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STOCK MARKET DEVELOPMENT AND ECONOMIC GROWTH: THE CAUSAL LINKAGE

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This paper addresses the question: does stock market development cause growth? It examines the causal linkage between stock market development, financial development and economic growth. The argument is that any inference that financial liberalisation causes savings or investment or growth, or that financial intermediation causes growth, drawn from bivariate causality tests may be invalid, as invalid causality inferences can result from omitting an important variable. The empirical part of this study exploits techniques recently developed by Toda and Yamamoto (1995) to test for causality in VARs, and emphasises the possibility of omitted variable bias. The evidence obtained from a sample of seven countries suggests that a well-developed stock market can foster economic growth in the long run. It also provides support to theories according to which well-functioning stock markets can promote economic development by fuelling the engine of growth through faster capital accumulation, and by tuning it through better resource allocation.

Keywords: Financial Development, Economic Growth, Stock Market, Causality Testing, VARs, Incomplete Systems
JEL classification: C12, C32, O16

1. INTRODUCTION

The idea that financial markets may be related with real activities is not new, but the view of this relationship has changed over time. The main function of money or capital was to trade in credit for the purpose of financing development before the Great Depression. Gurley and Shaw (1955) were the first to study the relationship between financial markets and real activity. They argued that one of the differences between developed and developing countries is that the financial system is more developed in the former. The argument was that financial markets could extend a borrower's financial capacity and improve the efficiency of trade. With well-developed financial markets investors can be provided with the necessary funds for their projects. They concluded

that financial markets contribute to economic development through enhancing physical capital accumulation. Much of the literature on the relationship between financial markets and real output suffered a lack of evidence until the 1970s when studies by Goldsmith (1969), Shaw (1973) and McKinnon (1973) found that development of financial markets was significantly correlated with the level of per capita income.

However, the theoretical literature offers conflicting predictions about the role of stock markets and banks in promoting economic growth. The literature on financial liberalisation has emphasised abolishing interest rate ceilings and encourages free competition among banks as the way forward to achieve economic growth. However, it has largely overlooked the possibility that endogenous constraints in the credit market, such as imperfect information, could be a significant obstacle to efficient credit allocation even when assuming that banks are free from interest rate ceilings. Stiglitz and Weiss (1981) were the first to consider the importance of banks in allocating credit efficiently, particularly to new and innovative investments. In LDCs as in developed countries banks will normally either avoid lending to new innovative and productive borrowers simply because of the high risk of default associated with new borrowers, or charge a risk premium on the lending rate. A high risk premium would only encourage the riskier borrowers, as the higher the risk the higher the expected return from investment. The expected return of the borrowers is an increasing function of the riskiness of their projects, the higher the risk the higher the return. This fact would discourage less risky investments from taking place, although they could be more productive (selection effect). Safe borrowers, which deal with banks only, will be left with no other choice. At times of high interest rates, investors would favour investments with a high probability of default (incentive effect). Reducing opportunities to innovate will have a negative impact on economic growth in the long run. However, the literature has emphasised the role of the banking sector as the only organised capital market in most developing countries. It has neglected the potential role of stock markets for efficient capital allocation and risk sharing in a liberalised financial market.

King and Levine (1993) use different measures of bank development for several countries, find that banking sector development can spur economic growth in the long run. Boyd and Prescott (1986) and Stiglitz (1985) argue that banking sector development can play an important role in promoting economic growth, as banks are better than stock markets when it comes to resource allocation. Arestis *et al*. (2001) show that while both banks and stock markets play an important role in the growth process, the banking sector development effect on economic growth in the long run is much higher than the stock market development one. More recently, the emphasis has increasingly shifted to stock market indicators and the effect of stock markets on economic development. Stock market development has been the subject of intensive theoretical and empirical studies (see Demirguc-Kunt and Levine (1995), Levine and Zervos (1993, 1995, 1998)). In principle a well-developed stock market should increase saving and efficiently allocate capital to productive investments, which leads to an increase in the rate of economic growth. Stock markets contribute to the mobilisation of domestic savings by enhancing

