



# Stock markets, banks, and growth: Panel evidence

Thorsten Beck<sup>\*</sup>, Ross Levine

*The World Bank, Mail Stop MC 3-300, 1818 H Street NW, Washington, DC 20433, USA*

Received 18 January 2002; accepted 13 August 2002

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## Abstract

This paper investigates the impact of stock markets and banks on economic growth using a panel data set for the period 1976–1998 and applying recent generalized-method-of-moments techniques developed for dynamic panels. On balance, we find that stock markets and banks positively influence economic growth and these findings are not due to potential biases induced by simultaneity, omitted variables or unobserved country-specific effects.

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*JEL classification:* G10; G21; O16; O40

*Keywords:* Economic growth; Stock markets; Banks

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## 1. Introduction

Theory provides conflicting predictions about both the impact of overall financial development on growth and about the separate effects of stock markets on growth and banks on economic growth. Many models emphasize that well-functioning financial intermediaries and markets ameliorate information and transactions costs and thereby foster efficient resource allocation and hence faster long-run growth (Bencivenga and Smith, 1991; Bencivenga et al., 1995; King and Levine, 1993a). These models, however, also show that financial development can hurt growth. Specifically, financial development, by enhancing resource allocation and hence the returns to saving, may lower saving rates. If there are sufficiently large externalities

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<sup>\*</sup> Corresponding author. Tel.: +1-202-473-3215; fax: +1-202-522-1155.

*E-mail addresses:* [tbeck@worldbank.org](mailto:tbeck@worldbank.org) (T. Beck), [rlevine@csom.umn.edu](mailto:rlevine@csom.umn.edu) (R. Levine).

associated with saving and investment, then financial development slows long-run growth. Theory also provides conflicting predictions about whether stock markets and banks are substitutes, compliments, or whether one is more conducive to growth than the other. For instance, Boyd and Prescott (1986) model the critical role that banks play in easing information frictions and therefore in improving resource allocation, while Stiglitz (1985) and Bhidé (1993) stress that stock markets will not produce the same improvement in resource allocation and corporate governance as banks. On the other hand, some models emphasize that markets mitigate the inefficient monopoly power exercised by banks and stress that the competitive nature of markets encourages innovative, growth-enhancing activities as opposed to the excessively conservative approach taken by banks (Allen and Gale, 2000). Finally, some theories stress that it is not banks or markets, it is banks and markets; these different components of the financial system ameliorate different information and transaction costs.<sup>1</sup>

Although a burgeoning empirical literature suggests that well-functioning banks accelerate economic growth, these studies generally do not simultaneously examine stock market development. King and Levine (1993a,b) show that bank development – as measured by the total liquid liabilities of financial intermediaries (e.g., M3) divided by Gross Domestic Product (GDP) – helps explain economic growth in a sample of more than 80 countries. Levine (1998, 1999); Beck et al. (2000) and Levine et al. (2000) confirm this finding but improve upon King and Levine (1993a,b) by (1) using measures of bank development that include only credit to private firms and therefore exclude credit to the public sector and by (2) using instrumental variable procedures to control for simultaneity bias.<sup>2</sup> This literature, however, omits measures of stock market development because measures of stock market development for a 20-year period are only available for about 40 countries.

Omitting stock market development makes it difficult to assess whether (a) the positive relationship between bank development and growth holds when controlling for stock market development, (b) banks and markets each have an independent impact on economic growth, or (c) overall financial development matters for growth but it is difficult to identify the separate impact of stock markets and banks on economic success.

Levine and Zervos (1998) empirically assess the relationship between growth and both stock markets and banks, but their study suffers from an assortment of econometric weaknesses. Levine and Zervos (1998) find that initial measures of stock market liquidity and banking sector development are both strong predictors of economic growth over the next 18 years. To measure bank development, they use bank credit to the private sector as a share of GDP. They use an assortment of stock market development measures, including the overall size of the market (market capitalization

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<sup>1</sup> See Levine (1997), Boyd and Smith (1998), Huybens and Smith (1999) and Demirgüç-Kunt and Levine (2001).

<sup>2</sup> For time-series evidence that documents the positive impact of financial intermediary development on economic growth, see Rousseau (1998) and Wachtel and Rousseau (1995).

relative to GDP), stock market activity (the value of trades relative to GDP), and market liquidity (the value of trades relative to market capitalization). The ordinary least squares (OLS) approach taken by Levine and Zervos (1998), however, does not account formally for potential simultaneity bias, nor does it control explicitly for country fixed effects or the routine use of lagged dependent variables in growth regressions.<sup>3</sup> Further, while theory stresses the potential relationship between economic growth and the contemporaneous level of financial development, Levine and Zervos (1998) use initial values of stock market and bank development. This not only implies an informational loss vis-à-vis using average values, but also a potential consistency loss.

While recent work has attempted to resolve some of the statistical weaknesses in the Levine and Zervos (1998) study, statistical and conceptual problems remain. For instance, Arestis et al. (2001) use quarterly data and apply time series methods to five developed economies and show that while both banking sector and stock market development explain subsequent growth, the effect of banking sector development is substantially larger than that of stock market development. The sample size, however, is very limited and it is not clear whether the use of quarterly data and Johansen's (1988) vector error correction model fully abstracts from high frequency factors influencing the stock market, bank, and growth nexus to focus on long-run economic growth.

