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Equity markets and growth: Cross-country evidence on timing and outcomes, 1980–1995

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Abstract

The rapid expansion of organized equity exchanges in both emerging and developed markets has prompted policymakers to raise important questions about their macroeconomic impact, yet the need to focus on recent data poses implementation difficulties for econometric studies of dynamic interactions between stock markets and economic performance in individual countries. This paper overcomes some of these difficulties by applying recent developments in the analysis of panels with a small time dimension to estimate vector autoregressions for a set of 47 countries with annual data for 1980–1995. After describing recent theories on the role of stock markets in growth and considering a pure cross-sectional empirical approach, our panel VARs show leading roles for stock market liquidity and the intensity of activity in traditional financial intermediaries on per capita output. The findings underscore the potential gains associated with developing deep and liquid financial markets in an increasingly global economy. © 2000 Elsevier Science B.V. All rights reserved.

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1. Introduction

The explosive growth of organized equity exchanges in emerging and developed markets in recent years, especially in light of events in the East Asian economies, has prompted policymakers to raise important questions about their macroeconomic impact. [1] The relative brevity of this global expansion, however, poses implementation difficulties for dynamic studies of the effects of growth in equity markets within individual countries. At the same time, advances in the analysis of panel data have made it possible to explore dynamic links between stock markets and growth in a cross-country framework. This investigation applies one such technique to annual data from 1980 to 1995 (i.e., the eve of the East Asian financial crises) for 47 countries and finds strong support for the notion that deep and liquid equity markets have had a significant and persistent impact on economic performance.

Specifically, we examine the relationship between equity markets and economic growth with panel data vector autoregressions that apply the generalized method of moments techniques developed by Holtz-Eakin et al. (1988) and Arellano and Bond (1991). Our dynamic panels, which are the first to our knowledge to apply VAR estimation with annual data to a cross-country context, allow us to explore the directions of causality between the growth of stock markets and economic outcomes. The size of equity market effects on output are then assessed with the use of impulse response functions. The VARs include measures of activity for traditional intermediaries, such as banks, as well as for organized exchanges in an attempt both to distinguish stock market effects from those attributable to the financial sector generally and to characterize their interactions.

We explore the effects of two aspects of stock market development: the size of the market as indicated by total market capitalization and a combination of size and liquidity in the market as indicated by the volume of trading activity. In both instances, the measures of stock market activity will increase when local share prices increase as a consequence of expected profitability or some other reason. For this reason, and in order to focus on market development, we deflate the measures of market activity for each country with its index of local share prices. To the extent that share prices in an efficient equity market incorporate current information about future economic prospects, this deflation cleanses our measures of market activity of any "forward-looking" component that is directly related to stock prices. Even after applying these adjustments,

[1] Increases in the market value of outstanding equity among exchange-listed companies in 33 emerging markets from $238 billion in 1986 to over $1.8 trillion in 1995 reflect the size of the expansion. Market capitalization also rose from $6.2 trillion to $15.8 trillion in 23 developed markets over the same period (International Finance Corporation, 1998, pp. 16–17).

we find a significant role for stock market development in promoting economic growth. In particular, the results indicate that the liquidity of the market and its interaction with size are more important for growth in per capita incomes than the size of the market alone.

The paper is organized as follows. Section 2 describes channels that have been identified by the theoretical literature through which stock markets can affect economic growth, summarizes the related empirical work, and examines the growth in stock market activity that has characterized the global economy since 1980. Section 3 describes our data and the motivation which underlies our choice of stock market indicators. It then outlines our cross-sectional and dynamic methodologies, discusses the timing questions that can be most effectively addressed with a dynamic approach, and reviews the econometric issues that surround estimation of a panel VAR. Section 4 presents our findings and our conclusions are in Section 5.

2. Finance, stock markets, and economic growth

Growing interest among macroeconomists over the past decade in the role of the financial sector in promoting economic activity has produced a burgeoning literature. [2] In a useful survey, Pagano (1993) lists three theoretical channels of causation that have emerged: first, better screening of fund-seekers and monitoring of recipients can lead to more efficient resource allocations; second, the provision of financial services can encourage the mobilization of otherwise idle resources; and finally, improvements in risk-sharing and reductions in origination costs can enhance savings rates and promote the start of innovative, high-quality projects. Most theoretical models that formally characterize these channels, however, do not distinguish between the equity market and other intermediaries (e.g., Boyd and Prescott, 1986; Greenwood and Jovanovic, 1990; Rousseau, 1998), although the recent treatment of Boyd and Smith (1998) makes some progress in characterizing complementarities which may exist between markets for equity and intermediated debt.

Empirical efforts have also largely taken a broad view of the financial sector. For example, King and Levine (1993) relate the overall depth of the banking sector to economic growth in a cross-section of over eighty countries. More recently, Levine and Zervos (1996, 1998) have extended this

[2] Schumpeter (1911) was among the first to posit links between the financial and real sectors. These ideas were formally developed and expanded in the seminal contributions of Goldsmith (1969), McKinnon (1973) and Shaw (1973), to which the new literature owes much of its underpinnings.

analysis to include stock market development and political factors in a cross-section of about forty countries. [3] In time series studies of industrialized countries over the past century, Wachtel and Rousseau (1995) and Rousseau and Wachtel (1998) present evidence that the dominant causal link runs from the intensity of intermediary activity to economic performance. [4] Other investigations (e.g., Jung, 1986; Demetriades and Hussein, 1996) use coarse measures of financial activity (such as the ratio of the money stock to output) and report mixed causal findings, especially for developing economies.

The focus of earlier work on broad measures of financial sector activity is understandable. Even in the most advanced industrialized countries, equity markets are only a small part of the overall financial markets. Most new investment is funded either internally by firms, through banks and other intermediaries or directly through financial markets. New issuance of stock is never a large fraction of total sources of funds. It is reasonable to ask why the literature places such emphasis on equity markets. [5]

Nevertheless, there are at least four reasons why a stock market is an important financial institution even when equity issuance is a relatively minor source of funds. First, an equity market provides investors and entrepreneurs with a potential exit mechanism. For example, venture capital investments will be more attractive in countries where an equity market exists than one without an adequately functioning public equity market. When the market exists, the venture capital investor knows that it is possible to realize the gains from a successful project when the company makes an initial public offering. The option to exit through a liquid market mechanism makes venture capital investments more attractive and might well increase entrepreneurial activity generally. The impact of the market will be felt well beyond the firms that actually do use the market for raising capital.

Second, capital inflows – both foreign direct investment and portfolio investments – are potentially important sources of investment funds for emerging market and transition economies (see the discussion in International Monetary

[3] These studies use initial conditions and multi-year averages of growth outcomes to identify the influence of market developments, but the pure cross-sectional approach cannot decisively determine the direction of causality. The unresolved causality issue is critical, however, since increases in stock market activity can be a response to economic growth and an increased demand for liquidity.

[4] A limited role for equity markets enters these studies through the use of measures of financial development that include the assets of both bank and non-bank intermediaries, which may hold equities in their portfolios.

[5] Part of the answer is emotional. Pictures of Wall Street and the buzz of activity on the floor of the stock exchange are powerful symbols of the world of finance. The dramatic pictures draw disproportionate attention to the stock market.