the set of financial instruments available to savers to diversify their portfolios. In doing so they provide an important source of investment capital at relatively low cost (Dailami and Aktin (1990)). In a well-developed stock market share ownership provides individuals with a relatively liquid means of sharing risk when investing in promising projects. Stock markets help investors to cope with liquidity risk by allowing those who are hit by a liquidity shock to sell their shares to other investors who do not suffer from a liquidity shock. The result is that capital is not prematurely removed from firms to meet short-term liquidity needs. Moreover, stock markets play a key role in allocating capital to the corporate sector, which will have a real effect on the economy on aggregate. Debt finance is likely to be unavailable in many countries, particularly in developing countries, where bank loans may be limited to a selected group of companies and individual investors. This limitation can also reflect constraints in credit markets (Mirakhor and Villanueva (1990)) arising from the possibility that a bank's return from lending to a specific group of borrowers does not increase as the interest rate it charges to borrowers rises (Stiglitz and Weiss (1981) and Cho (1986)). McKinnon (1988) suggests that stock market development should have priority even over liberalised bank lending in the first several years of transition to a capitalist financial market where the preceding order has created a large bad debt problem for banks. From a monetary growth prospective a well-developed stock market provides a means for the exercise of monetary policy through the issue and repurchase of government securities in a liquid market. This is an important step in financial liberalisation. In addition, well-developed and active stock markets alter the pattern of demand for money, and booming stock markets create liquidity, and hence spur economic growth.

The arguments for stock market development were supported by various empirical studies, such as Levine and Zervos (1993), Atje and Jovanovic (1993), Levine and Zervos (1998). Although these studies emphasise the importance of stock market development in the growth process, they do not simultaneously examine banking sector development, stock market development, and economic growth in a unified framework. On the other hand, Rousseau and Wachtel (2000) and Beck and Levine (2003) show that stock market development is strongly correlated with growth rates of real GDP per capita. More importantly, they found that stock market liquidity and banking development both predict the future growth rate of economy when they both enter the growth regression. Nevertheless, these studies suffer from various statistical weaknesses.

To resolve them this paper uses VAR procedures developed by Toda and Yamamoto (1995) to examine the linkage between stock market development, bank development and economic growth. The remainder of the paper is organised as follows. Section 2 reviews the existing literature on finance and economic growth, paying particular attention to the empirical methods and what we think are some of the shortcomings. Section 3 outlines the Toda and Yamamoto (1995) approach to causality testing which we adopt for the empirical analysis. Section 4 presents the empirical evidence. Section 5 offers some concluding remarks.

2. FINANCIAL DEVELOPMENT, STOCK MARKET, AND ECONOMIC GROWTH

The most efficient allocation of capital is achieved by liberalising financial markets and letting the market allocate the capital. But if the financial market is composed of banks only, the market will fail to achieve efficient allocation of capital because of the shortcoming of debt finance in the presence of asymmetric information. Thus, the development of stock markets is necessary to achieve full efficiency of capital allocation if the government is to liberalise the financial system. While banks finance only well-established, safe borrowers, stock markets can finance risky, productive and innovative investment projects. The primary benefit of a stock market is that it constitutes a liquid trading and price determining mechanism for a diverse range of financial instruments. This allows risk spreading by capital raisers and investors and matching of the maturity preferences of capital raisers (generally long-term) and investors (short-term). This in turn stimulates investment and lowers the cost of capital, contributing in the long term to economic growth.

The argument here is that if economic growth is a function of stock market development (for example), and so too is financial development, then it is at least a plausible hypothesis that stock markets cause both financial development and economic growth, with implications which may be summarised as follows.

Let x and y denote financial development and economic growth respectively and assume that previous bivariate tests indicate some causal relationship between them. Imagine now a third variable w (say GDP for the moment) which was omitted from the model used as the basis for previous tests but which could be causally related to x and y in a number of ways. If w does not cause either x or y, there is no problem and the previously drawn inferences are valid. Difficulties begin, however, if w causes either x or y, or both (see Caporale and Pittis (1997)). In these circumstances, then:

1. if w affects both x and y, inference on causality between x and y is invalid in both directions;

2. if w affects x only (or y only), causality inference is invalid in one direction, y causing x (or x causing y).