Rousseau and Wachtel (2000) make an important contribution to the literature by using panel techniques with annual data to assess the relationship between stock markets, banks, and growth. They use M3/GDP to measure bank development and the Levine and Zervos (1998) measures of stock market size and activity, which they deflate by the price index of the national stock exchange to eliminate price changes from their measure of how well the stock market functions. Rousseau and Wachtel (2000) use the *difference* panel estimator – developed by Arellano and Bond (1991) and Holtz-Eakin et al. (1990) – that (a) differences the growth regression equation to remove any bias created by unobserved country-specific effects, and then (b) instruments the right-hand-side variables (the differenced values of the original regressors) using lagged values of the original regressors to eliminate potential parameter inconsistency arising from simultaneity bias. Rousseau and Wachtel (2000) show that both banking and stock market development explain subsequent growth.

Nevertheless, problems remain. First, the goal is to assess the relationship between stock markets, banks, and economic growth. The use of annual data, however, does not abstract from business cycle phenomena. Second, Alonso-Borrego and Arellano (1999) show that the instruments in the difference panel estimator are frequently weak, which induces biases in finite samples and poor precision asymptotically. Recent econometric developments, however, permit the use of statistical procedures that control for these problems.

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<sup>3</sup> Also, see Atje and Jovanovic (1993), Harris (1997), Levine (2001), and especially Bekaert et al. (2001) for additional evidence on the stock market, bank, and growth relationship. These studies, however, do not use panel econometric procedures that control for simultaneity bias.

This paper uses new panel econometric techniques that reduce statistical shortcomings with existing growth studies along with new data to re-examine the relationship between stock markets, banks, and economic growth. More specifically, we examine whether measures of stock market and bank development each have a positive relationship with economic growth after (i) controlling for simultaneity bias, omitted variable bias, and the routine inclusion of lagged dependent variables in growth regressions, (ii) moving to data averaged over five-years, instead of quarterly or annual data, to abstract from business-cycle influences, (iii) using a new system, panel estimator that eliminates the biases associated with the difference panel estimator, (iv) assessing the robustness of the results using several variants of the system estimator, and (v) controlling for many other growth determinants. We also assess whether the stock market and bank indicators jointly enter the growth regression significantly. In terms of data, we use the same basic measures of bank and stock market development as in Levine and Zervos (1998), but we improve on previous efforts by more carefully deflating the data. Indicators of financial development are frequently measured at the end of the period. These financial development indicators, however, are frequently divided by the GDP, which is measured over the period. We rectify this problem since it may create substantial mis-measurement in high-inflation countries.

Methodologically, we (1) construct a panel with data averaged over five-year intervals from 1976 to 1998 to abstract from business cycle relationships and (2) employ the *system* panel estimator developed by Arellano and Bover (1995) since Blundell and Bond (1998) show that a system panel estimator that simultaneously uses both the difference panel data and the data from the original *levels* specification produces dramatic increases in both consistency and efficiency. We use different variants of the system panel estimator. As discussed in Arellano and Bond (1991), the one-step system estimator assumes homoskedastic errors, while the two-step estimator uses the first-step errors to construct heteroskedasticity-consistent standard errors (e.g., White, 1982). Due to the large number of instruments that are employed in the system estimator, however, the asymptotic standard errors from the two-step panel estimator may be a poor guide for hypothesis testing in small samples where over-fitting becomes a problem. This is not a problem in the one-step estimator.

Consequently, we use the one-step panel estimator, the two-step estimator, and a novel, alternative procedure developed by Calderon et al. (2000). This alternative system estimator reduces the dimensionality of the instruments to avoid the over-fitting problem but still permits the construction of heteroskedasticity consistent standard errors. The shortcoming of this alternative procedure is that we lose a period from the sample.

Thus, besides assessing the impact of stock markets and banks on economic growth, this paper contributes to the literature on panel estimation procedures. While Arellano and Bond (1991) and Blundell and Bond (1998) note the potential biases associated with standard errors emerging from the two-step estimator in small samples and while they recognize that these potential biases must be balanced against advantages of using heteroskedasticity-consistent standard errors, this paper exemplifies the differences that emerge from these two procedures. Moreover, we use

Calderon et al.'s (2000) modification that limits the over-fitting problem and thereby reduces potential biases associated with the two-step estimator. We provide evidence using all three approaches. The results suggest that it is indeed important to use all three estimates in drawing economic inferences.

This paper finds that markets and banks are important for economic growth. Bank and stock market development always enter jointly significant in all the system panel estimators that we employ. These findings are strongly consistent with models that predict that well-functioning financial systems ease information and transaction costs and thereby enhance resource allocation and economic growth. Further, the measure of stock market development and the measure of bank development frequently both enter the growth regression significantly after controlling for other growth determinants, country specific effects, and potential simultaneity bias. This suggests that both banks and markets are important for growth. This conclusion, however, must be qualified. The two-step indicator always indicates that both stock markets and banks independently boost growth. There are, however, a few combinations of control variables – government size, inflation, trade openness and the black market premium – when using the one-step and alternative panel estimators in which *only* bank development *or* stock market liquidity enters with a *p*-value below 0.05. While we read the bulk of the results as suggesting that both markets and banks independently spur economic growth, the fact that the results are not fully consistent across all econometric methods and specifications may lead some to conclude that overall financial development matters for growth but it is difficult to identify the specific components of the financial system most closely associated with economic success.

The remainder of the paper is organized as follows. Section 2 presents the data and simple OLS regressions. Section 3 introduces the econometric methodology. Section 4 presents the main results and Section 5 concludes.