Fund, 1997a). International portfolio investments have grown rapidly in recent years as portfolio managers around the world have begun to understand the importance of international diversification. [6] Portfolio flows tend to be larger to countries with organized and liquid markets. Thus, the existence of equity markets facilitates capital inflow and the ability to finance current account deficits. [7]

Third, the provision of liquidity through organized exchanges encourages both international and domestic investors to transfer their surpluses from short-term assets to the long-term capital market, where the funds can provide access to permanent capital for firms to finance large, indivisible projects that enjoy substantive scale economies. Since the $54.1 billion of new equity alone raised by firms traded on emerging stock markets in 1995 was more than double the $22.1 billion in foreign equity portfolio flows to these markets, (International Finance Corporation, 1996, pp. 9–10), the importance of domestic resource mobilization cannot be underestimated.

Finally, the existence of a stock market provides important information that improves the efficiency of financial intermediation generally. For traded companies, the stock market improves the flow of information from management to owners and quickly produces a market evaluation of company developments. As firms increasingly link the compensation of their managers to stock price performance, a deep equity market may also provide managers with incentives to exert more effort in monitoring risky, high-return projects (e.g., Paul, 1992). Finally, the valuation of company assets by the stock market provides benchmarks for the value of business assets, which can be helpful to other businesses and investors, thereby improving the depth and efficiency of company assets generally.

There are arguments to the contrary as well. The higher returns from improved efficiency, the additional liquidity, and the ability to realize capital gains from the stock market might discourage savings because of income effects. Similarly, a stock market can affect perceptions of risk. If risk falls, there might be less precautionary saving and if risk rises, then savings might be discouraged. Although such effects are feasible (e.g., Devereux and Smith, 1994), we are not aware of evidence that relates the existence of equity markets to reductions in the supply of savings. Indeed, the ability of equity markets to provide investors with better opportunities to diversify is usually viewed pos-

[6] Foreign direct investment in emerging markets rose from $11.3 billion in 1985 to a record $90.3 billion in 1995, while portfolio equity flows increased from $0.14 billion in 1985 to $22.1 billion in 1995, which was down from a high of $34.9 billion in 1994 (International Finance Corporation, 1996, p. 6).

[7] Portfolio flows can also be destabilizing since a change in market sentiment can lead to massive outflows which often lead to exchange rate crises (as in Mexico in 1995 and the Czech Republic in 1997).

itively as it may lower the risk premia charged by financiers for funding new projects and thus lower the hurdle rate on new investments.

A few recent theoretical treatments include an explicit role for equity markets in growth. For example, Greenwood and Smith (1997) show that stock markets can emerge to co-exist with banks as the costs of participation fall. Competition for the provision of market services leads participants to perceive the market as efficient and to place their surpluses in equities, which in turn promotes growth through specialization and the delivery of resources to projects with the highest social returns. Bencivenga et al. (1995) show that reductions in transactions costs encourage agents to seek the liquidity offered by organized markets. The ensuing flows to the equity markets promote the start of projects with long gestation periods. In both models, increases in liquidity lead to expansions in trading activity and aggregate equity capital.

In addition to Levine and Zervos (1996, 1998), there have been several other efforts to examine empirically the specific role of equity markets in real sector activity, but these have used fairly small panels and have not focused on dynamics. Atje and Jovanovic (1993), for example, construct a cross-country panel for the 1980s and show that trading volume has a strong influence on growth after controlling for lagged investment while bank credit does not. Interestingly, Harris (1997) applies instrumental variables to a similar specification with current investment and finds that stock markets do not affect growth in the full sample and among less-developed countries. Bonser-Neal and Dewenter (1996) examine the effects of market capitalization and trading volume on savings rates in a ten-year panel of sixteen emerging market economies. Their sample is small and any positive influence of equity markets on savings rates is due to two outliers (Malaysia and Korea) with high saving rates and active equity markets throughout the period. The most complete descriptive investigation to date is Demirgüc-Kunt and Levine (1996) although it does not test specific hypotheses. Clearly, attempts so far to investigate the role of equity markets in economic growth have to date left key issues unresolved.

3. Data and methodology

3.1. Measures of market depth and liquidity

To study timing relationships among equity markets, financial intermediaries and the real sector, we construct a panel data set with annual observations from 1980–1995 for 47 countries. The country coverage and time dimension are based primarily on the availability of data on stock market development in annual issues of the International Finance Corporation's (IFC) *Emerging Stock Markets Factbook*, which tracks market capitalization and total value traded (among other quantities and performance indices) for as many as 84

countries. [8] The *Factbook* publishes these aggregates as year-end totals that have been converted to US dollars using market exchange rates when available and official exchange rates otherwise.

Market capitalization is the product of share price and the number of shares outstanding for all stocks traded on the principal exchange(s) of a given country, and should reflect the importance of financing through equity issues in the capital mobilization and resource allocation processes. Total value traded is the product of market price and the number of shares traded, and as such contains components of both liquidity and size. Increases in liquidity are particularly important in emerging markets since they raise the confidence of both individual and portfolio investors in the values of information and risk diversification associated with trading on an organized exchange. This facilitates the transfer of surpluses from the short to long-term capital market and encourages the inflow of venture capital, which ultimately promote growth in the number of firms and shares available to investors. With its emphasis on liquidity and its interaction with market size, total value traded is a better measure of stock market development than capitalization alone. [9, 10]

General stock price movements are potentially important components in the annual fluctuations of both market capitalization and total value traded and may detract from the usefulness of these quantities as measures of stock market development. For example, consider deflation of market capitalization by a measure of the general price level such as the GDP deflator. In this case, episodes of exuberance in the stock market might raise stock prices and capitalization in "real" terms with no change in market depth. More im-

[8] Country coverage in the *Factbook* is by no means uniform over the 1980–1995 period. For example, market capitalization is available for 47, 55 and 84 markets in 1980, 1987 and 1995, respectively. The IFC tracks nine of the emerging markets from 1976, but we have chosen to limit our study to a period over which fairly continuous data for a broad set of countries is available. Our desire to maintain breadth also precludes the use of monthly or quarterly data from sources other than the IFC since the measures of market development, with which we are primarily concerned, are not available over a sufficient length of time for many of the emerging markets that we consider.

[9] A country with substantial equity ownership and little trading may be similar in terms of financial sector development to a country with privately held firms.

[10] The ratio of total value traded to market capitalization sometimes appears in the cross sectional literature (e.g., Levine and Zervos, 1996, 1998) as a measure of share liquidity or "turnover". When taken as an initial value or averaged over multi-year periods for use as a country characteristic, however, this ratio is correlated with market size (at the 5% level in the cross section which we consider in Section 4.1) and thus captures the same interactions which we attribute to the real per capita value of traded securities. Turnover is a less useful measure of these interactions in dynamic specifications such as ours which difference annual data. This is because changes in the degree of turnover will reflect short-term fluctuations associated with "churning" and the business cycle much more closely than any notion of long-run shifts in the liquidity or size of the equity market.

portantly, such price-related changes would impart a forward-looking component to "real" capitalization that could render any measured effects of market capitalization on economic growth a result of fulfilled expectations previously signaled through prices. For this reason, we purge measures of capitalization and value traded of direct price effects by deflating them with the US dollar-equivalent local share price indices for individual countries prior to performing time series analysis. [11] With this deflation, increases in stock prices which result from greater demand for shares will not be directly reflected in our measures of market capitalization or value traded. While deflation of financial quantities with share prices is particularly important in an investigation with annual data such as ours, these adjustments address the "forward-looking" nature of stock prices more firmly than previous cross-sectional studies of stock markets and growth (e.g., Levine and Zervos, 1998). This is because partial correlations between initial levels of stock market development and subsequent growth in the pure cross section may reflect expectations summarized by high share prices at the start of a given data period.

