches Gesetzbuch)* was completed almost a century later in 1896. The German Code exerted a big influence on Austria and Switzerland, as well as China (and hence Taiwan), Czechoslovakia, Greece, Hungary, Italy, and Yugoslavia. Also, the German Civil Code heavily influenced the Japanese Civil Code, which helped spread the German legal tradition to Korea.

Unlike these civil law countries, the English legal system is common law, where the laws were primarily formed by judges trying to resolve particular cases. Through colonialism it was spread to many African and Asian countries, Australia, New Zealand and North America.

There are two conditions under which the legal origin variables serve as appropriate instruments for financial development. First, they have to be exogenous to economic growth during our sample period. Second, they have to be correlated with financial intermediary development. In terms of exogeneity, the English, French and German legal systems were spread mainly through occupation and colonialism. Thus, we take the legal origin of a country as an exogenous "endowment." Furthermore, we provide specification tests regarding the validity of the instruments. In terms of the links between legal origin and financial intermediary development, a growing body of evidence suggests that legal origin helps shape financial development. LLSV (1998) show that the legal origin of a country materially influences its legal treatment of shareholders, the laws governing creditor rights, the efficiency of contract enforcement, and accounting standards. Shareholders enjoy

greater protection in common law countries than in civil law countries, whereas creditors are better protected in German Civil Law countries. French Civil Law countries are comparatively weak both in terms of shareholder and creditor rights. In terms of accounting standards, French origin countries tend to have company financial statements that are comparatively less comprehensive than the company financial statements in countries with other legal origins. Statistically, these legal, regulatory and informational characteristics affect the operation of financial intermediaries as shown in LLSV (1997), Levine (1998, 1999), and Levine, Loayza, and Beck (1998).

2. Cross-country estimation

In the pure cross-sectional analysis we use data averaged for 63 countries over 1960-95, such that there is one observation per country.[19] The basic regression takes the form:

$$Y_i = \alpha + \beta FINANCE_i + \gamma' X_i + \varepsilon_i \tag{8}$$

where Y is either *GROWTH, CAPGROWTH, PROD,* or *SAVING*. *FINANCE* equals PRIVATE CREDIT, or in the robustness checks it equals either LIQUID LIABILITIES or COMMERCIAL-CENTRAL BANK. *X* represents a vector of conditioning information that controls for other factors associated with economic growth and ε is the error term.[20]

To examine whether cross-country variations in the exogenous component of financial intermediary development explain cross-country variations in the rate of economic growth, the legal origin indicators are used as instrumental variables for FINANCE. Specifically, assuming that the variables in vector Z are proper instruments in regression (8) amounts to the set of orthogonality conditions E[Z'ε]=0. We can use standard GMM techniques to estimate our model, which produces instrumental variable estimators of the coefficients in (8). After computing these GMM estimates, the Hansen test of the overidentifying restrictions assesses whether the instrumental variables are

associated with growth beyond their ability to explain cross-country variation in financial sector development. Under the null-hypothesis that the instruments are not correlated with the error terms, the test is distributed χ^2 with *(J-K)* degrees of freedom, where *J* is the number of instruments and *K* the number of regressors. The estimates are robust to heteroskedasticity.

B. Dynamic panel techniques

1. Motivation

The cross-country estimations help us determine whether the cross-country variance in economic growth and the sources of growth can be explained by variance in exogenous component of financial intermediary development. There are, however, some shortcomings with the pure cross-sectional instrumental variable estimator. Using appropriate panel techniques can alleviate many of these problems.

First, besides the cross-country variance, we also would like to know whether changes in financial development over time within a country have an effect on economic growth through its various channels. By using a panel, we gain degrees of freedom by adding the variability of the time-series dimension. Specifically, the within-country standard deviation of PRIVATE CREDIT in our panel data set is 15.1%, which in the panel estimation is added to the between-country standard deviation of 28.4%. Similarly, for real per capita GDP growth, the within-country standard deviation is 2.4% and the between-country standard deviation is 1.7%.[21] Thus, we are able to exploit substantial additional variability by adding the time-series dimension of the data.

We construct a panel that consists of data for 77 countries over the period 1960-95. We average the data over seven non-overlapping five-year periods.[22] The regression equation can be specified in the following form:

$$y_{i,t} = \alpha' X^1_{i,t-1} + \beta' X^2_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (9)$$

where y represents our dependent variable, X^1 represents a set of lagged explanatory variables and X^2 a set of contemporaneous explanatory variables, μ is an unobserved country-specific effect , λ is a time-specific effect, ε is the time-varying error term, and *i* and *t* represent country and (5-year) time period, respectively.

We can now observe a second advantage of using particular panel techniques to estimate equation (9). In a pure cross-sectional regression, the unobserved country-specific effect is part of the error term. Therefore, a possible correlation between μ and the explanatory variables results in biased coefficient estimates. Furthermore, if the lagged dependent variable is included in X^1, then the country-specific effect is certainly correlated with X^1. Under assumptions explained below, we use a system, dynamic panel estimator that controls for the presence of unobserved country-specific effects and thereby produces consistent and efficient estimates even when the country-specific effect is correlated with X^1.

Third, the pure cross-sectional estimator that we use does not control for the endogeneity of all the explanatory variables; it only controls for the endogeneity of financial intermediary development. This can lead to inappropriate inferences. To draw more accurate conclusions, the dynamic, panel estimator uses "internal" instruments (instruments based on previous realizations of the explanatory variables) to consider the potential joint endogeneity of the other regressors as well. This method, however, does not control for full endogeneity but for a weak type of it. To be precise, we assume that the explanatory variables are only "weakly exogenous," which means that they can be affected by current and past realizations of the growth rate but must be uncorrelated with future realizations of the error term. Thus, the weak exogeneity assumption implies that future *innovations* of the growth rate do not affect current financial development. This assumption is not particularly stringent conceptually and

we can examine its validity statistically. First, weak exogeneity does not mean that economic agents do not take into account expected future growth in their decision to develop the financial system; it just means that future (unanticipated) shocks to growth do not influence current financial development. It is the *innovation* in growth that must not affect financial development. Second, given that we are using five-year periods, the forecasting horizon for the growth innovation (that is, its unanticipated component) is of about five years in the future. Finally, we statistically assess the validity of the weak exogeneity assumption below.

Before describing the panel estimator more rigorously, note that the panel has a small number of time-series observations (seven) but the number of cross-sectional units is large (77 countries). Qualitatively, these are the characteristics of the data for which the specific panel estimator that we use were designed. (Indeed, the panels used in microeconomic studies are usually much larger in the cross-sectional dimension and a little shorter in the time-series one.) The small number of time-series observations should be of no concern given that all the asymptotic properties of our GMM estimator rely on the size of the cross-sectional dimension of the panel.