## 2. The data and preliminary regressions

### 2.1. Data

We analyze the link between stock market and bank development and economic growth in a panel of 40 countries and 146 observations. Data are averaged over five 5-year periods between 1976 and 1998.<sup>4</sup> Moving to a panel from pure cross-sectional data allows us to exploit the time-series dimension of the data and deal rigorously with simultaneity. The theories we are evaluating focus on the long-run relationships between stock markets, banks, and economic growth. Thus, we use five-year averages rather than annual (or quarterly) data to focus on longer-run (as opposed to higher frequency) relationships. Nevertheless, there are important

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<sup>4</sup> Thus, the first period covers the years 1976–1980; the second period covers the years 1981–1985, and so on. The last period only comprises the years 1996–1998. Financial data are from Beck et al. (2000).

weaknesses with the measures. Theory focuses on the role that stock markets and banks may play in reducing informational asymmetries and lowering transactions costs. We do not, however, have direct measures of the degree to which markets and banks in a broad cross-section of countries ameliorate information and transactions costs. Consequently, while recognizing the absence of a direct link between theory and measurement, we use proxy measures of banking system size and stock market activity to gauge cross-country differences in stock market and bank development. This section describes the indicators of stock market and bank development, the conditioning information set, presents descriptive statistics, and provides OLS regression results of stock markets, banks, and economic growth.

To measure stock market development, we use the *turnover ratio* measure of market liquidity, which equals the value of the trades of shares on domestic exchanges divided by total value of listed shares. It indicates the trading volume of the stock market relative to its size. Some models predict countries with illiquid markets will create disincentives to long-run investments because it is comparatively difficult to sell one's stake in the firm. In contrast, more liquid stock markets reduce disincentives to long-run investment, since liquid markets provide a ready exit-option for investors. This can foster more efficient resource allocation and faster growth (Levine, 1991; Bencivenga et al., 1995).

We experimented with other measures of stock market development that were used by Levine and Zervos (1998) and Rousseau and Wachtel (2000). *Value traded* equals the value of the trades of domestic shares on domestic exchanges divided by GDP. Value traded has two potential pitfalls. First, it does not measure the liquidity of the market. It measures trading relative to the size of the economy. Second, since markets are forward looking, they will anticipate higher economic growth by higher share prices. Since value traded is the product of quantity and price, this indicator can rise without an increase in the number of transactions. Turnover ratio does not suffer from this shortcoming since both numerator and denominator contain the price. We also considered *market capitalization*, which equals the value of listed shares divided by GDP. Its main shortcoming is that theory does not suggest the mere listing of shares will influence resource allocation and growth. Levine and Zervos (1998) show that market capitalization is not a good predictor of economic growth. Finally, as noted in the introduction, we deflate the market capitalization ratio, which is measured at the end-of-period by end of period price deflators and the flow variables (GDP and trading variables) by a deflator for the whole period. This eliminates the potential mis-measurement induced by inflation.

To measure bank development, we follow Levine and Zervos (1998) and use *bank credit*, which equals bank claims on the private sector by deposit money banks divided by GDP. Although bank credit does not directly measure the degree to which banks ease information and transaction costs, bank credit improves upon alternative measures. First, unlike many studies of finance and growth that use the ratio of M3 to GDP as an empirical proxy of financial development, the bank credit variable isolates bank credit to the private sector and therefore excludes credits by development banks and loans to the government and public enterprises. Second, as noted, we de-

Table 1  
Summary statistics: 1975–1998

	Economic growth	Turnover ratio	Bank credit
<i>Descriptive statistics</i>			
Mean	1.89	41.54	50.00
Maximum	8.57	340.02	124.38
Minimum	-4.77	1.31	4.13
Std. dev.	2.23	42.91	28.16
Observations	146	146	146
<i>Correlations</i>			
Economic growth	1 (0.001)		
Turnover ratio	0.38 (0.001)	1	
Bank credit	0.11 (0.194)	0.41 (0.001)	1

*p*-Values are reported in parentheses.

flate the end-of-period credit variables by end-of-period deflators and the GDP flow variables by a deflator for the whole period. Then we take the average of the real credit variable in period  $t$  and period  $t - 1$  and relate it to the real flow variable for period  $t$ . This reduces mis-measurement that is common in past studies of stock markets, banks, and growth.

To assess the strength of the independent link between both stock markets and growth and bank development and economic growth, we control for other potential determinants of economic growth in our regressions. In the *simple conditioning information set* we include the initial real GDP per capita to control for convergence and the average years of schooling to control for human capital accumulation. In the *policy conditioning information set*, we use the simple conditioning information set plus either (i) the black market premium, (ii) the share of exports and imports to GDP, (iii) the inflation rate or (iv) the ratio of government expenditures to GDP.

Table 1 presents descriptive statistics and correlations. There is a wide variation of bank and stock market development across the sample. While Taiwan had a turnover ratio of 340% of GDP in 1986–1990, Bangladesh had a turnover ratio of only 1.3% in 1986–1990. While Taiwan's banks lent 124% of GDP to the private sector in 1991–1995, Peru's financial intermediaries lent only 4% during 1981–85. We note that while economic growth is correlated significantly with the turnover ratio, it is not significantly correlated with bank credit. Turnover is significantly correlated with bank development.