More traditional intermediaries also play a potentially important role in the placement of resources among firms. For this reason, we believe that any examination of stock market effects on growth should simultaneously consider the impact of growing sophistication in the intermediating sector. Among the measures of intermediary activity that have appeared in the recent literature, broad money (M2) and the stock of liquid liabilities (M3) are the most common, with both quantities usually expressed as ratios to output in order to capture the notion of "financial depth". We choose the more comprehensive M3 measure, which includes currency, demand deposits, all time deposits, and the liabilities of money market mutual funds. M3 is available continuously from the World Bank's (1997) *World Development Indicators* for all of the countries in our sample.

If stock markets are able to mobilize funds that would be otherwise less productive and channel them to innovative, high-quality projects in the long-term capital market, new placements should pay off in the form of additional output. We thus use per capita real gross domestic product from *World Development Indicators* to measure economic performance.

To obtain a sample of countries that is representative of both developed and emerging markets yet does not allow the number of cross-sectional units to

[11] The *Factbook* publishes year-end US dollar-equivalent share price indices for most of the emerging markets. In other cases, we convert year-end local share price indices from either the *Factbook* or the International Monetary Fund's (1997b) *International Financial Statistics* to US dollar terms by multiplying the local index by the year-end market exchange rate (in American terms). We rescale all indices to set $1987 = 1$.

vary too widely over time, we require that a country have data for at least six years to be included in any estimated system. We also eliminate countries with populations of less than 1 million in 1987 and average per capita income of less than $300 (constant 1987 US$) over the sample period. Since economies dominated by resource extraction cannot be expected to perform as predicted by standard growth models, we also eliminate the major oil exporters. This leaves 47 countries as the focus of our study. Table 1 lists these countries along with some key economic indicators.

The remarkable feature of Table 1 is the growth in the ratios of nominal market capitalization and value traded to GDP between 1987 and 1995 (the clear exception is Japan). While to some extent this reflects the increase in market values over this period, it also reflects the deepening of equity markets. Fig. 1 provides a more complete picture of global market deepening by presenting these ratios as equally-weighted annual averages for the entire time period (1980–1995). The figure does indicate that the depth of equity markets is subject to cyclical variation but it is also striking how strong the equity market deepening has been since 1985.

3.2. Empirical methodology

Our investigation of relationships between stock markets, intermediated finance and economic performance includes both cross-sectional and dynamic elements. Use of the cross-sectional regression has become a near-tradition in the empirical analysis of growth and its possible determinants in the years since Barro (1991) isolated key variables, such as education and political stability, as members of a benchmark set of robust correlates. Given that most existing studies of financial factors in growth are extensions of this framework (e.g., King and Levine, 1993; Levine and Zervos, 1996, 1998), we begin by exploring differences in the partial correlations between growth and the ratios of M3, market capitalization, and value traded to output.

We next examine the size and direction of dynamic relationships between financial markets and per capita output with panel data vector autoregressions. This focus on the nature of transition paths stands in contrast to the cross-sectional approach in that it can shed considerable light on whether causality runs from the growth of stock markets to economic outcomes. To estimate the panel VARs, we use an adaptation of the generalized method of moments technique developed by Arellano and Bond (1991). The approach has two attractive features. First, by starting with a specification in real per capita levels and then differencing, we eliminate country specific effects such as differences in taste and technology that by virtue of their almost certain correlation with the included system variables would otherwise contribute to omitted variable

Table 1
Country coverage and selected macroeconomic indicators[a]

	Average per capita GDP (1987 US$)	GDP 1987 mil. US$	M3/GDP % 1987	MCAP/GDP % 1987	MCAP/GDP % 1995	VT/GDP % 1987	VT/GDP % 1995
Argentina	3561	111 106	22.46	1.37	22.53	0.23	2.74
Australia	12 846	208 933	54.96	50.60	73.75	28.17	29.44
Austria	15 473	117 175	87.52	6.33	17.48	8.32	13.85
Belgium	14 144	139 601	49.52	29.64	49.38	5.12	7.17
Brazil	2092	294 084	19.89	5.75	35.45	3.27	19.01
Canada	15 474	412 355	66.57	53.07	60.11	14.83	30.14
Chile	1650	20 682	40.30	25.82	160.81	2.43	24.11
Colombia	1142	36 372	20.57	3.45	27.66	0.22	1.94
Cote D'Ivoire	941	10 088	30.67	4.54	6.64	0.14	0.11
Denmark	19 957	102 321	61.05	19.72	37.96	1.87	17.52
Finland	17 841	88 010	51.96	22.38	36.69	6.87	15.80
France	15 960	887 857	76.83	19.38	39.02	9.92	27.25
Greece	4631	46 311	87.21	9.64	25.46	0.95	9.09
India	337	256 901	46.82	6.64	25.27	2.63	2.73
Indonesia	494	75 743	27.47	0.09	37.54	0.01	8.12
Israel	8825	38 556	68.37	31.13	48.99	12.52	12.32
Italy	13 411	759 066	78.88	15.75	18.66	4.27	7.74
Jamaica	1290	3033	53.25	20.81	25.02	2.41	6.72
Japan	19 806	2 418 192	176.97	115.91	95.27	84.66	31.99
Jordan	2293	6525	109.12	40.51	76.74	6.44	7.65
Kenya	372	7972	42.46	5.32	14.78	NA	0.51
Korea	3279	136 317	43.88	24.14	56.17	18.28	57.17
Malaysia	1911	31 602	124.84	58.64	278.98	12.12	96.22
Mauritius	1822	1881	57.39	NA	36.77	NA	1.93
Mexico	1792	140 157	30.34	5.97	44.93	11.10	17.03
Morocco	830	18 746	52.58	1.90	20.17	0.04	8.22
Netherlands	14 839	217 623	77.92	39.63	104.35	18.17	72.78
New Zealand	11 173	36 903	33.77	42.58	57.94	7.16	15.25

Nigeria	349	27 113	29.02	3.59	4.03	0.03	0.03
Norway	21 825	91 383	58.43	12.93	31.62	9.78	17.32
Pakistan	328	33 353	45.76	5.88	14.72	0.49	5.09
Peru	1182	23 905	20.08	3.48	37.57	1.26	12.54
Philippines	578	3143	8.90	29.29	106.85	4.60	26.73
Portugal	4185	41 820	21.18	28.02	71.88	3.63	6.46
Singapore	7922	20 232	123.21	88.63	288.86	33.88	118.00
South Africa	2370	82 070	45.60	156.77	245.09	11.66	14.90
Spain	7582	292 716	72.76	24.32	43.28	12.32	13.08
Sri Lanka	415	6681	39.29	9.10	16.91	0.17	1.87
Sweden	19221	161 440	51.09	43.71	80.99	12.13	42.39
Switzerland	26 095	170 793	145.67	75.25	180.76	NA	129.62
Thailand	943	50 534	66.77	10.85	103.34	9.17	41.63
Trinidad/Tobago	3978	4798	60.79	8.09	17.76	0.27	2.16
Turkey	1654	87 173	31.18	3.70	14.30	0.13	35.38
United Kingdom	12 094	689 448	72.14	98.73	140.26	56.54	50.83
United States	18 433	4 496 570	70.94	57.58	98.64	53.89	73.48
Venezuela	2672	48 027	49.40	4.74	5.00	0.31	0.70
Zimbabwe	605	5380	54.59	13.35	24.01	0.43	1.77

[a] GDP, liquid liabilities (M3) and population are from the World Bank's *World Development Indicators*. Stock market capitalization (MCAP) and value traded (VT) are from various issues of the International Finance Corporation's *Emerging Stock Markets Factbook*.