2. Dynamic panels: A GMM estimator[23]

Arellano and Bond (1991) propose to first-difference the regression equation to eliminate the country-specific effect.

$$y_{i,t} - y_{i,t-1} = \alpha'(X^1_{i,t-1} - X^1_{i,t-2}) + \beta'(X^2_{i,t} - X^2_{i,t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \qquad (10)$$

This procedure solves the first econometric problem, as described above, but introduces a correlation between the new error term $\varepsilon_{i,t} - \varepsilon_{i,t-1}$ and the lagged dependent variable $y_{i,t-1} - y_{i,t-2}$ when it is included in $X^1_{i,t-1} - X^1_{i,t-2}$. To address this and the endogeneity problem, Arellano and Bond (1991) propose using the lagged values of the explanatory variables in levels as instruments. Under the

assumptions that there is no serial correlation in the error term ε and that the explanatory variables X - where $X = [X^1\ X^2]$ - are weakly exogenous, we can use the following moment conditions:

$$E[X_{i,t-s} \cdot (\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0 \qquad \text{for } s \geq 2; t = 3,\ldots,T \tag{11}$$

Using these moment conditions, Arellano and Bond (1991) propose a two-step GMM estimator. In the first step the error terms are assumed to be independent and homoskedastic across countries and over time. In the second step, the residuals obtained in the first step are used to construct a consistent estimate of the variance-covariance matrix, thus relaxing the assumptions of independence and homoskedasticity. We will refer to this estimator as the *difference estimator*.

There are several conceptual and econometric shortcomings with the *difference estimator*. First, by first-differencing we lose the pure cross-country dimension of the data. Second, differencing may decrease the signal-to-noise ratio thereby exacerbating measurement error biases (see Griliches and Hausman, 1986). Finally, Alonso-Borrego and Arellano (1996) and Blundell and Bond (1997) show that if the lagged dependent and the explanatory variables are persistent over time, lagged levels of these variables are weak instruments for the regressions in differences. Simulation studies show that the difference estimator has a large finite-sample bias and poor precision.

To address these conceptual and econometric problems, we use an alternative method that estimates jointly the regression in differences with the regression in levels, as proposed by Arellano and Bover (1995). Using Monte Carlo experiments, Blundell and Bond (1997) show that this *system estimator* reduces the potential biases in finite samples and asymptotic imprecision associated with the *difference estimator*. The key reason for this improvement is the inclusion of the regression in levels, which does not eliminate cross-country variation or intensify the strength of measurement error. Furthermore, the variables in levels maintain a stronger correlation with their instruments (explained below) than the variables in differences, particularly as variables in levels are more serially correlated

than in differences (see Blundell and Bond, 1997). However, being able to use the regression in levels comes at the cost of requiring an additional assumption. This is so because the regression in levels does not directly eliminate the country-specific effect. Instead, appropriate instruments must be used to control for country-specific effects. The estimator uses *lagged differences* of the explanatory variables as instruments. They are valid instruments under the assumption that the correlation between μ and the levels of the explanatory variables is constant over time:

$$E[X_{i,t+p} \cdot \mu_i] = E[X_{i,t+q} \cdot \mu_i] \quad \text{for all } p \text{ and } q \tag{12}$$

Under this assumption there is no correlation between the *differences* of the explanatory variables and the country-specific effect. For example, this assumption implies that financial intermediary development may be correlated with the country-specific effect, but this correlation does not change through time. Thus, under this assumption, lagged differences are valid instruments for the regression in levels, and the moment conditions for the regressions in levels are as follows:[24]

$$E[(X_{i,t-s} - X_{i,t-s-1}) \cdot (\varepsilon_{i,t} + \mu_i)] = 0 \qquad \text{for } s = 1; t = 3, \ldots, T \tag{13}$$

The system thus consists of the stacked regressions in differences and levels, with the moment conditions in (11) applied to the first part of the system, the regressions in differences, and the moment conditions in (13) applied to the second part, the regressions in levels. As with the *difference estimator*, the model is estimated in a two-step GMM procedure generating consistent and efficient coefficient estimates.[25]

The consistency of the GMM estimator depends on the validity of the assumption that ε does not exhibit serial correlation and on the validity of the instruments. We use two tests proposed by Arellano and Bond (1991) to test for these assumptions. The first is a Sargan test of over-identifying restrictions, which tests the overall validity of the instruments by analyzing the sample analog of the

moment conditions used in the estimation procedure. Under the null-hypothesis of the validity of the instruments this test is distributed χ^2 with *(J-K)* degrees of freedom, where *J* is the number of instruments and *K* the number of regressors. The second test examines the assumption of no serial correlation in the error terms. We test whether the differenced error term is second-order serially correlated.[26] Under the null-hypothesis of no second-order serial correlation, this test is distributed standard-normal. Failure to reject the null hypotheses of both tests gives support to our model.

IV. Finance and the channels to economic growth

This section presents the results of the cross-country and panel regressions of real per capita GDP growth, productivity per capita growth, and capital per capita growth on financial development and a conditioning information set.

A. The conditioning information sets

To assess the strength of an independent link between financial development and the growth variables we use various conditioning information sets. The simple conditioning information set includes the **logarithm of initial real per capita GDP** to control for convergence and the **average years of schooling** as indicator of the human capital stock in the economy. The policy conditioning information set includes the simple conditioning information set plus four additional policy variables, that have been identified by the empirical growth literature as being correlated with growth performance across countries (Barro 1991; Easterly, Loayza, and Montiel 1997). We use the **inflation rate** and the ratio of **government expenditure** to GDP as indicators of macroeconomic stability. We use the sum of **exports and imports** as share of GDP and the **black market premium** to capture the degree of openness of an economy. In our sensitivity analysis for the cross-country regressions, we will also include the number of revolutions and coups, the number of assassination per thousand inhabitants, and a measure of ethnic diversity.[27]

B. Finance and Economic Growth

The results in Table 2 show a statistically and economically significant relationship between the exogenous component of financial intermediary development and economic growth.[28] The first two columns report the results of the pure cross-country regressions using the simple and the policy

conditioning information set. PRIVATE CREDIT is significantly correlated with long-run growth at the five percent significance level in both regressions. The Hansen-test of overidentifying restrictions indicates that the orthogonality conditions cannot be rejected at the five percent level. Thus, we do not reject the null hypothesis that the instruments are appropriate. The strong link between finance and growth does not appear to be driven by simultaneity bias. The variables in the conditioning information set also have the expected sign, except for inflation. Consistent with Boyd, Levine, and Smith (1999), we find that inflation affects growth by influencing financial sector performance. Specifically, when we omit PRIVATE CREDIT from the regressions in Table 2, inflation enters with a negative, statistically significant, and economically large coefficient. However, when we control for the level of financial intermediary development, inflation enters insignificantly.