## 2.2. Ordinary least squares regressions

Table 2 presents OLS regression of economic growth averaged over the 1976–1998 period with one observation per country. There are 40 countries in the sample

Table 2

Stock markets, banks and growth, cross-country regressions, OLS

Regressors	(1)	(2)	(3)	(4)	(5)
Constant	0.341 (0.811)	1.189 (0.472)	-0.267 (0.885)	0.532 (0.699)	1.721 (0.327)
Logarithm of initial income per capita	-0.853 (0.017)	-0.797 (0.023)	-0.837 (0.022)	-0.819 (0.054)	-0.775 (0.039)
Average years of schooling <sup>a</sup>	0.539 (0.604)	0.657 (0.558)	0.492 (0.645)	0.471 (0.687)	0.095 (0.933)
Government consumption <sup>b</sup>		-0.692 (0.145)			
Trade openness <sup>b</sup>			0.194 (0.594)		
Inflation rate <sup>a</sup>				-0.436 (0.745)	
Black market premium <sup>a</sup>					-1.949 (0.257)
Bank credit <sup>b</sup>	1.465 (0.001)	1.601 (0.001)	1.378 (0.002)	1.368 (0.029)	1.197 (0.009)
Turnover ratio <sup>b</sup>	0.79 (0.025)	0.743 (0.027)	0.823 (0.027)	0.809 (0.042)	0.766 (0.039)
R <sup>2</sup>	0.537	0.556	0.540	0.538	0.554
Wald test for joint significance ( <i>p</i> -value)	0.001	0.001	0.001	0.001	0.001
Countries	40	40	40	40	40

*p*-Values in parentheses.

The regressions also includes dummy variables for the different time periods that are not reported.

<sup>a</sup> In the regression, this variable is included as log(1 + variable).<sup>b</sup> In the regression, this variable is included as log(variable).

Table 3

List of countries

Australia	Greece	Norway
Austria	India	Pakistan
Bangladesh	Indonesia	Peru
Belgium	Israel	Philippines
Brazil	Italy	Portugal
Canada	Jamaica	South Africa
Chile	Japan	Sweden
Colombia	Jordan	Taiwan
Denmark	Korea	Thailand
Egypt	Malaysia	US
Finland	Mexico	Uruguay
France	Netherlands	Venezuela
Germany	New Zealand	Zimbabwe
Great Britain		

(Table 3). The dependent variable is real per capita GDP growth. Each of the five reported regressions control for the logarithm of initial income and the logarithm

of average years of schooling. The regressions include bank credit and the turnover ratio. The regressions also control sequentially for government consumption, trade openness, inflation, and the black market exchange rate premium. The  $p$ -values of the coefficient estimates are reported in parentheses.

The OLS regressions demonstrate a strong positive association between stock market development, bank development, and economic growth. Both bank development (bank credit) and stock market development (turnover ratio) enter each of the five regressions significantly at the 0.05 significance level. Table 2 also indicates that the bank credit and the turnover ratio enter jointly significantly as indicated by the  $p$ -value of less 0.01 on the Wald test for joint significance. Interestingly, the sizes of the coefficients are economically large. According to the lowest coefficient estimates, an improvement of Egypt's level of bank credit from the actual value of 24% to the sample mean of 44% would have been associated with 0.7% points higher annual growth over the period 1975–1998. Similarly, if Egypt's turnover ratio had been the sample mean of 37% instead of its actual value of 10%, Egypt would have enjoyed nearly one-percentage point higher annual growth. While these counterfactual examples should not be viewed as exploitable elasticities, they do suggest an economically meaningful relationship between financial development and economic growth. As we will see, the sizes of the coefficients in the simple OLS regressions are very similar to the results we obtain using more sophisticated dynamic panel estimators.

### 3. The methodology

While Levine and Zervos (1998) show that stock market development and banking sector development are robust predictors of growth, their results do not imply a causal link between the financial sector and economic growth. To control for possible simultaneity, they use initial values of stock market and bank development. Using initial values of the explanatory variables, however, implies not only an efficiency (informational) loss but also a potential consistency loss. If the contemporaneous behavior of the explanatory variables matters for current growth, we run the risk of grossly mis-measuring the “true” explanatory variables by using initial values, which could bias the coefficient estimates. Using proper instruments for the contemporaneous values of the explanatory variables is therefore preferable to using initial values.

To assess the relationship between stock market development, bank development and economic growth in a panel, we use the generalized-method-of moments (GMM) estimators developed for dynamic panel models by Holtz-Eakin et al. (1990), Arellano and Bond (1991) and Arellano and Bover (1995). We can write the traditional cross-country growth regression as follows:

$$y_{i,t} - y_{i,t-1} = \alpha y_{i,t-1} + \beta' X_{i,t} + \eta_i + \varepsilon_{i,t}, \quad (1)$$

where  $y$  is the logarithm of real per capita GDP,  $X$  represents the set of explanatory variables, other than lagged per capita GDP and including our indicators of stock market and bank development,  $\eta$  is an unobserved country-specific effect,  $\varepsilon$  is the

error term, and the subscripts  $i$  and  $t$  represent country and time period, respectively. We also include time dummies to account for time-specific effects.

Arellano and Bond (1991) propose to difference Eq. (1):

$$(y_{i,t} - y_{i,t-1}) - (y_{i,t-1} - y_{i,t-2}) = \alpha(y_{i,t-1} - y_{i,t-2}) + \beta'(X_{i,t} - X_{i,t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}). \quad (2)$$

While differencing eliminates the country-specific effect, it introduces a new bias; by construction the new error term,  $\varepsilon_{i,t} - \varepsilon_{i,t-1}$  is correlated with the lagged dependent variable,  $y_{i,t-1} - y_{i,t-2}$ . Under the assumptions that (a) the error term,  $\varepsilon$ , is not serially correlated, and (b) the explanatory variables,  $X$ , are weakly exogenous (i.e., the explanatory variables are assumed to be uncorrelated with future realizations of the error term), Arellano and Bond propose the following moment conditions.

$$E[y_{i,t-s}(\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0 \quad \text{for } s \geq 2; t = 3, \dots, T, \quad (3)$$

$$E[X_{i,t-s}(\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0 \quad \text{for } s \geq 2; t = 3, \dots, T. \quad (4)$$

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. The two-step estimator is thus asymptotically more efficient relative to the first-step estimator. We refer to the GMM estimator based on these conditions as the difference estimator. This is the estimator that Rousseau and Wachtel (2000) use with annual data to examine the relationship between stock markets, banks, and economic growth.