This framework could be used to analyse causal links between financial development, economic growth, and stock markets (as the potential omitted variable, w). The results obtained in the earlier bivariate framework (financial development and economic growth only) should change if the third variable is 'relevant' and case (1) or (2) hold. The essential condition for inference to be invariant to model selection is that the omitted variable should not cause either financial development or economic growth (see Caporale and Pittis (1997)). If it is caused by either of the two, but does not cause them, then inference in the bivariate or trivariate system is equivalent. If, however, the stock

market is an omitted variable in the causal nexus, then, depending upon the precise details of that nexus, inferences drawn from bivariate tests may be invalid. Furthermore, even in those cases where inference is not rendered invalid, the two variable model will have less desirable forecasting properties. In this paper, therefore, we carry out a series of trivariate causality tests to examine the possibility that the existing evidence that financial development causes economic growth is dependent upon an omitted variable. In the tests that follow, however, the third variable is the stock market.

This follows the work by Levine and Zervos (1993), Atje and Jovanovic (1993), Levine and Zervos (1998), Rousseau and Wachtel (2000) and Beck and Levine (2003) which shows that stock market development is strongly correlated with growth rates of real GDP per capita. More importantly, they found that stock market liquidity and banking development both predict the future growth rate of the economy when they both enter the growth regression. They concluded that stock markets provide different services from those provided by banks. This is also consistent with the work by Levine and Zervos (1995) and the argument by Demirguc-Kunt (1994) that stock markets can give a big boost to economic development.

In the light of this evidence, we have theoretical and empirical reasons to believe that stock markets, w, could affect both financial development, x, and economic growth, y. If that is the case, then causality tests on the linkages between financial development and economic growth performed in a bivariate context are invalid. If causality runs from stock market to economic growth only, then bivariate inference on financial development affecting economic growth is invalid (though causality tests on the latter affecting the former are valid). Therefore, in this paper we examine the causal linkage between all three variables: stock market development, financial development and economic growth.

Some earlier studies have examined the relationship between growth and stock markets, and the banking sector, using either cross-country or panel methods. However, their empirical approach typically suffers from serious econometric weaknesses. For instance, the OLS regressions estimated by Levine and Zervos (1998) are potentially affected by simultaneity bias, and do not control for country fixed effects. Beck et al (2000) tried to control for simultaneity bias by using instrumental variable procedures, but did not include a measure of stock market development in their analysis, as this was available only for a much smaller group of countries than the ones they considered. Rousseau and Wachtel (2000) improved upon earlier contributions by using the difference panel estimator introduced by Arellano and Bond (1991), which removes both the bias resulting from unobserved country effects and simultaneity bias. However, as shown by Alonso-Borrego and Arellano (1999), this estimator suffers from finite sample bias and is not very accurate asymptotically. The latest contribution to this type of literature is due to Beck and Levine (2003), who apply more recent generalised-method-of-moments techniques for dynamic panels in an attempt to resolve the statistical weaknesses of previous studies. Specifically, they construct five-year averages to filter cyclical fluctuations, and use three different versions of the system panel

estimator developed by Arellano and Bover (1995), that has been shown to have a superior performance in terms of both consistency and efficiency. All three variants, though, still give rise to some problems. In particular, the one-step estimator requires the errors to be homoscedastic, which is not an empirically supported assumption; the two-step estimator is based on heteroscedasticity-consistent standard errors, but its finite sample performance is likely to be affected by over-fitting, with the empirical critical values of the corresponding test statistic being very different from the asymptotic ones; finally, the modified estimator introduced by Calderon *et al*. (2000) attenuates the over-fitting problem, but implies the loss of an observation. It is not entirely surprising, therefore, that the empirical results produced by these estimators are not always consistent. Consequently, Beck and Levine (2003) are not able to identify independent contributions of stock markets and banks to economic growth, although their analysis does suggest that financial development as a whole is beneficial to growth.