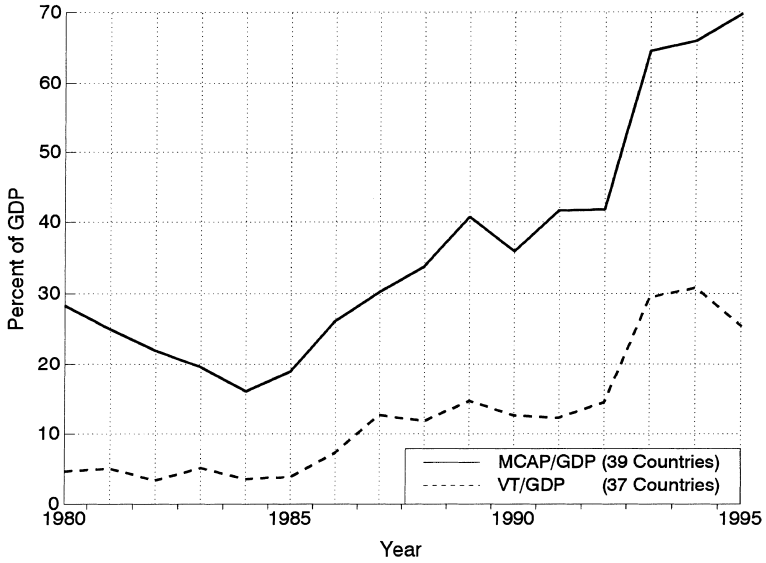

Fig. 1. Average market capitalization (MCAP) and value traded (VT) as percentages of GDP. The averages include only those countries for which data are available for the plotted ratio over the full 1980–1995 period.

bias. [12] Second, by including both liquid liabilities and measures of stock market activity in our specifications, we can capture the explicit effects of organized equity markets beyond those that can be attributed to financial depth more generally. Of course, to the extent that activity in intermediaries and stock exchanges are related, collinearity among the regressors may reduce the apparent impact of equity markets from those indicated in simpler models. Our findings will thus offer conservative estimates of the macroeconomic importance of stock markets.

The VAR systems will include real per capita output as a measure of general economic activity, real per capita M3 as a measure of the intensity of financial intermediation, and one or both measures of per capita equity market activity – market capitalization or value traded – that have been purged of direct price effects. [13] After reporting the directions of timing relationships in our VARs with *F*-tests for block exogeneity, we evaluate the relative size of these effects over time by computing the impulse responses.

[12] An inability to control adequately for such country-specific factors has been cited as a potentially serious shortcoming of standard cross-sectional growth regressions (see Caselli et al., 1996).

[13] We work with the data in per capita levels and first differences rather than logs since the constant elasticity assumptions of the latter imply increasing effects of market development on per capita income as markets deepen, which appears unlikely for more developed economies.

3.3. Estimation issues

In a panel of N countries for T years, our tri-variate vector autoregressions with fixed effects have the form:

$$y_{i,t} = \sum_{j=1}^{k} \alpha_{1,j} y_{i,t-j} + \sum_{j=1}^{k} \beta_{1,j} m_{i,t-j} + \sum_{j=1}^{k} \gamma_{1,j} s_{i,t-j} + \eta_{1,i} + \Phi_{1,t} + \epsilon_{1,i,t}, \tag{1a}$$

$$m_{i,t} = \sum_{j=1}^{k} \alpha_{2,j} y_{i,t-j} + \sum_{j=1}^{k} \beta_{2,j} m_{i,t-j} + \sum_{j=1}^{k} \gamma_{2,j} s_{i,t-j} + \eta_{2,i} + \Phi_{2,t} + \epsilon_{2,i,t}, \tag{1b}$$

$$s_{i,t} = \sum_{j=1}^{k} \alpha_{3,j} y_{i,t-j} + \sum_{j=1}^{k} \beta_{3,j} m_{i,t-j} + \sum_{j=1}^{k} \gamma_{3,j} s_{i,t-j} + \eta_{3,i} + \Phi_{3,t} + \epsilon_{3,i,t}, \tag{1c}$$

where $y_{i,t}$ is output or investment for country i at time t, $m_{i,t}$ is liquid liabilities (M3), $s_{i,t}$ is a measure of stock market development, η_i is a country-specific fixed effect, Φ_t is a time effect, and $\varepsilon_{i,t}$ is a random disturbance whose distribution approximates the normal. The specification of (1a), (1b), and (1c) as a set of projection equations implies that the error terms $\varepsilon_{i,t}$ are orthogonal to the fixed and time effects as well as lagged values of the endogenous variables. We also make the standard assumptions that the errors have positive variance and are uncorrelated across cross-sectional units and time. We choose a fixed effects specification over the alternative of random effects because the η_i are likely to represent omitted country-specific characteristics that are correlated with the other explanatory variables. [14] We include time effects to account for trending behavior in the system variables.

Since the least squares dummy variable (LSDV) estimator is known to produce biased coefficient estimates when applied to equations with lagged values of the dependent variable and fixed effects in a data set with a small time dimension, [15] we first remove the fixed effects by differencing. [16] The first equation of the VAR (1a) becomes

[14] Hsiao (1986) shows that a generalized least squares estimator for the random effects model under an assumption of independence between the effects and the explanatory variables will be biased.

[15] Nickell (1981) derives the bias of the OLS estimator of the coefficient on the lagged dependent variable under these conditions. Judson and Owen (1999) show that this bias can be as much as 20% even as T approaches 30.

[16] Kiviet (1995) suggests a correction for the LSDV estimator that does not require differencing and appears to perform well in Monte Carlo studies with large N and small T, but its requirement of a balanced panel would severely restrict the coverage of our sample.

$$(y_{i,t} - y_{i,t-1}) = \sum_{j=1}^{k} \alpha_{1,j}(y_{i,t-j} - y_{i,t-j-1}) + \sum_{j=1}^{k} \beta_{1,j}(m_{i,t-j} - m_{i,t-j-1}) + \sum_{j=1}^{k} \gamma_{1,j}(s_{i,t-j} - s_{i,t-j-1}) + (\Phi_{1,t} - \Phi_{1,t-1}) + (\epsilon_{1,i,t} - \epsilon_{1,i,t-1}) \tag{2}$$

with the other equations of the system defined similarly. The form of equation (2) makes clear the bias that may result from least squares estimation of the differenced system due to the possible correlation between the lags of the endogenous variables and the errors. Arellano and Bond (1991) propose a linear instrumental variables technique that uses the predetermined lags of the system variables as instruments to exploit a potentially large set of overidentifying restrictions and deliver consistent coefficient estimates. The technique also permits processing of an unbalanced panel. The tri-variate VARs that we actually estimate have the form:

$$\bar{y}_{i,t} = \sum_{j=1}^{k} \alpha_{1,j}\bar{y}_{i,t-j} + \sum_{j=1}^{k} \beta_{1,j}\bar{m}_{i,t-j} + \sum_{j=1}^{k} \gamma_{1,j}\bar{s}_{i,t-j} + \bar{\Phi}_{1,t} + \bar{\epsilon}_{1,i,t}, \tag{3a}$$

$$\bar{m}_{i,t} = \sum_{j=1}^{k} \alpha_{2,j}\bar{y}_{i,t-j} + \sum_{j=1}^{k} \beta_{2,j}\bar{m}_{i,t-j} + \sum_{j=1}^{k} \gamma_{2,j}\bar{s}_{i,t-j} + \bar{\Phi}_{2,t} + \bar{\epsilon}_{2,i,t}, \tag{3b}$$

$$\bar{s}_{i,t} = \sum_{j=1}^{k} \alpha_{3,j}\bar{y}_{i,t-j} + \sum_{j=1}^{k} \beta_{3,j}\bar{m}_{i,t-j} + \sum_{j=1}^{k} \gamma_{3,j}\bar{s}_{i,t-j} + \bar{\Phi}_{3,t} + \bar{\epsilon}_{3,i,t}, \tag{3c}$$

where $\bar{y}$, $\bar{m}$, $\bar{s}$, $\bar{\Phi}$ and $\bar{\epsilon}$ are first differences, and the errors of the transformed equations satisfy the orthogonality conditions

$$E[y_{i,s}\bar{\epsilon}_{i,t}] = E[m_{i,s}\bar{\epsilon}_{i,t}] = E[s_{i,s}\bar{\epsilon}_{i,t}] = 0, \qquad s < (t-1). \tag{4}$$