There are, however, conceptual and statistical shortcomings with this difference estimator. Conceptually, we would also like to study the cross-country relationship between financial sector development and economic growth, which is eliminated in the difference estimator. Statistically, Alonso-Borrego and Arellano (1999) and Blundell and Bond (1998) show that in the case of persistent explanatory variables, lagged levels of these variables are weak instruments for the regression equation in differences. This influences the asymptotic and small-sample performance of the difference estimator. Asymptotically, the variance of the coefficients rises. In small samples, Monte Carlo experiments show that the weakness of the instruments can produce biased coefficients. Finally, differencing may exacerbate the bias due to measurement errors in variables by decreasing the signal-to-noise ratio (see Griliches and Hausman, 1986).

To reduce the potential biases and imprecision associated with the difference estimator, we use an estimator that combines in a system the regression in differences with the regression in levels (Arellano and Bover, 1995 and Blundell and Bond, 1998). The instruments for the regression in differences are the same as above. The instruments for the regression in levels are the lagged differences of

the corresponding variables. These are appropriate instruments under the following *additional* assumption: although there may be correlation between the levels of the right-hand side variables and the country-specific effect in Eq. (1), there is no correlation between the differences of these variables and the country-specific effect. Given that lagged levels are used as instruments in the regression in differences, only the most recent difference is used as an instrument in the regression in levels. Using additional lagged differences would result in redundant moment conditions (Arellano and Bover, 1995). Thus, additional moment conditions for the second part of the system (the regression in levels) are:

$$E[(y_{i,t-s} - y_{i,t-s-1})(\eta_i + \varepsilon_{i,t})] = 0 \quad \text{for } s = 1, \quad (5)$$

$$E[(X_{i,t-s} - X_{i,t-s-1})(\eta_i + \varepsilon_{i,t})] = 0 \quad \text{for } s = 1. \quad (6)$$

Thus, we use the moment conditions presented in Eqs. (3)–(6) and employ the system panel estimator to generate consistent and efficient parameter estimates.

The consistency of the GMM estimator depends on the validity of the assumption that the error terms do not exhibit serial correlation and on the validity of the instruments. To address these issues we use two specification tests suggested by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). 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 process. The second test examines the hypothesis that the error term  $\varepsilon_{i,t}$  is not serially correlated. We test whether the differenced error term is second-order serially correlated (by construction, the differenced error term is probably first-order serially correlated even if the original error term is not). Failure to reject the null hypotheses of both tests gives support to our model.

Both the difference and the system estimator present certain problems when applied to samples with a small number of cross-sectional units. As shown by Arellano and Bond (1991) and Blundell and Bond (1998), the asymptotic standard errors for the two-step estimators are biased downwards. The one-step estimator, however, is asymptotically inefficient relative to the two-step estimator, even in the case of homoskedastic error terms. Thus, while the coefficient estimates of the two-step estimator are asymptotically more efficient, the asymptotic inference from the one-step standard errors might be more reliable. This problem is exacerbated when the number of instruments is equal to or larger than the number of cross-sectional units. This biases both the standard errors and the Sargan test downwards and might result in biased asymptotic inference.

We address this problem threefold. First, we consider the first-stage results. While the coefficient estimates are less efficient, the asymptotic standard errors are unbiased. Second, we include a limited number of control variables at a time. Specifically, for the policy conditioning information set, we only include one additional policy variable at the time, rather than including them all at once, as in the usual cross-country growth regressions. This reduces the number of instruments to less than the number of cross-sectional observations. By keeping the instrument set small,

we minimize the over-fitting problem and maximize the confidence that one has in the more efficient two-step system estimator.

Third, we use an alternative specification of the instruments employed in the two-step system estimator. Typically, users of the difference and system estimator treat the moment conditions as applying to a particular time period. This provides for a more flexible variance–covariance structure of the moment conditions (Ahn and Schmidt, 1995) because the variance for a given moment condition is not assumed to be the same across time. This approach has the drawback that the number of overidentifying conditions increases dramatically as the number of time periods increases. Consequently, this typical two-step estimator tends to induce over-fitting and potentially biased standard errors. To limit the number of overidentifying conditions, we follow Calderon et al. (2000) and apply each moment condition to all available periods. This reduces the over-fitting bias of the two-step estimator. However, applying this modified estimator reduces the number of periods in our sample by one. While in the standard DPD estimator time dummies and the constant are used as instruments for the second period, this modified estimator does not allow the use of the first and second period. While losing a period, the Calderon et al. (2000) specification reduces the over-fitting bias and therefore permits the use of a heteroskedasticity-consistent system estimator.

#### 4. The results

##### 4.1. System estimator: One- and two-step results

The results in Table 4 show that (i) the development of stock markets and of banks have both a statistically and economically large positive impact on economic growth, and (ii) these results are not due to simultaneity bias, omitted variables or country-specific effects. The  $p$ -values in parentheses are from the two-step estimator. The stars in Table 4 indicate the significance of the coefficients on the stock market and bank variables based on the one-step standard errors. Thus, Table 4 indicates the significance of stock market and bank development for both the two-step and one-step estimators.<sup>5</sup>

The turnover ratio and bank credit both enter significantly (at the one-percent level) and positively in all five regressions using the two-step estimator. The one-step estimator, however, indicates that bank credit does not always enter with a  $p$ -value below 0.10. Specifically, bank credit does not enter significantly when controlling for either trade openness or inflation.<sup>6</sup> However, even with the one-step estimator, the financial indicators always enter jointly significantly. Our specification tests indicate

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<sup>5</sup> None of the other explanatory variables enters significantly in the first-step regressions.