The results are economically significant. For example, Mexico's value for PRIVATE CREDIT over the period 1960-95 was 22.9% of GDP. An exogenous increase in PRIVATE CREDIT that had brought it up to the sample median of 27.5% would have resulted in a 0.4 percentage point higher real per capita GDP growth per year.[29] This conceptual experiment, however, must be viewed cautiously: it does not indicate how to increase financial intermediary development. Nonetheless, the example suggests that exogenous changes in financial intermediary development have economically meaningful repercussions.

The dynamic panel estimates also indicate that (i) financial intermediary development has an economically large impact on economic growth and (ii) the strong, positive link between financial development and growth is not due to simultaneity bias, omitted variables, or the use of lagged dependent variables as regressors. Columns 3 and 4 in Table 2 report the results of the panel regressions. PRIVATE CREDIT is significant at the five percent level with both conditioning information sets. The variables in the conditioning information set have significant coefficients with

the expected sign. Furthermore, our tests indicate that our econometric specification and the assumption of no serial correlation in the error terms cannot be rejected. Thus, the pure cross-section, instrumental variable results and the dynamic panel procedure findings are both consistent with the view that financial intermediaries exert a large impact on economic growth.

C. Finance and Productivity Growth

The results in Table 3 show that financial intermediary development has a large, significant impact on productivity growth. The Hansen-test for overidentifying restrictions shows that the data do not reject the orthogonality conditions at the five percent level. The variables in the conditioning information set have the expected sign except for inflation, which reflects the close connection between inflation and financial intermediary development discussed above. To assess the economic magnitude of the coefficients, we continue to use Mexico as an example. Using the coefficient of 1.5 on PRIVATE CREDIT in Table 3, an exogenous increase in Mexico's PRIVATE CREDIT ratio over the 1960-95 period (22.9%) to the sample median (27.5%) would have translated into almost 0.3 percentage points faster productivity growth per year over the 35 year period.

The results for the panel regressions confirm the pure cross-country estimates. The strong link between PRIVATE CREDIT and productivity growth is not due to simultaneity bias or omitted variable bias. The p-values for the Sargan test and the serial correlation test indicate the appropriateness of our instruments and the lack of serial correlation in ε.

D. Finance and Capital Growth

The empirical relationship between financial intermediary development and physical capital accumulation is less robust than the link between financial intermediary development and productivity growth. The Table 4 results indicate that PRIVATE CREDIT enters significantly at the five percent

level in both the pure cross-country and the dynamic panel regressions. In the case of the cross-section estimator, we reject the Hansen-test of overidentifying restrictions when using the simple conditioning information set. However, when we expand the conditioning information set, the cross-sectional estimator passes the specification test. Thus, PRIVATE CREDIT exhibits a strong, positive link with capital growth that does not appear to be driven by simultaneity bias. Nevertheless, other measures of financial intermediary development do not produce the same results. In the pure cross-section results, none of the other measures of financial sector development enjoy a significant link with capital growth as we discuss below in the subsection on sensitivity results.[30] The panel results are more robust. Financial intermediary development is positively and significantly correlated with capital accumulation when using alternative conditioning information sets and alternative measures of financial intermediary development. The test statistic for serial correlation, however, rejects the null hypothesis of no serial correlation at the five percent level when using the simple conditioning information set and at the 10% level when using the policy information set. By including the private saving rate or lagged values of capital growth in the conditioning information set, however, we (i) eliminate the serial correlation, (ii) find a positive impact of financial intermediary development on physical capital growth, and (iii) obtain very similar coefficient estimates to those reported in Table 4.[31] The difference between the panel and cross-country results may reflect data frequency. While the long-run relationship between capital accumulation and financial intermediary development is not robust to alternations in different measures of financial intermediary development, the short-term relationship – which may reflect business cycle activity – is positive and robust.

E. Sensitivity Analyses

Table 5 presents the coefficients on all three measures of financial development in both the cross-country and panel regressions with real per capita GDP growth as dependent variable. The coefficient estimates for LIQUID LIABILITIES and COMMERCIAL-CENTRAL BANK are significantly positive across both samples and both conditioning information sets. All regressions pass the different specification tests. We also ran the regressions with the full conditioning information set in the cross-country sample with similar results. These results strengthen the hypothesis of a statistically and economically significant causal impact of the exogenous component of financial development on economic growth.

The Table 6 sensitivity results further suggest that financial intermediary development exerts a positive influence on productivity growth. Table 6 presents sensitivity analyses of the productivity growth regressions with the three financial intermediary development indicators. In sum, the Table 6 sensitivity results generally confirm our results with PRIVATE CREDIT: greater financial intermediary development is associated with faster productivity growth and this positive link is not due to simultaneity, omitted variable, or lagged dependent variable biases.

Table 7 presents the corresponding results for capital per capita growth. Unlike PRIVATE CREDIT, LIQUID LIABILITIES and COMMERCIAL-CENTRAL BANK do not have a significant impact on capital per capita growth in the cross-country sample. In the panel estimations, all three financial intermediary development indicators are associated with faster capital per capita growth. But, only in the regressions with COMMERCIAL-CENTRAL BANK is the null hypothesis of no serial correlation in the error term not rejected in all the specifications. Thus, while evidence suggests that financial intermediary development positively influences physical capital accumulation, the pure,

cross-sectional relationship between physical capital growth and financial intermediary development is highly dependent on the measure of financial intermediary development used.

V. Finance and Private Saving

This section explores the impact of the exogenous component of financial development on private saving rates. As in the previous section, we will use both cross-country and panel samples, but a different set of conditioning information.

A. The conditioning information set

The set of conditioning information is selectively determined by various theories of consumption, including the classical permanent-income and life-cycle hypotheses and the more recent theories accounting for consumption habits, subsistence consumption, precautionary saving motives, and borrowing constraints (see Loayza, Schmidt-Hebbel, and Serven, 1998). The variables included in the set of conditioning information for the saving regression are listed below.