These conditions imply that under the assumption of serially uncorrelated errors, the vector of instrumental variables available to identify the parameters of equation (3a) has the form

$$z_{i,t} = [y_{i,t-2}, \ldots, y_{i,1}, m_{i,t-2}, \ldots, m_{i,1}, s_{i,t-2}, \ldots, s_{i,1}]. \tag{5}$$

Define Z_i^* as a block diagonal matrix whose sth block is given by (5) for $s = 1, \ldots, T-2$. Then the matrix of instrumental variables for each equation of the VAR is $Z = (Z_1^*, \ldots, Z_N^*)'$. Define X as the $N(T-k-1) \times q$ design matrix stacked by cross-sectional unit with typical row

$$\bar{x}_{i,t} = [\bar{y}_{i,t-1}, \ldots, \bar{y}_{i,t-k}, \bar{m}_{i,t-1}, \ldots, \bar{m}_{i,t-k}, \bar{s}_{i,t-1}, \ldots, \bar{s}_{i,t-k}, \phi_t]. \tag{6}$$

The GMM estimator for the coefficient vector $[\alpha_1, \ldots, \alpha_k, \beta_1, \ldots \beta_k, \gamma_1, \ldots, \gamma_k, \phi_1, \ldots, \phi_T]$ is then

$$\hat{\delta} = (X'ZA_NZ'X)^{-1}X'ZA_NZ'Y, \tag{7}$$

where Y is a $(T - \text{lag} - 1)N \times 1$ vector of the stacked $\bar{y}_i$ dependent variables. We choose A_N to be

$$A_N = \left(\frac{1}{N}\sum_{i=1}^{N} Z_i^{*\prime} H Z_i^*\right)^{-1}, \tag{8}$$

where H is a $T-2$ square matrix with twos in the main diagonals, minus ones in the first subdiagonals, and zeros otherwise. [17] Following the recommendation of Arellano and Bond for handling missing observations, we delete rows of the design matrix with missing values prior to estimation along with the corresponding rows of Z. Remaining missing values in the instrument matrix are then replaced with zeros. The asymptotic variance-covariance matrix of the GMM coefficient vector is

$$\text{avar}(\hat{\delta}) = N(X'ZA_NZ'X)^{-1}(X'ZA_NV_NA_NZ'X)(X'ZA_NZ'X)^{-1}, \tag{9}$$

where $V_N = N^{-1}\Sigma_i Z_i'\bar{\epsilon}_i\bar{\epsilon}_i'Z_i$ and $\bar{\epsilon}$ are the GMM residuals.

In estimating the VARs, we are particularly interested in Granger-causal patterns that may arise among the system variables. To facilitate this analysis, we construct F-tests for block exclusion based on the difference in criterion functions of the restricted and unrestricted models of the form

$$F(r, \text{obs} - q + k) = \frac{[(e_R ZA_N Z' e_R) - (e_U ZA_N Z' e_U)]/k}{e_R' e_R/(\text{obs} - q + k)}, \tag{10}$$

where e_R and e_U are the residuals from the restricted and unrestricted models respectively, r is the number of restrictions, and 'obs' is the number of observations in the panel.

[17] This produces the one-step (GMM1) estimator. A two-step (GMM2) estimator can also be computed that uses the GMM1 residuals to refine H. Monte Carlo evidence, however, suggests that GMM1 in most cases produces less-biased and more efficient estimates than the GMM2 alternative (e.g., Arellano and Bond, 1991; Judson and Owen, 1999).

4. Results and discussion

4.1. Growth in the cross-section

Our cross-sectional specifications model the average growth rate of per capita real GDP over two distinct time periods: 1980–87 and 1988–95. [18] In addition to a standard set of conditioning variables that have been identified in earlier work (see Barro and Sala-i-Martin, 1995), [19] each regression equation includes one of three alternative measures of financial sector development: the ratios to output of nominal liquid liabilities, market capitalization, and total value traded. We attempt to ameliorate the effects of simultaneity between the financial variables and output growth by applying two-stage least squares. [20]

Table 2 presents the regression results. The coefficients on the ratios of liquid liabilities and value traded to GDP are positive and significant when included separately, yet the positive coefficient on the ratio of market capitalization to GDP has a *t*-statistic of only one. This suggests that the liquidity component of value traded may be largely responsible for the observed correlation. In addition, the size of the coefficient on value traded implies a link between equity market activity and growth that is economically important. For example, the mean of the ratio of value traded to GDP over 1988–1995 for our 47 countries is 17.05%. An increase in this ratio by 10 percentage points would imply an increase in annual per capita real output growth of over 0.5 percentage points.

The cross-sectional regressions offer evidence which is *consistent* with a leading role for financial factors in output growth, yet offer limited insights about the dominant causal direction. In particular, even after extracting the pre-determined components of the financial variables with instruments, these components remain highly correlated with the contemporaneous averages from which they are constructed. In addition, countries with high average growth rates over a given time period are likely to be those that previously experienced robust growth. The possibility thus remains that the observed relationships to some extent reflect effects of economic performance on the financial sector. The main results of the paper, which we report in the next section, make a case for

[18] We compute an average when three or more observations are available in a subperiod for a given variable and country. This allows a maximum of two observations per country.

[19] The conditioning set includes the initial logs of per capita real GDP and the secondary school enrollment rate (from *World Development Indicators*) in each subperiod, the average number of revolutions and coups over the 1980s (from Banks, 1994), and the log of one plus the average black market exchange rate premium (from various issues of *Picks Currency Yearbook* prior to 1985 and the *World Currency Yearbook* of International Currency Analysis, Inc. thereafter).

[20] As in Levine and Zervos (1996, 1998), we employ a constant, the initial values of the regressors, the inflation rate, and the ratios of government expenditure and trade (exports plus imports) to GDP as instruments.

Table 2
Cross-sectional instrumental variables regressions[a]

	Dependent variable: Growth of per capita real GDP		
	(1)	(2)	(3)
Constant	0.0281	0.0304	0.0362
	(1.305)	(1.418)	(1.783)
Log of initial real GDP per capita	−0.0077	−0.0064	−0.0081
	(2.511)	(2.216)	(2.897)
Log of initial secondary enrollment rate	0.0109	0.0096	0.0107
	(1.538)	(1.359)	(1.613)
Number of revolutions and coups	−0.0102	−0.0107	−0.0125
	(0.954)	(1.013)	(1.264)
Log of 1 + the black market exchange rate premium	−0.0319	−0.0363	−0.0292
	(1.571)	(1.836)	(1.548)
Ratio liquid liabilities (M3) to GDP	0.0153		
	(1.594)		
Ratio market capitalization to GDP		0.0076	
		(1.059)	
Ratio total value traded to GDP			0.0518
			(2.853)
No. countries	47	47	47
(Observations)	(92)	(92)	(92)

[a] The table reports coefficients from two-stage least squares regressions with t-statistics in parentheses. All data items are eight-year averages covering 1980–1987 and 1988–1995. Initial values are from 1980 and 1988. Instruments include the initial values of all regressors, the inflation rate, and the ratios of M3, market capitalization, value traded, government expenditure and international trade (exports plus imports) to GDP.

finance-led growth and the particular importance of liquidity in this process by adding a time series dimension to the analysis and exploring the dynamic transitions that underlie these partial correlations.