<sup>6</sup> These results are consistent with the findings by Boyd et al. (2001) that inflation exerts a negative impact on financial development.

Table 4  
Stock markets, banks and growth, GMM estimator

Regressors	(1)	(2)	(3)	(4)	(5)
Constant	−0.774 (0.570)	−1.757 (0.090)	−4.095 (0.048)	−1.062 (0.265)	−0.156 (0.855)
Logarithm of initial income per capita	−0.717 (0.008)	−0.350 (0.099)	−0.242 (0.291)	−0.189 (0.356)	−0.384 (0.010)
Average years of schooling <sup>a</sup>	−0.388 (0.646)	−1.156 (0.111)	−1.492 (0.076)	−1.297 (0.040)	−1.629 (0.013)
Government consumption <sup>b</sup>		−0.073 (0.868)			
Trade openness <sup>b</sup>			0.679 (0.045)		
Inflation rate <sup>a</sup>				−0.35 (0.257)	
Black market premium <sup>a</sup>					0.549 (0.444)
Bank credit <sup>b</sup>	1.756*** (0.001)	1.539** (0.001)	0.977 (0.001)	0.538 (0.001)	1.045* (0.001)
Turnover ratio <sup>b</sup>	0.958** (0.001)	1.078*** (0.001)	1.522*** (0.001)	1.667*** (0.001)	1.501*** (0.001)
Sargan test <sup>c</sup> ( <i>p</i> -value)	0.488	0.602	0.452	0.558	0.656
Serial correlation test <sup>d</sup> ( <i>p</i> -value)	0.595	0.456	0.275	0.272	0.335
Wald test for joint significance ( <i>p</i> -value)	0.001***	0.001***	0.001***	0.001***	0.001***
Countries	40	40	40	40	40
Observations	146	146	146	146	146

*p*-Values in parentheses.

The regressions also includes dummy variables for the different time periods that are not reported.

\*, \*\*, \*\*\* indicate significance at the 10%, 5% and 1% level in the first-stage regression respectively.

<sup>a</sup> In the regression, this variable is included as  $\log(1 + \text{variable})$ .

<sup>b</sup> In the regression, this variable is included as  $\log(\text{variable})$ .

<sup>c</sup> The null hypothesis is that the instruments used are not correlated with the residuals.

<sup>d</sup> The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation.

that we cannot reject the null-hypothesis of no second-order serial correlation in the differenced error-term and that our instruments are adequate.

As noted earlier, we use the system estimator because the more commonly used difference estimator (i) eliminates the cross-country relationship and focuses only on time differences, (ii) suffers from imprecision and potentially biased estimates in small samples (Alonso-Borrego and Arellano, 1999; Blundell and Bond, 1998), and (iii) may exacerbate biases by decreasing the signal-to-noise ratio (Griliches and Hausman, 1986). Thus, econometric theory suggests that the system estimator offers gains in both consistency and efficiency. Our results support this contention. The system results in Table 4 produce sharper results than the difference estimator and the level estimator results, which are given in Tables 5 and 6 respectively. Thus, using the system estimator makes a difference in terms for the inferences that one

Table 5  
Stock markets, banks and growth, GMM difference estimator

Regressors	(1)	(2)	(3)	(4)	(5)
Constant	2.089 (0.014)**	2.067 (0.001)**	1.536 (0.008)**	2.028 (0.054)**	2.06 (0.005)**
Logarithm of initial income per capita	-13.59 (0.001)**	-8.517 (0.001)**	-7.374 (0.019)*	-15.956 (0.001)**	-10.547 (0.001)**
Average years of schooling <sup>a</sup>	1.554 (0.717)	-1.395 (0.690)	-10.605 (0.012)	2.557 (0.495)	3.76 (0.271)
Government consumption <sup>b</sup>		2.992 (0.229)			
Trade openness <sup>b</sup>			5.676 (0.001)**		
Inflation rate <sup>a</sup>				0.866 (0.336)	
Black market premium <sup>a</sup>					-0.788 (0.738)
Bank credit <sup>b</sup>	0.749 (0.388)	0.683 (0.426)	-0.471 (0.644)	0.370 (0.656)	0.626 (0.552)
Turnover ratio <sup>b</sup>	-0.36 (0.674)	-0.145 (0.803)	0.699 (0.129)	-0.225 (0.828)	-0.496 (0.506)
Sargan test <sup>c</sup> ( <i>p</i> -value)	0.259	0.120	0.315	0.305	0.155
Serial correlation test <sup>d</sup> ( <i>p</i> -value)	0.859	0.530	0.102	0.710	0.800
Wald test for joint significance ( <i>p</i> -value)	0.361	0.483	0.189	0.787	0.323
Countries	40	40	40	40	40
Observations	106	106	106	106	106

*p*-Values in parentheses.

The regressions also includes dummy variables for the different time periods that are not reported.

\*, \*\*, \*\*\* indicate significance at the 10%, 5% and 1% level in the first-stage regression respectively.

<sup>a</sup> In the regression, this variable is included as  $\log(1 + \text{variable})$ .

<sup>b</sup> In the regression, this variable is included as  $\log(\text{variable})$ .

<sup>c</sup> The null hypothesis is that the instruments used are not correlated with the residuals.

<sup>d</sup> The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation.

draws concerning the relationship between stock markets, banks, and economic growth.