Private income and its growth rate have ambiguous effects on saving regressions, depending on whether their change is permanent or temporary and whether it takes place within a generation or across generations. The same argument holds for the **terms of trade**, which can be considered an exogenous determinant of income. The level of **income** may have an additional, positive impact on the private saving rate if a large share of the country's population is near subsistence consumption levels. **Government saving** (expressed as a rate to GPDI in our saving regressions) is another important variable, serving to account for Ricardian equivalence effects; its expected sign is negative, reflecting at least a partial private saving offset of changes in public saving. We include a measure of the **real interest rate**, which has well known negative substitution and positive income effects on consumption, resulting in an ambiguous sign on saving regressions. We include the **inflation rate** as a proxy for

uncertainty, expecting a positive association between saving and the inflation rate, consistent with a precautionary saving motive. This would only be the partial effect of inflation on saving; the net effect would also consider the negative effect of inflation on, among other variables, income growth.

We include several demographic variables. The first are the **old-age** and **young-age population dependency ratios**, defined, respectively, as the ratios of population under 15 years of age and over 65 year of age to total population. Including the dependency ratios helps account for life-cycle effects. The standard life-cycle hypothesis predicts a negative effect of dependency ratios on saving, whereas the permanent-income hypothesis predicts insignificance of either. The second demographic variable is the **urbanization rate.** Since agents engaged in agricultural activities face higher income uncertainty, economies more highly urbanized should have, *ceteris paribus,* lower private savings rates.

B. Regressions Results

The results in Tables 8 and 9 do not suggest that financial intermediary development exerts a strong, positive effect on private saving rates. Whereas the coefficient on PRIVATE CREDIT is significantly positive in the cross-country regression, it is insignificant in the panel regression. The results for the cross-country regression indicate a small positive effect of financial development on private saving rates. To see this, note that Mexico's value for PRIVATE CREDIT over the period 1970-95 was 21.7%. If this were exogenously raised to the sample median of 29.1%, the coefficient estimates in Table 8 indicate that Mexico's private saving would have increased only from 19.95% to 19.97%. The Hansen-Test of overidentifying restrictions indicates that the orthogonality conditions cannot be rejected at the five percent level and that the instruments are therefore appropriate.

The panel estimations, however, indicate an insignificant impact of PRIVATE CREDIT on private savings rates. The econometric specification tests indicate that we cannot reject the null hypotheses of the appropriateness of the instruments and the assumption of no serial correlation of the differenced error terms. In sum, the results indicate that there is not a substantial economic impact of financial intermediary development on private saving rates. As shown in Table 9, alternative measures of financial intermediary development do not alter this conclusion.

VI. Conclusions

This paper examined the impact of financial development on the sources of economic growth. We use two econometric methods. To assess the long-run impact of the exogenous component of financial intermediary development on the sources of economic growth, we use a cross-country sample with data averaged over the period 1960-95 and we use the legal origin of countries as instruments. To exploit the time-series nature of the data, we create a panel data set and use recent dynamic panel techniques as proposed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1997). This procedure controls for the possible endogeneity of the regressors and for country-specific effects in dynamic, lagged-dependent variable models, such as growth regressions.

We find an economically large and statistically significant relationship between financial intermediary development and both real per capita GDP growth and total factor productivity growth. Specification tests indicate that the robust, positive relationship between financial development and both growth and productivity growth are not due to simultaneity bias or country-specific effects. This result is robust to the use of different estimation procedures, conditioning information sets, and indicators of financial development. The results, however, indicate an ambiguous relationship between financial intermediary development and both physical capital growth and private saving rates. While there tends to be a positive link between financial intermediary development and both physical capital accumulation and private saving rates, these results are sensitive to alterations in estimation techniques and measures of financial intermediary development. This paper's results support the view that better functioning financial intermediaries improve resource allocation and accelerate total factor productivity growth with positive repercussions for long-run economic growth.

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Data Appendix

A. Countries in the Sample

1 in the 63 country cross-country sample for GDP, capital and productivity growth
2 in the 77 country panel sample for GDP, capital and productivity growth
3 in the 61 country cross-country sample for private saving
4 in the 72 country panel sample for private saving

Algeria (2)
Argentina (1,2)
Australia (1-4)
Austria (1-4)
Bahamas (4)
Bangladesh (3,4)
Belgium (1-4)
Belize (4)
Bolivia (1,2)
Brazil (1,2)
Cameroon (2,4)
Canada (1-4)
Central African Republic (2,4)
Chile (1-4)
Colombia (1-4)
Congo (2)
Costa Rica (1-4)
Cote d"Ivoire (4)
Cyprus (1-4)
Denmark (1-4)
Dominican Republic (1,2)
Ecuador (1-4)
Egypt (2-4)
El Salvador (1,2,4)
Ethiopia (4)
Finland (1-4)
France (1-4)
Gambia (2-4)
Germany (1,2,4)
Ghana (1-4)
Great Britain (1-4)
Greece (1-4)
Guatemala (1-4)
Guyana (1,2)
Haiti (1,2)
Honduras (1-4)
Iceland (3,4)
India (1-4)
Indonesia (2,3,4)
Iran (2)
Ireland (1-4)
Israel (1,2)
Italy (1-4)
Jamaica (1-4)
Japan (1-4)
Jordan (4)
Kenya (1-4)
Korea (1-4)
Lesotho (2,4)
Luxembourg (4)
Madagascar (3,4)
Malawi (2-4)
Malaysia (1-4)
Malta (1-3)
Mauritius (1-4)
Mexico (1-3)
Morocco (4)
Myanmar (3,4)
Nepal (4)
Netherlands (1-4)
New Zealand (1-4)
Nicaragua (2)
Niger (1-4)
Nigeria (3,4)
Norway (1-4)
Pakistan (1-4)
Panama (1,2)
Papua New Guinea (1-4)
Paraguay (1,2)
Peru (1-3)
Philippines (1-4)
Portugal (1-4)
Rwanda (2-4)
Senegal (1-4)
Sierra Leone (2-4)
South Africa (1-4)
Spain (1-4)
Sri Lanka (1-4)
Sudan (2)
Swaziland (4)
Sweden (1-4)
Switzerland (1-4)
Syria (2-4)
Taiwan (1)
Thailand (1-4)
Togo (1-4)
Trinidad and Tobago (1-4)
United States of America (1-4)
Uruguay (1-3)
Venezuela (1-4)
Zaire (1,2)
Zimbabwe (1,2,4)

B. Data Sources

The first eleven variables are from Loayza, Lopez, Schmidt-Hebbel, and Serven (1998). These numbers are revised and cross-checked National Account data.

1. Log level and growth rate of per capita GDP.

2. Log level and growth rate of per capita gross private disposable income (GPDI).

3. Private saving rates is the ratio of gross private savings and GPDI. Gross private saving is measured as the difference between gross national saving (gross national product minus consumption expenditure, both measured at current prices) and gross public saving. GPDI is measured likewise as the difference between gross national disposable income (GNDI) and gross public disposable income (sum of public saving and consumption).