4.2. Selection and estimation of panel VARs

The first set of VARs include real per capita measures of output (GDP) and liquid liabilities (M3), [21] and share price-adjusted measures of either per capita

[21] *World Development Indicators* includes GDP and year-end measures of M3 and population for the 47 countries in our sample. Output is available in constant 1987 US dollars, while M3 was deflated with the year-end implicit price deflator for gross domestic product from *International Financial Statistics*.

Table 3
Panel GMM estimates of VAR systems with per capita real output, liquid liabilities (M3) and share price-adjusted market capitalization or total value traded[a]

	GDP	M3	MCAP	GDP	M3	VT
GDP_{-1}	1.2968**	0.1483*	0.1302	1.2584**	0.1902**	−0.2982*
	(0.0488)	(0.1033)	(0.2429)	(0.0591)	(0.1060)	(0.2270)
GDP_{-2}	−0.4529**	−0.1153	−0.0555	−0.4252**	−0.1665**	0.3198**
	(0.0541)	(0.0977)	(0.1474)	(0.0659)	(0.0992)	(0.1843)
$M3_{-1}$	0.0502*	0.9948**	0.2075**	−0.0002	0.9465**	0.0864
	(0.0360)	(0.0951)	(0.0594)	(0.0276)	(0.0924)	(0.0822)
$M3_{-2}$	−0.0151	−0.1488*	−0.0569	0.0384**	−0.0372	−0.1188
	(0.0345)	(0.1026)	(0.0492)	(0.0230)	(0.0956)	(0.1190)
$STOCK_{-1}$	0.0433**	0.0453**	0.7049**	0.0494**	0.1312**	0.6946**
	(0.0159)	(0.0254)	(0.0413)	(0.0109)	(0.0434)	(0.0672)
$STOCK_{-2}$	−0.0354**	0.0710	−0.1669**	−0.0017	−0.0939**	−0.1629**
	(0.0187)	(0.0719)	(0.0360)	(0.0098)	(0.0504)	(0.0547)
No. countries	47	47	47	47	47	47
(observations)	(550)	(546)	(551)	(531)	(527)	(532)
Significance levels						
F-GDP	NA	0.664	0.625	NA	0.447	0.375
F-M3	0.006	NA	0.000	0.004	NA	0.463
F-STOCK	0.086	0.135	NA	0.000	0.003	NA
Sargan test	0.953	0.995	0.999	0.971	0.996	0.954

[a] The table presents linear GMM estimates of tri-variate panel VARs that use two lags of the system variables, with robust asymptotic standard errors in parentheses. Year dummies are included in the equations but not reported. The system in the left panel includes market capitalization (MCAP) as the STOCK market measure, while the right panel includes total value traded (VT). The columns of each panel correspond to Eqs. (3a), (3b), and (3c) in the text. GDP and M3 are in per capita 1987 US dollars. MCAP and VT are per capita US dollars that have been adjusted by US dollar-equivalent local share price indices. The significance levels of *F*-statistics for the exclusion of GDP, M3 and the stock market measures are reported in the lower part of the table with the significance levels of Sargan tests of the overidentifying restrictions.

* Significance of the individual coefficients at the 10% level.

** Significance of the individual coefficients at the 5% level.

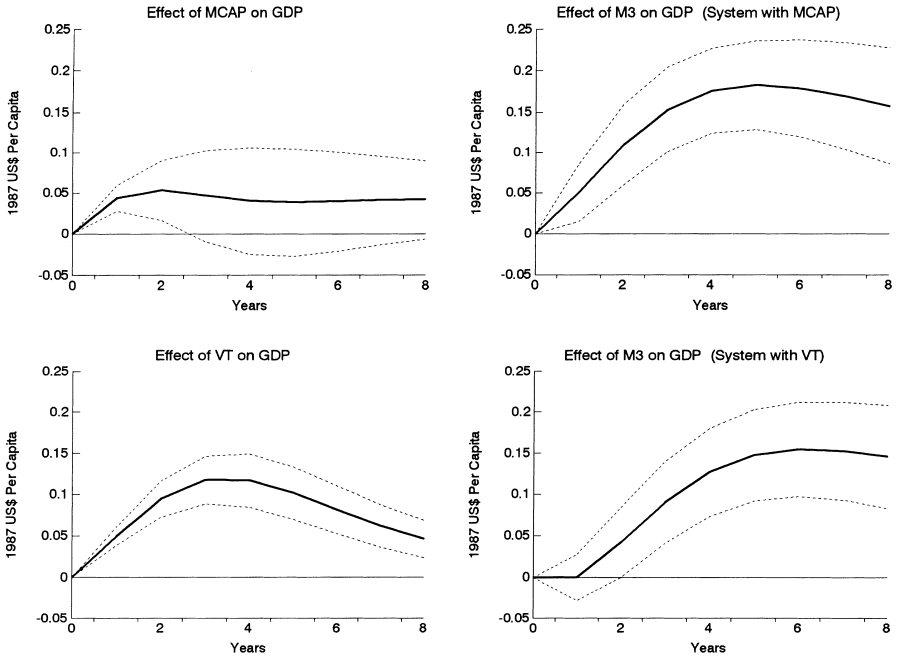

Fig. 2. Upper plots show the per capita response of GDP to $1 increases (1987 US) in real liquid liabilities (M3) and share price-adjusted market capitalization (MCAP). Lower plots use value traded (VT) instead of MCAP. Using the Monte Carlo integration technique described in Doan (1995), the thick solid lines show the mean impulse responses that result from 2500 random draws from the estimated distribution of the coefficients in each system, and the dotted lines are one standard error bands. The multiplier responses can be interpreted as permanent movements in the level of per capita real output over an eight-year horizon.

market capitalization (MCAP) or value traded (VT). Applying a share price deflator to market capitalization (as described in Section 3.2) purges this measure of its direct price component to yield a reasonable representation of market size. Deflating the value traded measure similarly facilitates a comparison of the importance of market size against liquidity and its interaction with size.