Finally, Bekaert *et al*. (2003) use an instrumental variable estimator which reduces to pooled OLS under simplifying assumptions on the weighting matrix. They focus on financial liberalisation, arguing that this is not just another aspect of more general financial (banking and stock market) development, and conclude that equity market liberalisation leads to a one percent increase in annual real economic growth over a five-year period in a broad cross-section of developed and emerging countries. However, once again there are some econometric difficulties arising from their panel approach. For instance, the results depend to some extent on the weighting matrix, whose appropriate definition is not the same if one assumes heteroscedasticity across countries and time, group-wise heteroscedasticity, overlapping observations etc. Also, the choice of interval, and more generally omitted variable bias (see Mankiw (1995)) can affect their results. Even more importantly, this type of regression, despite being predictive, is informative about association, rather than causality.

In contrast to cross-section and panel studies, the time series approach we take is based on a transparent framework providing *robust* evidence on *causality* linkages. Essentially, it by-passes the estimation issues faced by alternative methods to concentrate on the more fundamental question of causality. As it involves the estimation of a simple VAR, it does not require rather implausible assumptions about the Data Generation Process (DGP) as in the case of cross-section/panel estimators. Moreover, the test we employ is specifically designed to detect the *direction* of causality, and follows a well-defined distribution, enabling us to draw robust statistical inference on the causal structure of the system. It is, therefore, much more informative about the issue of interest, namely the role played by stock markets in promoting growth.

3. ECONOMETRIC METHODOLOGY

Sims (1972) was the first to argue that Granger causality in a two variable system could be due to an omitted variable. If the potential omitted variable causes either or

both variables in the univariate system, then causality inferences will be invalid. Testing for causality in possibly unstable VARs with the possibility that cointegration also exists was first addressed by Sims, Stock and Wallace (1990) in a trivariate VAR, and by Toda and Phillips (1993) for systems of higher dimension. The argument was that Wald test statistics for noncausality in an unrestricted VAR will have a nonstandard limit distribution. When estimating a VAR in levels, a Wald test will have a limiting χ^2 distribution conditioned on the presence and the location of the unit roots in the VAR, which is normally not easy to obtain.

Taking the discussion a step forward, Toda and Yamamoto (1995) have suggested an alternative approach to causality testing.[1] The basic idea is to artificially augment the correct order, K, of the VAR by the maximal order of integration, say $T_{\max}$. The augmented $(K + T_{\max})$ VAR is then estimated, and Wald tests for linear or non-linear restrictions are carried out on the first K coefficient matrix as follows:

Consider the following VAR:

$$Z_t = \Phi + \Phi t + \Pi_1 Z_{t-1} + ... + \Pi_k Z_{t-k} + E_t, t = 1, \ldots T \tag{1}$$

where $E_t \sim N(0, \Omega)$

Economic hypotheses can be expressed as restrictions on the coefficients of the model as follows:

$$H_0 : f(\pi) = 0 \tag{2}$$

where $\pi = vec(P)$ is a vector of parameters from Model (1), $P = [\Pi_1, ..., \Pi_k]$, and $f(.)$ is a twice continuously differentiable m-vector valued function with $F(\phi) = \partial f(\phi) / \partial \phi'$ and rank $(F(.)) = m$.

Assume that the maximum order of integration which is expected to characterise the process of interest is at most two, i.e., $d_{\max} = 2$. Then, in order to test the hypothesis (2), one estimates the following VAR by OLS:

$$Z_t = \hat{\Phi}_0 + \hat{\Phi}_1 t + \hat{\Pi}_1 Z_{t-1} + ... + \hat{\Pi}_k Z_{t-k} + \hat{\Pi}_{k+1} Z_{t-k-1} ... + \hat{\Pi}_p Z_{t-p} + \hat{E}_t \tag{3}$$

where $p \geq k + d_{\max} = k + 2$, i.e., at least two more lags than the true lag length k are included. The parameter restriction (2) does not involve the additional matrices

[1] See Caporale and Pittis (1999) for further details and a discussion of other methods.

$\Pi_{k+1},...,\Pi_p$, since these consist of zeros under the assumption that the true lag length is k.