The two-step results in Table 4 are not only statistically, but also economically significant. If Mexico's turnover ratio had been at the average of the OECD countries (68%) instead of the actual 36% during the period 1996–1998, it would have grown 0.6% points faster per year. Similarly, if its bank credit had been at the average of all OECD countries (71%) instead of the actual 16%, it would have grown 0.8% points faster per year.<sup>7</sup> These results suggest that both bank and stock market development have an economically large impact on economic growth.

<sup>7</sup> We calculate this by taking the lowest coefficients across the five columns, 0.958 in the case of turnover ratio and 0.538 in the case of bank credit.

Table 6  
Stock markets, banks and growth, GMM level estimator

Regressors	(1)	(2)	(3)	(4)	(5)
Constant	−1.04 (0.721)	−3.628 (0.180)	−0.104 (0.986)	0.489 (0.857)	1.889 (0.326)
Logarithm of initial income per capita	−0.236 (0.759)	0.16 (0.738)	−0.485 (0.362)	0.002 (0.996)	−0.715 (0.367)
Average years of schooling <sup>a</sup>	−1.759 (0.576)	−3.493 (0.071)	−1.202 (0.605)	−2.358 (0.150)	−0.492 (0.883)
Government consumption <sup>b</sup>		0.551 (0.518)			
Trade openness <sup>b</sup>			−0.231 (0.845)		
Inflation rate <sup>a</sup>				−0.495 (0.787)	
Black market premium <sup>a</sup>					−0.725 (0.602)
Bank credit <sup>b</sup>	0.349 (0.756)	1.702 (0.015)	0.375 (0.716)	0.037 (0.942)	−0.343 (0.653)
Turnover ratio <sup>b</sup>	2.336 (0.089)*	0.9 (0.137)*	2.636 (0.004)**	1.999 (0.001)**	2.882 (0.032)*
Sargan test <sup>c</sup> ( <i>p</i> -value)	0.572	0.421	0.659	0.509	0.621
Wald test for joint significance ( <i>p</i> -value)	0.002**	0.001***	0.001**	0.001**	0.002
Countries	40	40	40	40	40
Observations	146	146	146	146	146

*p*-Values in parentheses.

The regressions also includes dummy variables for the different time periods that are not reported.

\*, \*\*, \*\*\* indicate significance at the 10%, 5% and 1% level in the first-stage regression respectively.

<sup>a</sup> In the regression, this variable is included as  $\log(1 + \text{variable})$ .

<sup>b</sup> In the regression, this variable is included as  $\log(\text{variable})$ .

<sup>c</sup> The null hypothesis is that the instruments used are not correlated with the residuals.

#### 4.2. Alternative system estimator

We also examine the Calderon et al. (2000) alternative system estimator that reduces the over-fitting problem of the two-step estimator while obtaining heteroskedasticity-consistent standard errors. Unlike in Table 4 we only report the significance levels of the two-step estimator in Table 7 because we do not have an over-fitting problem.

Stock market liquidity and bank development each enter the growth regressions significantly in Table 7, except when controlling for trade openness. In the regression controlling for trade openness, bank credit enters with a *p*-value below 0.05, but turnover is insignificant. Even in this regression, however, they enter jointly significantly. Both bank development and stock market development, however, enter individually significantly in the other four regressions. Overall, these results suggest an independent link between growth and both stock market liquidity (turnover) and bank development (bank credit). The Calderon et al.

Table 7  
 Stock markets, banks and growth, alternative GMM estimator

Regressors	(1)	(2)	(3)	(4)	(5)
Constant	1.898 (0.394)	6.156 (0.182)	4.582 (0.685)	3.113 (0.189)	1.884 (0.430)
Logarithm of initial income per capita	-0.683 (0.275)	0.048 (0.945)	-0.299 (0.691)	-0.619 (0.249)	-0.723 (0.239)
Average years of schooling <sup>a</sup>	-3.004 (0.277)	-3.738 (0.119)	-4.08 (0.168)	-3.221 (0.157)	-2.979 (0.283)
Government consumption <sup>b</sup>		-2.581 (0.111)			
Trade openness <sup>b</sup>			-0.693 (0.753)		
Inflation rate <sup>a</sup>				-1.976 (0.079)	
Black market premium <sup>a</sup>					-0.069 (0.966)
Bank credit <sup>b</sup>	2.202 (0.001)	1.762 (0.025)	2.133 (0.048)	1.954 (0.003)	2.262 (0.001)
Turnover ratio <sup>b</sup>	0.993 (0.012)	0.944 (0.064)	0.736 (0.172)	0.950 (0.008)	1.058 (0.014)
Sargan test <sup>c</sup> ( <i>p</i> -value)	0.448	0.554	0.649	0.698	0.552
Serial correlation test <sup>d</sup> ( <i>p</i> -value)	0.558	0.752	0.528	0.422	0.507
Wald test for joint significance ( <i>p</i> -value)	0.001	0.002	0.018	0.001	0.001
Countries	40	40	40	40	40
Observations	106	106	106	106	106

*p*-Values in parentheses.

The regressions also includes dummy variables for the different time periods that are not reported.

<sup>a</sup> In the regression, this variable is included as  $\log(1 + \text{variable})$ .

<sup>b</sup> In the regression, this variable is included as  $\log(\text{variable})$ .

<sup>c</sup> The null hypothesis is that the instruments used are not correlated with the residuals.

<sup>d</sup> The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation.

(2000) adjustment to the standard two-step system estimator produces both consistent coefficients and heteroskedasticity consistent standard errors in the Table 7 results. It does this at the cost of reducing the size the instrumental variable matrix. Since the regressions in Table 7 pass the Sargan and serial correlation tests, this adjusted two-step system estimator seems to offer a particularly useful assessment of the stock market, bank and growth relationship.