Table 3 reports coefficient estimates and test statistics for these systems, which include two lags of each variable as selected with the nested likelihood ratio tests described in Holtz-Eakin et al. (1988). In the left panel, the coefficients on M3 and MCAP have positive sums in the output equation and the *F*-tests indicate a leading role at the one percent level for M3 and at the ten percent level for MCAP. There is no evidence of feedback from GDP to the financial variables. The Sargan general specification tests do not reject the validity of the instrument set. The findings suggest a critical role for

Table 4
Summary of panel GMM estimates for VAR with per capita real output, liquid liabilities (M3), and share price-adjusted measures of market capitalization and value traded[a]

	GDP	M3	MCAP	VT
GDP	0.8506	0.0282	0.0959	0.0571
	(NA)	(0.350)	(0.505)	(0.306)
M3	0.0341	0.8965	0.1353	−0.0383
	(0.021)	(NA)	(0.001)	(0.519)
MCAP	−0.0104	0.0756	0.5114	−0.0554
	(0.355)	(0.186)	(NA)	(0.435)
VT	0.0487	0.0278	0.0825	0.5417
	(0.001)	(0.002)	(0.047)	(NA)
No. obs.	531	527	532	532
(Sargan)	(0.997)	(0.999)	(0.999)	(0.999)

[a] The table reports the sum of the GMM coefficients for two lags of each system variable in a four-variable VAR, with the significance level of the *F*-test for block exclusion in parentheses. The column labels identify the dependent variable in each equation of the VAR. Year dummies are included in the equations but are not reported. GDP and M3 are in per capita 1987 US dollars. MCAP and VT are per capita US dollars that have been adjusted by the US dollar-equivalent local share price index. The final row of each panel reports the number of observations used in estimating each equation with the tail probability of the Sargan test of the overidentifying restrictions in parentheses.

intermediaries and a less important role for stock market size in per capita incomes.

The results in the right panel of Table 3, which use value traded as the measure of equity market development, are more striking. Here both M3 and VT enter the output equation with positive coefficient sums and *F*-tests for Granger-causality that are significant at the one percent level. There is again no feedback from GDP to the financial variables and no indication of misspecification in any of the equations. These findings offer strong support for the belief that liquidity rather than size is the key channel through which stock markets enhance growth.

Fig. 2 presents impulse response functions with one standard error bands and an eight-year horizon for the above systems that further support these interpretations. Both stock market measures affect output positively, but the impact of VT is larger and more persistent than that of MCAP. M3 affects output strongly and positively in both systems over the full eight-year horizon.

The cumulative responses implied by Fig. 2 for per capita real GDP over a five-year horizon are also economically important. For example, the average level of per capita real output in 1987 for the countries in our sample is $7021. In the system with VT (right panel of Table 3), an increase in VT that raises its share in output by one percentage point from its mean of 10.72% would raise real output per head after five years by $33.70, or 0.48%. Under constant growth, this would imply a 0.1% increase in the annual growth rate of per

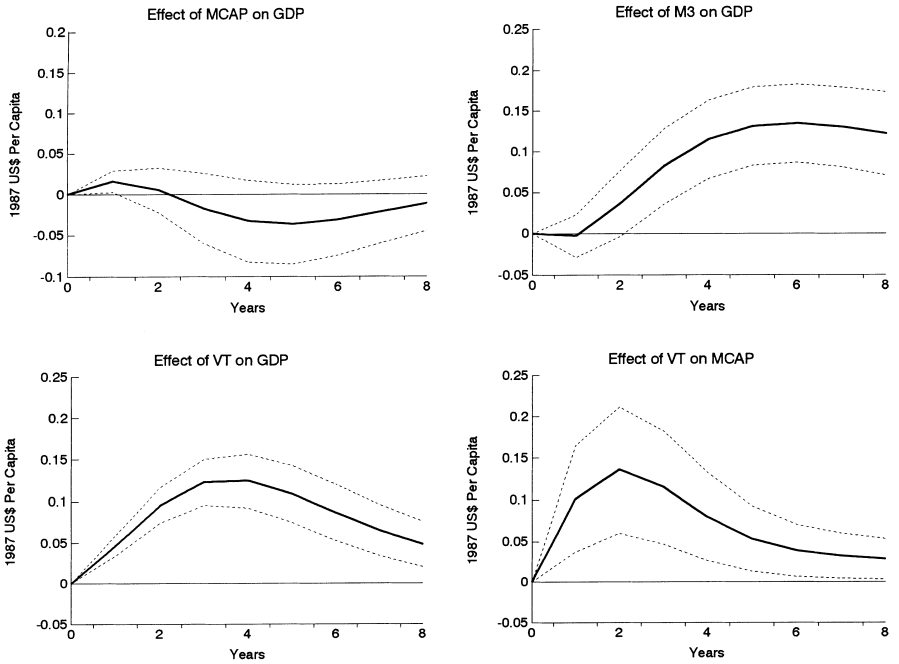

Fig. 3. Selected responses in four-variable system to $1 increases (1987 US) in real liquid liabilities (M3) and share price-adjusted market capitalization (MCAP) and value traded (VT). See note to Fig. 2 for details on construction and interpretation.

capita income. In the same system, an increase in M3 that raises its share in output by one percentage point from its 1987 mean of 29.1% would raise output per head over five years by $28.79 (0.41%), which implies an increase in annual output growth of about 0.08%. When market capitalization serves as the measure of market development (left panel of Table 3), a similar one percentage point increase in its share in GDP from its 1987 mean of 56.73% raises output per head by only $15.44 (0.22%), which corresponds to an increase in annual output growth of only about 0.04%. Thus, the tri-variate systems suggest a joint role for liquidity and size in economic growth that is more than twice as large as that attributable to market capitalization alone. We also observe that the growth implications of market liquidity in the dynamic regressions are larger, but on the same order of magnitude, as those obtained in the cross section.

The dominance of the liquidity component of value traded and the potential importance of its interaction with market size are even more apparent when both stock measures are included in the same VAR. Table 4 summarizes results from such a four-variable specification. Here, M3 and VT continue to Granger-cause output at the five percent level or less, but MCAP is no longer significant.

Table 5
Panel GMM estimates of VAR systems with per capita real output, liquid liabilities (M3) and unadjusted market capitalization or total value traded[a]

	GDP	M3	MCAP	GDP	M3	VT
GDP_{-1}	1.2654**	0.1382	−0.4489	1.2441**	0.1691*	−0.0994
	(0.0525)	(0.1248)	(0.7145)	(0.0615)	(0.1119)	(0.3118)
GDP_{-2}	−0.4270**	−0.1051	0.4640	−0.4082**	−0.1431*	0.3563*
	(0.0503)	(0.1005)	(0.4284)	(0.0628)	(0.1002)	(0.2413)
$M3_{-1}$	0.0443	0.9925**	−0.0019	−0.0003	0.9451**	−0.0766
	(0.0382)	(0.0896)	(0.1428)	(0.0285)	(0.0903)	(0.0665)
$M3_{-2}$	−0.0148	−0.1271*	0.0689	0.0311*	−0.0449	0.0011
	(0.0344)	(0.0924)	(0.0878)	(0.0232)	(0.0948)	(0.0956)
$STOCK_{-1}$	0.0294**	0.0326**	0.9344**	0.0324**	0.0658**	0.9292**
	(0.0077)	(0.0181)	(0.0563)	(0.0052)	(0.0283)	(0.1320)
$STOCK_{-2}$	−0.0177**	−0.0106	−0.0862	0.0007	−0.0428**	−0.2824**
	(0.0101)	(0.0200)	(0.1046)	(0.0054)	(0.0250)	(0.1086)
No. countries	47	47	47	47	47	47
(observations)	(573)	(569)	(574)	(551)	(547)	(552)
Significance levels						
F-GDP	NA	0.699	0.615	NA	0.534	0.262
F-M3	0.017	NA	0.808	0.030	NA	0.646
F-STOCK	0.000	0.220	NA	0.000	0.019	NA
Sargan test	0.972	0.991	0.664	0.950	0.989	0.836

[a] See note to Table 3. All quantities have been deflated with the year-end GDP deflator to reflect per capita 1987 US dollars (i.e., MCAP and VT are NOT adjusted with the US dollar-equivalent local share prices indices).