Equation (3) can be written in more compact notation as follows:

$$Z_t = \hat{\Phi}\tau_t + \hat{P}x_t + \hat{\Psi}y_t + \hat{E}_t \tag{4}$$

where:

$$\hat{\Phi} = [\hat{\Phi}_0, \hat{\Phi}_1]$$

$$\tau_t = [1, t]$$

$$x_t = [Z'_{t-1},..., Z'_{t-k}]'$$

$$y_t = [Z'_{t-k-1},..., Z'_{t-p}]'$$

$$\hat{P} = [\hat{\Pi}_1,..., \Pi_k]$$

$$\hat{\Psi} = [\hat{\Pi}_{k+1},..., \hat{\Pi}_p]$$

or, in the usual matrix notation

$$Z' = \hat{\Phi}T + \hat{P}X' + \hat{\Psi}Y' + \hat{E}' \tag{4a}$$

where $X = [x_1,...x_T]'$ and so on.

One can then construct the following Wald statistic W_2 to test the hypothesis (2):

$$W_2 = f(\hat{\phi})'[F(\hat{\phi})\{\hat{\Sigma}_E \otimes (X'QX)^{-1}\}F(\hat{\phi})']^{-1} f(\hat{\phi}) \tag{5}$$

where $\hat{\Sigma}_E = T^{-1}\hat{E}'\hat{E}, Q = Q_\tau - Q_\tau Y(Y'Q_\tau Y)^{-1}Y'Q_\tau$ and $Q_{\tau=}I_T - T(T'T)^{-1}T$.

Toda and Yamamoto's (1995) theorem 1 (pp. 234-235) proves that the Wald statistic (5) converges in distribution to a χ^2 random variable with m degrees of freedom, regardless of whether the process Z_t is stationary, I(1), I(2), possibly around a linear trend, or whether it is cointegrated.

This method also requires some pretesting in order to determine the lag length of the process. Sims *et al*. (1990) showed that lag selection procedures, commonly employed for stationary VARs, which are based on testing the significance of lagged vectors by means of Wald (or LM or LR) tests, are also valid for VARs with I(1) processes which might exhibit cointegration. Toda and Yamamoto (1995) extended their analysis and proved that the asymptotic distribution of a Wald of Likelihood Ratio test for the hypothesis that the lagged vector of order p is equal to zero is a χ^2, unless the process is Markovian and I(2).

4. EMPIRICAL ANALYSIS

4.1. Data

The selected countries are Argentina, Chile, Greece, Korea, Malaysia, Philippines and Portugal. The selection criterion was to include countries that have at least fifty continuous quarterly observations. The sample under investigation covers the period 1977:1-1998:4. For stock market development, we use two standard indicators: 1) the market capitalisation ratio, which equals the value of listed shares divided by GDP. 2) the value traded ratio, which equals the total value of shares traded on the stock exchange divided by GDP. Bank deposit liabilities to nominal GDP and the ratio of bank claims on the private sector to nominal GDP are used as a proxy for bank development. Following standard practice in the cross-sectional literature, we use GDP in levels as a measure for economic development. As in Demetriades and Hussein (1996), this variable is measured in domestic currencies since the purpose of this study is not so much to compare growth across countries but to look at its trend over time in each country. The data source for stock market development variables is the Emerging Market Data Base (EMDB (1998)), and for the financial development variables it is the IMF's International Financial Statistics (1998).

4.2. Causality Tests

As suggested by Toda and Yamamoto (1995), the first step is to determine the order of the VAR. We started by estimating a VAR (4) and then dropped one lag at a time. The AIC and SIC were used for selecting the lag-length of the VAR.[2] Moreover, misspecification tests were carried out for serial correlation, normality, and ARCH structure in the residuals of the VAR. The results are reported in Table 2. The unit root tests indicate that the series are integrated of order one I(1), and hence follow stochastic trends.

[2] To select the optimal lag length of the VAR, these criteria for model choice are necessary but not sufficient (see Stock (1994)).