4. Capital stock numbers are constructed using data from Penn World Tables 5.6.

5. Government size is real general government consumption as share of real GDP.

6. Openness to trade is the sum of real exports and real imports of goods and nonfinancial services as share of real GDP.

7. Government saving is the ratio of gross public saving and gross private disposable income.

8. Real interest rate is defined as $\ln[(1+i)/1+\pi)]$, where i is the nominal interest rate and π the inflation rate. The inflation rate is the average of the current and year-ahead inflation.

9. Terms of Trade

10. Old and young dependency ratios are the shares of population under 15 and over 65, respectively, in total population.

11. Urbanization ratio

12. Inflation rates are calculated using average annual CPI data from the International Financial Statistics (IFS), line 64.

13. The average years of schooling in the total population (25 years and over) come from Barro and Lee (1996): They are for the initial year of the period

14. Data on the black market premium are from World's Currency Yearbook; and Adrian Wood, Global trends in real exchange rates: 1960-84, WB Discussion paper no. 35. 1988.

15. Data on Private Credit are calculated using IFS numbers and the following method:

$$\{(0.5)*[F(t)/P\_e(t) + F(t-1)/P\_e(t-1)]\}/[GDP(t)/P\_a(t)],$$

where F is credit by deposit money financial intermediaries and other financial institutions to the private sector (lines 22d + 42d). If there are no data on 42d, we assume that the value is zero. GDP is line 99b, P_e is end-of period CPI (line 64) and P_a is the average annual CPI.

16. Data on Liquid Liabilities are calculated using IFS numbers and the following method:

$$\{(0.5)*[F(t)/P\_e(t) + F(t-1)/P\_e(t-1)]\}/[GDP(t)/P\_a(t)]$$

where F is liquid liabilities (line 55l) or money plus quasi money (line 35l), if liquid liabilities is not available. If neither liquid liabilities nor money plus quasi money are available, we use time and savings deposits (line 25). GDP is line 99b, P_e is end-of period CPI (line 64) and P_a is the average annual CPI. The numbers are averages over the 5 year periods.

17. Data on Commercial versus Central Bank are calculated using IFS numbers, using the following method:

$$DBA(t) / (DBA(t) + CBA(t))$$

where DBA is assets of deposit money financial intermediaries (lines 22a-d) and CBA is central bank assets (lines 12 a-d).

18. Data on legal origin are from LLSV (1998a) and from Reynolds and Flores (1996).

Endnotes

[1] Recent theoretical models have carefully documented the links between financial intermediaries and economic activity. By economizing on the costs of acquiring and processing information about firms and managers, financial intermediaries can influence resource allocation. Better financial intermediaries are lower cost producers of information with consequent ramifications for capital allocation and productivity growth [Diamond 1984; Boyd and Prescott 1986; Williamson 1987; Greenwood and Jovanovic 1990; and King and Levine 1993b]. For a comprehensive exposition of the Schumpeterian view of growth, see Aghion and Howitt (1998).

[2] See discussion and citations in King and Levine (1994), Fry (1995), Bandiera, Caprio, Honohan, and Schiantarelli (1999), and Easterly and Levine (1999).

[3] By including initial income as an explanatory variable, growth regressions are dynamic in nature.

[4] Results with the other productivity measures are available on request.

[5] For overviews of the literature see Gertler (1988) and Levine (1997).

[6] For example, King and Levine (1993a,b) use a measure of gross claims on the private sector divided by GDP. But, this measure includes credits issued by the monetary authority and government agencies, whereas PRIVATE CREDIT includes only credits issued by financial intermediaries and other financial intermediaries. Also, Levine and Zervos (1998) and Levine (1998) use a measure of deposit money bank credits to the private sector divided by GDP over the period 1976-1993. That measure, however, does not include credits to the private sector by non-deposit money financial intermediaries.

[7] Credits by nonbank financial intermediaries to the private sector grow as proportion of total credits by the financial system to the private sector as countries develop and the level of development of these nonbanks is positively correlated with long-run economic growth. The correlation between private credit by nonbanks and real per capita GDP over the 1960-95 period is 60% and the correlation between nonbank credit to the private sector and growth is 30%. Both correlations are significant at the one-percent level. Also, nonbank credits to the private sector are about equal to that of deposit money bank credits to the private sector in the United States, Sweden, Mexico, and Norway. Finally, across the entire sample, private credit by nonbanks accounts for about 25 percent of the PRIVATE CREDIT variable, but there is considerable cross-country variation.

[8] Some authors try to correct for this problem by using an average of financial intermediary balance sheet items in year t and t-1 and dividing by GDP measured in year t [King and Levine 1993a]. This however does not fully resolve the distortion. This paper deflates end-of-year financial balance sheet items by end of year consumer price indices (CPI) and deflates the GDP series by the annual CPI. Then, we compute the average of the real financial balance sheet item in year t and t-1 and divide this average by real GDP measured in year t.

[9] It would be valuable to construct a measure of financial intermediary development that identified credits issued by privately owned financial intermediaries. We could only obtain data, however, on 32 countries in scattered years over the 1980-95 period, so that we could not conduct the econometric procedures employed in this paper. Also, it would be valuable to incorporate measures of securities market development as in Levine and Zervos (1998). Unfortunately, data on stock market activity is not available for a sufficient number of years or countries to perform this paper's econometric methods.

[10] Among others it has been used by King and Levine (1993a).

[11] We also used the variable BANK CREDIT, which equal credits by deposit money banks to the private sector as a share of GDP. This is a less comprehensive measure of financial intermediary development than PRIVATE CREDIT because BANK CREDIT does not include nonbank credits to the private sector. Its correlation with PRIVATE CREDIT, however, is 0.92 and it produces very similar regression results. These results are available on request.

[12] For a detailed description of sources and construction of the data see appendix B.

[13] Using geometric growth rates yields virtually identical results.

[14] Note, alternative measures of capital growth based on assuming an initial capital stock of zero, tend to produce similar cross-country characterizations of capital growth as discussed in King and Levine (1994).

[15] In this broad cross-country study, this alternative capital measures turns out to be a robustness check. The aggregate and disaggregated capital numbers have a correlation coefficient of 0.85. However, the disaggregated measure, which (i) focuses on nonresidential investment and (ii) uses more appropriate depreciation rates for each component of investment, produces quite different information on individual countries, which may influence the choice of capital stock measures in individual country-studies.

[16] The consolidated state sector includes, in addition to the central government, local governments and public enterprises.