In addition, VT is significant at the five percent level in the equation with MCAP as the dependent variable. This suggests that greater liquidity encourages firms to issue new or additional public equity securities, and lends support to the liquidity channel outlined in Bencivenga et al. (1995).

Fig. 3 presents selected impulse responses for the four-variable system in Table 4. The roles of VT and M3 in per capita output are unaffected by the addition of MCAP to the system. The plot in the lower right of Fig. 3 also indicates a clear leading role for liquidity in promoting new equity issues and listings. The cumulative responses suggest that per capita income rises by \$34.92 (0.5%) and \$25.34 (0.36%) from its 1987 average over a five-year horizon when shocks to VT and M3 increase their respective shares in GDP by one percentage point. In addition, a one percent increase in VT from its 1987 average raises MCAP over five years by nearly 0.5%.

Table 5 reports estimates from tri-variate VAR systems in which MCAP and VT are adjusted with the implicit price deflator rather than share prices. The finding that both stock market indicators now Granger-cause output at less than the one percent level highlights the importance of correcting the stock market quantities for annual share price variations. In fact, failing to make the adjustments yields estimates that suggest an inordinately large role for market size, since it appears to be the common price component of MCAP and VT that now renders MCAP highly significant.

5. Conclusion

Stock markets can promote economic performance by (1) providing an exit mechanism to venture capitalists, (2) offering liquidity to investors that encourages international diversification and portfolio flows, (3) providing firms with access to permanent capital which can then be placed in large, indivisible projects, and (4) generating information about the quality of potential investments. Our panel VARs, which include share price-adjusted measures of per capita market capitalization and value traded in addition to real per capita liquid liabilities (M3), indicate that these channels are very plausible, and highlight the importance of liquidity in stimulating market development and growth in per capita incomes. Specifically, increases in both the intensity of activity in traditional intermediaries and the market value of equity traded on organized exchanges have a strong effect on output, while the effects of market capitalization are weaker.

Our study does not encompass the financial crises experienced by the East Asian economies in 1997, as more thorough information about the cycle of contraction, recovery and aftermath of these events can become available only with the passage of time. For now, however, our results indicate that stock exchanges have been key institutions in promoting economic activity in recent

years, and suggest that the occasional setbacks that appear to be consequences of rapid market development are perhaps best viewed in light of the more optimistic longer-term role for stock markets posited here.

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References

Arellano, M., Bond, S., 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment fluctuations. Review of Economic Studies 58, 277–297.

Atje, R., Jovanovic, B., 1993. Stock markets and development. European Economic Review 37, 632–640.

Banks, A.S., 1994. Cross-national time-series data archive. Center for Social Analysis, State University of New York at Binghamton, Binghamton, NY.

Barro, R.J., 1991. Economic growth in a cross section of countries. Quarterly Journal of Economics 56, 407–443.

Barro, R.J., Sala-i-Martin, X., 1995. Economic Growth. McGraw Hill, New York.

Bencivenga, V.R., Smith, B.D., Starr, R.M., 1995. Transactions costs, technological choice, and endogenous growth. Journal of Economic Theory 67, 153–177.

Bonser-Neal, C., Dewenter, K., 1996. Does financial market development stimulate savings? Evidence from emerging markets. Working Paper 96-09, Federal Reserve Bank of Kansas City.

Boyd, J.H., Prescott, E.C., 1986. Financial intermediary-coalitions. Journal of Economic Theory 38, 211–232.

Boyd, J.H., Smith, B.D., 1998. The evolution of debt and equity markets in economic development. Economic Theory 12, 519–560.

Caselli, F., Esquivel, G., Lefort, F., 1996. Reopening the convergence debate: A new look at cross-country growth empirics. Journal of Economic Growth 1, 363–389.

Demetriades, P.O., Hussein, K.A., 1996. Does financial development cause economic growth? Time series evidence from 16 countries. Journal of Development Economics 51, 387–411.

Demirgüc-Kunt, A., Levine, R., 1996. Stock market development and financial intermediaries: Stylized facts. World Bank Economic Review 10, 291–321.

Devereux, M.B., Smith, G.W., 1994. International risk sharing and economic growth. International Economic Review 35, 535–550.

Doan, T.A., 1995. RATS Users Manual, Version 4. Estima, Evanston, IL.

Goldsmith, R.W., 1969. Financial Structure and Development. Yale University Press, New Haven, CT.

Greenwood, J., Jovanovic, B., 1990. Financial development, growth, and the distribution of income. Journal of Political Economy 98, 1076–1107.

Greenwood, J., Smith, B.D., 1997. Financial markets in development, and the development of financial markets. Journal of Economic Dynamics and Control 21, 145–181.

Harris, R.D.F., 1997. Stock markets and development: A re-assessment. European Economic Review 41, 139–146.

Holtz-Eakin, D., Newey, W., Rosen, H.S., 1988. Estimating vector autoregressions with panel data. Econometrica 56, 1371–1395.

Hsiao, C., 1986. The Analysis of Panel Data. Cambridge University Press, Cambridge.

International Finance Corporation. Emerging Stock Markets Factbook. International Finance Corporation, Washington, DC, various issues.

International Monetary Fund, 1997a. Globalization: Opportunities and challenges. World Economic Outlook (May).

International Monetary Fund, 1997b. International Financial Statistics. International Monetary Fund, Washington, DC.

Judson, R.A., Owen, A.L., 1999. Estimating dynamic panel data models: A guide for macroeconomists. Economics Letters 65, 9–15.

Jung, W.S., 1986. Financial development and economic growth: International evidence. Economic Development and Cultural Change 34, 333–346.

King, R.G., Levine, R., 1993. Finance and growth: Schumpeter might be right. Quarterly Journal of Economics 108, 717–737.

Kiviet, J.F., 1995. On bias, inconsistency, and inefficiency of various estimators in panel data models. Journal of Econometrics 68, 53–78.

Levine, R., Zervos, S., 1996. Stock market development and long-run growth. World Bank Economic Review 10, 323–339.

Levine, R., Zervos, S., 1998. Stock markets, banks, and economic growth. American Economic Review 88, 537–558.

McKinnon, R.I., 1973. Money and Capital in Economic Development. Brookings Institution, Washington, DC.

Nickell, S., 1981. Biases in dynamic models with fixed effects. Econometrica 49, 1417–1426.

Pagano, M., 1993. Financial markets and growth: An overview. European Economic Review 37, 613–622.

Paul, J.M., 1992. On the efficiency of stock-based compensation. Review of Financial Studies 5, 471–502.

Picks Currency Yearbook. Picks Publishing Corporation, New York, various issues.

Rousseau, P.L., 1998. The permanent effects of innovation on financial depth: Theory and US historical evidence from unobservable components models. Journal of Monetary Economics 42, 387–425.

Rousseau, P.L., Wachtel, P., 1998. Financial intermediation and economic performance: Historical evidence from five industrialized countries. Journal of Money, Credit and Banking 30, 657–678.

Schumpeter, J., 1911. The Theory of Economic Development. Harvard University Press, Cambridge, MA.

Shaw, E.S., 1973. Financial Deepening in Economic Development. Oxford University Press, New York.

Wachtel, P., Rousseau, P.L., 1995. Financial intermediation and economic growth: A historical comparison of the United States, United Kingdom, and Canada. In: Bordo, M.D., Sylla, R. (Eds.), Anglo-American Financial Systems: Institutions and Markets in the Twentieth Century. Business One Irwin, Burr Ridge, IL, pp. 329–381.

World Bank, 1997. World Development Indicators. World Bank, Washington, DC.

World Currency Yearbook. International Currency Analysis Inc., New York, various issues.