Table 1. Unit Root Tests

Countries	ADF				
	Income	Capitalisation	Value Traded	Credit	Deposit
Argentina	-1.79	-2.29	-1.32	-1.76	-1.76
Chile	-1.45	-1.67	-0.16	-0.13	-0.12
Greece	-1.72	-2.44	-2.53	-2.56	-2.47
Korea	-1.79	-2.90	-2.04	-3.86	-3.68
Malaysia	-2.85	-1.94	-2.16	-2.20	-2.07
Philippines	-3.42	-2.39	-3.12	-2.24	-2.25
Portugal	-2.04	-0.22	-0.27	-0.34	-0.33

Table 2. Selection of the Order of the Bivariate VAR (k)

Countries	AIC				SIC				Optimal
	1	2	3	4	1	2	3	4	(K^*)
Argentina	165.2	170.5	171.2	176.3	142.1	144.3	132.4	129.3	4
Chile	115.7	118.9	122.4	132.1	104.5	107.3	110.8	98.2	4
Greece	54.1	57.6	43.4	61.3	39.9	47.3	43.2	41.2	4
Korea	182.5	191.3	193.8	213.4	119.3	124.6	131.2	112.2	4
Malaysia	196.3	215.2	218.3	221.1	185.4	186.3	174.7	165.3	4
Philippines	25.6	32.5	48.2	41.3	35.3	65.2	42.2	27.3	3
Portugal	176.5	158.2	185.1	194.1	115.6	125.3	138.5	114.1	4

Notes: AIC and SIC stand for Akaike and Schwartz information criteria respectively. K^* is the selected order of VAR. In case of contradicting results between AIC and SIC, we tend to use the AIC results as suggested by Stock (1994).

Table 2. (Continued) p-values for Misspecification Tests for the VAR (K), $K = K^*$

Countries	AR (4)			NORM			ARCH (4)		
	Income	Capitali-sation	Value Traded	Income	Capitali-sation	Value Traded	Income	Capitali-sation	Value Traded
Argentina	2.21	1.03	0.69	1.06	0.69	0.06	0.75	0.43	0.62
Chile	0.31	4.65*	0.21	0.24	0.07	2.14	0.36	0.05	0.33
Greece	1.02	2.55	3.01	2.04	1.23	1.27	0.04	0.29	0.81
Korea	4.52*	1.02	1.34	0.08	0.55	0.93	0.11	0.29	0.56
Malaysia	2.03	1.24	1.11	0.57	0.89	1.25	1.95	0.27	0.64
Philippines	0.94	3.16	1.54	2.24	1.03	0.06	0.39	0.26	0.44
Portugal	3.89*	2.67	2.82	2.09	1.08	2.27	0.007	0.16	0.92

Notes: AR (4) is a Lagrange Multiplier test for serial correlation up to the fourth order in the residuals, NORM is the Jarque-Bera test for normality of the residuals, and ARCH (4) is the Engle (1982) test for the null hypothesis that the residuals do not have an ARCH structure. For the Philippines the order of the VAR is 3. An asterisk indicates that the test is significant at the 5 % level.

The next step was to augment the VAR by the maximum order of integration in the series. In this case the variables are I(1). Therefore, we augmented the bivariate VARs by one lag, and tested for non-causality zero restrictions on the parameters of the original VAR by carrying out Wald tests on the first K coefficient matrix (see Toda and Yamamoto (1995)). The results from the non-causality bivariate tests on the links between real income and each of the financial series, namely, market capitalisation, share value traded, bank credit, and bank deposit are presented in Table 3.

Table 3. Bivariate Causality Tests

Countries	Credit ⇒ Income $p = 4$	Income ⇒ Credit $p = 4$	Deposit ⇒ Income $p = 4$	Income ⇒ Deposit $p = 4$
Argentina	$\chi^2(2) = 1.59$	$\chi^2(2) = 2.04$	$\chi^2(2) = 1.40$	$\chi^2(2) = 1.46$
	(0.45)	(0.35)	(0.49)	(0.48)
Chile	$\chi^2(2) = 4.72^*$	$\chi^2(2) = 9.10^*$	$\chi^2(2) = 5.24$	$\chi^2(2) = 9.01$
	(0.03)	(0.06)	(0.39)	(0.25)
Greece	$\chi^2(2) = 1.06$	$\chi^2(2) = 0.57$	$\chi^2(2) = 1.08$	$\chi^2(2) = 0.56$
	(0.58)	(0.74)	(0.59)	(0.75)
Korea	$\chi^2(2) = 3.75$	$\chi^2(2) = 3.02$	$\chi^2(2) = 14.02^*$	$\chi^2(2) = 18.38^*$
	(0.15)	(0.22)	(0.01)	(0.00)
Malaysia	$\chi^2(2) = 4.58$	$\chi^2(2) = 2.96$	$\chi^2(2) = 4.42$	$\chi^2(2) = 3.08$
	(0.10)	(0.22)	(0.11)	(0.21)
Philippines	$\chi^2(2) = 10.97$	$\chi^2(2) = 4.11$	$\chi^2(2) = 0.35$	$\chi^2(2) = 8.30^*$
	(0.04)	(0.12)	(0.83)	(0.06)
Portugal	$\chi^2(2) = 13.14^*$	$\chi^2(2) = 4.85^*$	$\chi^2(2) = 6.42^*$	$\chi^2(2) = 4.16^*$
	(0.01)	(0.08)	(0.04)	(0.10)