[17] Using a broader measure of the public sector, instead of the consolidated central government, would be analytically

preferable. This, however, limits the sample size. Nonetheless, this definition of the public sector yields very similar results to those presented below.

[18] This does not include countries with "communist" or Islamic legal systems.

[19] The cross-country sample for private saving has 61 countries over the period 1971-95.

[20] Due to the potential nonlinear relationship between economic growth and the assortment of economic indicators, we use natural logarithms of the regressors in the regressions of GROWTH, CAPGROWTH, and PROD.

[21] The within-country standard deviation is calculated using the deviations from country averages, whereas the between-country standard deviation is calculated from the country averages. The fact that the between-country standard deviations in the panel are not the same as in the cross-section sample results from the different country coverage.

[22] The panel sample for private saving includes 72 countries and five 5-year periods between 1971 and 1995.

[23] Chamberlain (1984), Holtz-Eakin, Newey, and Rosen, Arellano and Bond (1991) and Arellano and Bover (1995) proposed the General Method of Moments (GMM) estimator. The GMM estimator has been applied to cross-country studies, by, among others, Caselli, Esquivel and Lefort (1996), Easterly, Loayza and Montiel (1997) and Fajnzylber, Lederman and Loayza (1998).

[24] Given that lagged levels are used as instruments in the difference regressions, only the most recent difference is used as instrument in the level regressions. Using additional differences would result in redundant moment conditions (see Arellano and Bover 1995).

[25] We are grateful to Stephen Bond for providing us with a program to apply his and Arellano's estimator to an unbalanced panel data set.

[26] By construction, the error term is probably first-order serially correlated. We cannot use the error terms from the regression in levels since they include the country-specific effect μ.

[27] We cannot use the full conditioning information set in the panel estimations since there is not enough time series variation in the additional three variables.

[28] As noted in the Introduction, this paper's contribution is to investigate the relationship between financial intermediary development and the sources of growth. We include this section on overall growth to motivate this inquiry. Levine, Loayza, and Beck (1999) use identical econometric techniques to argue that financial intermediaries exert a causal impact on long-run growth, but they do not investigate the links between financial development and productivity growth, capital accumulation, and private saving rates.

[29] This result follows from $\ln(27.5) - \ln(22.9) = 0.18$ and $0.18*2.2=0.4$, where 2.2 is the smaller of the two parameter values on PRIVATE CREDIT in the cross-country regressions.

[30] For completeness, we can get the other measures of financial sector development to enter with positive and significant coefficients in the capital growth equations by using alternative conditioning information sets. But, the other measures are not significant when using the simple or policy conditioning information sets.

[31] The results are available on request. We do not include the results here because we wanted to keep a uniform set of control variables across the growth and sources of growth equations. Since the resulting coefficient estimates are of similar magnitude and significance, we merely want to make the point that the serial correlation reflected in Table 4 is not biasing the results in a meaningful way.

Table 1: Summary Statistics: 1960-1995

Descriptive Statistics

	Private Credit	Liquid Liabilities	Commercial-Central Bank	Economic Growth	Capital Growth	Productivity Growth	Private Saving
Mean	40.86	45.21	79.26	1.95	3.13	1.01	19.21
Median	27.81	41.02	83.89	1.98	3.11	1.15	19.98
Maximum	141.30	143.43	98.99	7.16	10.51	5.14	33.92
Minimum	4.08	14.43	23.72	-2.81	-1.84	-3.39	1.05
Std. Dev.	29.16	26.26	17.37	1.92	2.22	1.52	7.65
Observations	63	63	63	63	63	63	61

Correlations

	Private Credit	Liquid Liabilities	Commercial-Central Bank	Economic Growth	Capital Growth	Productivity Growth
Private Credit	1.00					
Liquid Liabilities	0.77	1.00				
	(0.001)					
Commercial-Central Bank	0.64	0.59	1.00			
	(0.001)	*(0.001)*				
Economic Growth	0.43	0.56	0.46	1.00		
	(0.001)	*(0.001)*	*(0.001)*			
Capital Growth	0.34	0.36	0.25	0.71	1.00	
	(0.006)	*(0.004)*	*(0.047)*	*(0.001)*		
Productivity Growth	0.39	0.55	0.47	0.95	0.46	1.00
	(0.002)	*(0.001)*	*(0.001)*	*(0.001)*	*(0.001)*	
Private Saving	0.75	0.65	0.73			
	(0.001)	*(0.001)*	*(0.001)*			

p-values are reported in parentheses

Statistics for private saving and its correlation with the three measures of financial intermediary development are from a different sample

Table 2: Financial Intermediation and Growth

	Cross-country		Panel	
Conditioning information set	simple	policy	simple	policy
Constant	6.571	2.643	1.272	0.082
	(0.006)	*(0.527)*	*(0.250)*	*(0.875)*
Initial income per capita[1]	-1.971	-1.967	-1.299	-0.496
	(0.001)	*(0.001)*	*(0.001)*	*(0.001)*
Average years of schooling[2]	1.936	1.548	2.671	0.950
	(0.008)	*(0.078)*	*(0.001)*	*(0.001)*
Openness to trade[1]		0.931		1.311
		(0.042)		*(0.001)*
Inflation[2]		4.270		0.181
		(0.096)		*(0.475)*
Government size[1]		-1.207		-1.445
		(0.132)		*(0.001)*
Black market premium[2]		-0.139		-1.192
		(0.914)		*(0.001)*
Private Credit[1]	2.215	3.215	2.397	1.443
	(0.003)	*(0.012)*	*(0.001)*	*(0.001)*
OIR-Test[3]	0.577	0.571		
Sargan test[4] (p-value)			0.183	0.506
Serial correlation test[5] (p-value)			0.516	0.803
Countries	63	63	77	77
Observations			365	365
	p-values in parentheses			

[1] In the regression, this variable is included as log(variable)

[2] In the regression, this variable is included as log(1 + variable)

[3] The null hypothesis is that the instruments used are not correlated with the residuals. Critical values for OIR-Test (2 d.f.): 10%=4.61; 5%=5.99

[4] The null hypothesis is that the instruments used are not correlated with the residuals.

[5] The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation.