We also examined the importance of the frequency of the data for our results by using annual data. The system panel estimator using data averaged over five-year periods and the pure cross-country regressions using data averaged over the entire 1975–1998 period produce very consistent results. However, the system panel results using annual data are different. As shown in Table 8, while both financial development indicators enter jointly significantly, only turnover enters individually significantly. The relationship between bank credit and growth breaks

Table 8  
Stock markets, banks and growth, annual data

Regressors	(1)	(2)
Constant	2.728 (0.463)	14.662 (0.326)
Logarithm of initial income per capita	-0.753 (0.006)	-1.066 (0.562)
Bank credit <sup>a</sup>	0.541 (0.437)	-1.64 (0.252)
Turnover ratio <sup>a</sup>	1.261 (0.001)	1.892 (0.001)
Sargan test <sup>b</sup> ( <i>p</i> -value)		0.022
Serial correlation test <sup>c</sup> ( <i>p</i> -value)	0.750	0.727
Wald test for joint significance ( <i>p</i> -value)	0.001	0.001
Countries	40	40
Observations	616	572

*p*-Values in parentheses.

Results in column 1 is from first-stage regression using the system estimator.

Results in column 2 is from regression using the alternative GMM estimator.

The regressions also includes dummy variables for the different time periods that are not reported.

<sup>a</sup> In the regression, this variable is included as log(variable).

<sup>b</sup> The null hypothesis is that the instruments used are not correlated with the residuals.

<sup>c</sup> The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation.

down when moving to annual data.<sup>8</sup> Given recent work, however, this result is not surprising. Loayza and Ranciere (2002) find that short-run surges in bank credit are good predictors of banking crises and slow growth, while high levels of bank credit over the long-run are associated with economic growth. These results emphasize the significance of using sufficiently low-frequency data to abstract from crises and business cycles and focus on economic growth.

<sup>8</sup> These results are not fully consistent with Rousseau and Wachtel's (2000) findings because they find that both bank and stock market development enter individually significantly, not just jointly significantly. Their empirical model differs from ours along several dimensions. First, they use different financial development indicators: M3/GDP to measure financial intermediary development, and stock market capitalization and trading relative to GDP (deflated by market price indices) to proxy for stock market development. In contrast, for reasons discussed above, we use credit to the private sector as a share of GDP to measure bank development, and we use trading relative to market size to measure stock market activity while simultaneously controlling for market price changes. For both of these measures, we carefully deflate the financial variables. Second, our sample period is different. Rousseau and Wachtel (2000) estimate their model over the 1980–1995 period, which does not comprise the East Asian crisis. We are able to extend the sample period back to 1976 and forward to 1998. Overall, although our annual results do not fully confirm Rousseau and Wachtel's (2000) findings, our results using both 5-year averages and data averaged over the entire period are consistent with Rousseau and Wachtel's results. This underlines the importance of controlling for business cycle effects when examining the stock market, bank, and long-run growth nexus.

## 5. Conclusions

In sum, the results strongly reject the notion that overall financial development is unimportant or harmful for economic growth. Using three alternative panel specifications, the data reject the hypothesis that financial development is unrelated to growth. Stock market development and bank development jointly enter all of the system panel growth regressions significantly using alternative conditioning information sets and alternative panel estimators. Thus, after controlling for country-specific effects and potential endogeneity, the data are consistent with theories that emphasize an important positive role for financial development in the process of economic growth.

This paper also assessed the independent impact of both stock market development and bank development on economic growth. In general, we find across different estimation procedures and across different control variables that both stock markets and banks enter the growth regression significantly. For instance, with the traditional two-step system estimator, both stock market liquidity and bank development each enter the growth regressions significantly regardless of the control variables. Similarly, with the Calderon et al. (2000) two-step alternative estimator that reduces the over-fitting problem of the two-step estimator but obtains heteroskedasticity-consistent standard errors, we find that both stock market liquidity and bank development enter all of the growth regressions significantly except for one. These findings suggest that stock markets provide different financial services from banks, or else multicollinearity would produce jointly significant results but would not produce results where stock market and bank indicators each enter the growth regression significantly. However, the one-step system estimator provides a more cautious assessment. In two out of the five specifications, only one financial development indicator enters individually significantly. While we interpret the bulk of the results as suggesting that both markets and banks independently spur economic growth, the one-step results may lead some readers to conclude that overall financial development matters for growth but it is difficult to identify the specific financial institutions associated with economic success.

Econometrically, this paper's techniques improve significantly over existing studies on the link between banks, stock markets and economic growth. By using average values and using instrumental variables to extract the exogenous component of bank and stock market development, we control for biases induced by simultaneity, reverse causation and unobserved country-specific effects, while at the same time avoiding the informational and consistency loss implied by using initial values. Furthermore, this paper's findings suggest that it is important to use alternative specifications of the system panel estimator in drawing inferences. The two-step estimator produces heteroskedasticity-consistent coefficients, but may produce standard errors that are biased downwards in small samples. The one-step estimator produces consistent standard errors, but does not yield heteroskedasticity-consistent coefficients, which is important in economic growth regressions. The Calderon et al. (2000) adjustment to the standard two-step system estimator produces both consistent stan-

dard errors and heteroskedasticity consistent coefficients, but it does this by reducing the information content of the instrumental variable matrix. In small samples, this adjusted measure seems to offer a reasonable compromise, especially if the system passes the Sargan and serial correlation tests.

## Acknowledgements

We thank Norman Loayza and two anonymous referees for helpful comments and Steve Bond for the use of his DPD program. This paper's findings, interpretations, and conclusions are entirely those of the authors and do not necessarily represent the views of the World Bank, its Executive Directors, or the countries they represent.

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