Table 3: Financial Intermediation and Productivity Growth

	Cross-country		Panel	
Conditioning information set	simple	policy	simple	policy
Constant	3.527	-1.189	2.473	-1.611
	(0.065)	*(0.717)*	*(0.001)*	*(0.033)*
Initial income per capita[1]	-1.266	-1.171	-1.244	-0.353
	(0.001)	*(0.001)*	*(0.001)*	*(0.001)*
Average years of schooling[2]	1.375	1.241	3.043	1.174
	(0.028)	*(0.060)*	*(0.001)*	*(0.001)*
Openness to trade[1]		0.956		1.337
		(0.015)		*(0.001)*
Inflation[2]		3.223		-0.415
		(0.096)		*(0.033)*
Government size[1]		-0.647		-0.431
		(0.286)		*(0.088)*
Black market premium[2]		-0.191		-1.003
		(0.861)		*(0.001)*
Private Credit[1]	1.500	1.986	1.332	0.296
	(0.004)	*(0.021)*	*(0.001)*	*(0.001)*
OIR-Test[3]	2.036	3.472		
Sargan test[4] (p-value)			0.205	0.401
Serial correlation test[5] (p-value)			0.772	0.865
Countries	63	63	77	77
Observations			365	365
	p-values in parentheses			

[1] In the regression, this variable is included as log(variable)

[2] In the regression, this variable is included as log(1 + variable)

[3] The null hypothesis is that the instruments used are not correlated with the residuals. Critical values for OIR-Test (2 d.f.): 10%=4.61; 5%=5.99

[4] The null hypothesis is that the instruments used are not correlated with the residuals.

[5] The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation.

Table 4: Financial Intermediation and Capital Growth

	Cross-country		Panel	
Conditioning information set	simple	policy	simple	policy
Constant	8.448	8.349	-1.273	5.694
	(0.004)	*(0.093)*	*(0.219)*	*(0.001)*
Initial income per capita[1]	-2.075	-2.225	-0.933	-0.070
	(0.001)	*(0.001)*	*(0.001)*	*(0.701)*
Average years of schooling[2]	0.663	0.628	0.985	-0.340
	(0.427)	*(0.559)*	*(0.055)*	*(0.552)*
Openness to trade[1]		0.245		-0.448
		(0.663)		*(0.097)*
Inflation[2]		4.196		0.445
		(0.236)		*(0.360)*
Government size[1]		-1.619		-3.229
		(0.082)		*(0.001)*
Black market premium[2]		0.304		-0.748
		(0.826)		*(0.001)*
Private Credit[1]	2.832	4.038	3.435	3.005
	(0.006)	*(0.012)*	*(0.001)*	*(0.001)*
OIR-Test[3]	6.747	3.039		
Sargan test[4] (p-value)			0.166	0.316
Serial correlation test[5] (p-value)			0.014	0.053
Countries	63	63	77	77
Observations			365	365
	p-values in parentheses			

[1] In the regression, this variable is included as log(variable)

[2] In the regression, this variable is included as log(1 + variable)

[3] The null hypothesis is that the instruments used are not correlated with the residuals.
Critical values for OIR-Test (2 d.f.): 10%=4.61; 5%=5.99

[4] The null hypothesis is that the instruments used are not correlated with the residuals.

[5] The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation.

Table 5: Financial Intermediation and Growth: Alternative Measures

Cross-country

Regression Set 1: simple conditioning information set

Financial variable	coefficient	p-value	OIR-test[1]	Number of countries
LIQUID LIABILITIES	1.667	0.023	1.553	63
COMMERCIAL - CENTRAL BANK	10.169	0.001	1.403	63
PRIVATE CREDIT	2.215	0.003	0.577	63

Regression Set 2: policy conditioning information set

Financial variable	coefficient	p-value	OIR-test[1]	Number of countries
LIQUID LIABILITIES	2.173	0.020	2.393	63
COMMERCIAL - CENTRAL BANK	9.641	0.021	2.350	63
PRIVATE CREDIT	3.215	0.012	0.571	63

[1] The null hypothesis is that the instruments used are not correlated with the residuals from the respective regression
Critical values for OIR-Test (2 d.f.): 10%= 4.61; 5%= 5.99

Panel

Regression Set 1: simple conditioning information set

Financial variable	coefficient	p-value	Sargan-test (p-value)[2]	2nd order serial corr. test (p-value)[3]	Number of countries	Number of observations
LIQUID LIABILITIES	2.093	0.001	0.227	0.522	77	365
COMMERCIAL - CENTRAL BANK	4.763	0.001	0.246	0.712	77	365
PRIVATE CREDIT	2.397	0.001	0.183	0.516	77	365

Regression Set 2: policy conditioning information set

Financial variable	coefficient	p-value	Sargan-test (p-value)[2]	2nd order serial corr. test (p-value)[3]	Number of countries	Number of observations
LIQUID LIABILITIES	2.321	0.001	0.607	0.722	77	365
COMMERCIAL - CENTRAL BANK	3.361	0.001	0.390	0.958	77	365
PRIVATE CREDIT	1.443	0.001	0.506	0.803	77	365

[2] The null hypothesis is that the instruments used are not correlated with the residuals from the respective regression
[3] The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation

simple conditioning information set: logarithm of initial income per capita, average years of schooling
policy conditioning information set: simple set plus government size, openness to trade, inflation and black market premium

LIQUID LIABILITIES: liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and nonbank financial intermediaries) divided by GDP
COMMERCIAL - CENTRAL BANK: assets of deposit money banks divided by assets of deposit money banks plus central bank assets
PRIVATE CREDIT: credit by deposit money banks and other financial institutions to the private sector divided by GDP

Table 6: Financial Intermediation and Productivity Growth: Alternative Measures

Cross-country

Regression Set 1: simple conditioning information set

Financial variable	coefficient	p-value	OIR-test[1]	Number of countries
LIQUID LIABILITIES	1.787	0.002	0.253	63
COMMERCIAL - CENTRAL BANK	5.853	0.001	0.092	63
PRIVATE CREDIT	1.500	0.004	2.036	63

Regression Set 2: policy conditioning information set

Financial variable	coefficient	p-value	OIR-test[1]	Number of countries
LIQUID LIABILITIES	2.168	0.006	3.315	63
COMMERCIAL - CENTRAL BANK	8.134	0.006	1.284	63
PRIVATE CREDIT	1.986	0.021	3.472	63

[1] The null hypothesis is that the instruments used are not correlated with the residuals from the respective regression
Critical values for OIR-Test (2 d.f.): 10%= 4.61; 5%= 5.99

Panel

Regression Set 1: simple conditioning information set

Financial variable	coefficient	p-value	Sargan-test (p-value)[2]	2nd order serial corr. test (p-value)[3]	Number of countries	Number of observations
LIQUID LIABILITIES	0.663	0.001	0.124	0.841	77	365
COMMERCIAL - CENTRAL BANK	2.388	0.001	0.242	0.965	77	365
PRIVATE CREDIT	1.332	0.001	0.205	0.772	77	365

Regression Set 2: policy conditioning information set

Financial variable	coefficient	p-value	Sargan-test (p-value)[2]	2nd order serial corr. test (p-value)[3]	Number of countries	Number of observations
LIQUID LIABILITIES	0.856	0.001	0.552	0.836	77	365
COMMERCIAL - CENTRAL BANK	1.669	0.001	0.486	0.758	77	365
PRIVATE CREDIT	0.296	0.001	0.401	0.865	77	365

[2] The null hypothesis is that the instruments used are not correlated with the residuals from the respective regression
[3] The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation

simple conditioning information set: logarithm of initial income per capita, average years of schooling
policy conditioning information set: simple set plus government size, openness to trade, inflation and black market premium

LIQUID LIABILITIES: liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and nonbank financial intermediaries) divided by GDP
COMMERCIAL - CENTRAL BANK: assets of deposit money banks divided by assets of deposit money banks plus central bank assets
PRIVATE CREDIT: credit by deposit money banks and other financial institutions to the private sector divided by GDP

Table 7: Financial Intermediation and Capital Growth: Alternative Measures

Cross-country

Regression Set 1: simple conditioning information set

Financial variable	coefficient	p-value	OIR-test[1]	Number of countries
LIQUID LIABILITIES	-0.345	0.767	4.693	63
COMMERCIAL - CENTRAL BANK	-1.046	0.832	4.578	63
PRIVATE CREDIT	2.832	0.006	6.747	63

Regression Set 2: policy conditioning information set

Financial variable	coefficient	p-value	OIR-test[1]	Number of countries
LIQUID LIABILITIES	0.511	0.562	4.605	63
COMMERCIAL - CENTRAL BANK	1.018	0.755	4.722	63
PRIVATE CREDIT	4.038	0.012	3.039	63

[1] The null hypothesis is that the instruments used are not correlated with the residuals from the respective regression
Critical values for OIR-Test (2 d.f.): 10%= 4.61; 5%= 5.99

Panel

Regression Set 1: simple conditioning information set

Financial variable	coefficient	p-value	Sargan-test (p-value)[2]	2nd order serial corr. test (p-value)[3]	Number of countries	Number of observations
LIQUID LIABILITIES	3.667	0.001	0.192	0.031	77	365
COMMERCIAL - CENTRAL BANK	8.848	0.001	0.258	0.172	77	365
PRIVATE CREDIT	3.435	0.001	0.166	0.014	77	365

Regression Set 2: policy conditioning information set

Financial variable	coefficient	p-value	Sargan-test (p-value)[2]	2nd order serial corr. test (p-value)[3]	Number of countries	Number of observations
LIQUID LIABILITIES	5.162	0.001	0.494	0.076	77	365
COMMERCIAL - CENTRAL BANK	6.493	0.001	0.338	0.169	77	365
PRIVATE CREDIT	3.005	0.001	0.316	0.053	77	365

[2] The null hypothesis is that the instruments used are not correlated with the residuals from the respective regression
[3] The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation

simple conditioning information set: logarithm of initial income per capita, average years of schooling
policy conditioning information set: simple set plus government size, openness to trade, inflation and black market premium

LIQUID LIABILITIES: liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and nonbank financial intermediaries) divided by GDP
COMMERCIAL - CENTRAL BANK: assets of deposit money banks divided by assets of deposit money banks plus central bank assets
PRIVATE CREDIT: credit by deposit money banks and other financial institutions to the private sector divided by GDP

Table 8: Financial Intermediation and Private Saving

	Cross-country	Panel
Constant	-0.102	0.474
	(0.387)	*(0.001)*
Real per capita GPDI[1]	0.041	0.000
	(0.005)	*(0.992)*
Growth rate of real per capita GPDI	1.378	0.531
	(0.001)	*(0.001)*
Real interest rate[2]	0.172	-0.101
	(0.282)	*(0.130)*
Terms of trade[1]	-0.024	-0.029
	(0.534)	*(0.094)*
Old dependency ratio	-0.313	-0.940
	(0.170)	*(0.001)*
Young dependency ratio	0.012	-0.300
	(0.884)	*(0.001)*
Urbanization ratio	-0.073	0.107
	(0.054)	*(0.010)*
Government Saving / GPDI	-0.129	-0.273
	(0.527)	*(0.001)*
Inflation[2]	0.039	-0.327
	(0.733)	*(0.001)*
Private Credit	0.085	0.021
	(0.027)	*(0.224)*
OIR-Test[3]	0.708	
Sargan test[4] (p-value)		0.311
Serial correlation test[5] (p-value)		0.335
Countries	61	72
Observations		247
	p-values in parentheses	

[1] In the regression, this variable is included as log(variable)

[2] In the regression, this variable is included as log(1 + variable)

[3] The null hypothesis is that the instruments used are not correlated with the residuals. Critical values for OIR-Test (2 d.f.): 10%=4.61; 5%=5.99

[4] The null hypothesis is that the instruments used are not correlated with the residuals.

[5] The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation.

Table 9: Financial Intermediation and Private Saving: Alternative Measures

Cross-country

Financial variable	coefficient	p-value	OIR-test[1]	Number of countries
LIQUID LIABILITIES	0.075	0.102	3.106	61
COMMERCIAL - CENTRAL BANK	0.896	0.338	1.370	61
PRIVATE CREDIT	0.085	0.027	0.708	61

[1] The null hypothesis is that the instruments used are not correlated with the residuals from the respective regression
Critical values for OIR-Test (2 d.f.): 10%= 4.61; 5%= 5.99

Panel

Financial variable	coefficient	p-value	Sargan-test (p-value)[2]	2nd order serial corr. test (p-value)[3]	Number of countries	Number of observations
LIQUID LIABILITIES	-0.012	0.588	0.631	0.286	72	247
COMMERCIAL - CENTRAL BANK	0.154	0.001	0.363	0.340	72	247
PRIVATE CREDIT	0.021	0.224	0.311	0.335	72	247

[2] The null hypothesis is that the instruments used are not correlated with the residuals from the respective regression
[3] The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation

conditioning information set: logarithm of real per capita GPDI, the growth rate of real per capita GPDI, the real interest rate, the log of terms of trade, the old and the young dependency ratios, the urbanization rate, the inflation rate and the ratio of government saving to GPDI

LIQUID LIABILITIES: liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and nonbank financial intermediaries) divided by GDP
COMMERCIAL - CENTRAL BANK: assets of deposit money banks divided by assets of deposit money banks plus central bank assets
PRIVATE CREDIT: credit by deposit money banks and other financial institutions to the private sector divided by GDP