Notes: An asterisk indicates significance at the 5% level. p is the lag length chosen. Y is an economic growth indicator.

They suggest that the ratio of domestic credit to GDP has a causal impact on economic growth in two countries out of seven (Chile, and Portugal). There is also evidence of two-way causality between economic growth and the ratio of domestic credit to GDP in both countries. Economic growth is also found to have a causal impact on the ratio of domestic credit to GDP in the same two countries.

On the other hand, Wald tests detect causality between economic growth and the ratio of bank deposits to GDP in three cases out of six. The ratio of bank deposits to GDP is found to have a causal effect on economic growth in two cases (Korea, and Portugal). Economic growth is found to have a causal impact on the ratio of bank deposits to GDP in three cases (Korea, Philippines, and Portugal), while two-way causality is found in one country out of six (Portugal). Causality links could not be

detected in four countries (Argentina, Chile, Greece, and Malaysia). The existence of a causal link in the other four cases does not give strong support to the hypothesis that there is a causal link between finance and economic growth.

The above conclusions are only valid if the system is not affected by the omission of relevant variable(s) (Caporale and Pittis (1997)). We would argue that in fact the above results are misleading because the model should include a stock market variable. This motivates our analysis of the trivariate case.

The final step in our investigation is therefore concerned with the dynamic interactions between financial development, stock market development, and economic growth in the context of a trivariate system. The trivariate VARs were estimated in levels, and the lag length was again determined using the AIC and SIC (see Table 4, which also reports a number of misspecification tests).

Table 4. Selection of the Order of the Trivariate VAR (k)

Countries	AIC				SIC				Optimal
	1	2	3	4	1	2	3	4	(K^*)
Argentina	331.18	355.5	364.9	386.4	305.21	306.75	291.81	290.41	4
Chile	259.8	271.10	297.3	303.6	206.3	222.0	205.6	184.9	4
Greece	60.7	18.5	31.5	68.12	33.9	59.8	47.0	40.7	4
Korea	302.7	305.2	306.4	375.3	240.4	265.0	214.2	256.6	4
Malaysia	377.9	402.8	395.6	416.6	338.0	340.1	308.0	297.9	4
Philippines	44.2	56.4	50.6	46.6	56.4	91.6	58.9	27.8	3
Portugal	311.1	331.0	352.6	368.1	206.2	238.3	175.8	139.3	4

Notes: AIC and SIC stand for Akaike and Schwartz information criteria respectively. K^* is the selected order of VAR. In case of contradicting results between AIC and SIC, we tend to use the AIC results as suggested by Stock (1994).

Table 4. (Continued) p-values for misspecification tests for the VAR (K), $K = K^*$

Countries	AR (4)					NORM				
	Income	Capitali-sation	Value Traded	Credit	Deposit	Income	Capitali-sation	Value Traded	Credit	Deposit
Argentina	1.03	2.23	0.53	0.41	0.78	3.82	4.12	0.62	2.01	0.26
Chile	0.62	1.27	2.24	1.54	3.54	3.25	2.58	3.21	0.78	2.24
Greece	1.23	1.22	2.83	4.89*	4.68*	1.25	2.58	3.63	2.24	0.27
Korea	2.35	0.73	0.42	2.43	1.15	0.12	0.39	0.14	0.09	1.21
Malaysia	0.29	0.75	0.28	1.33	2.56	2.01	2.68	3.23	2.26	1.06
Philippines	4.35*	2.25	1.08	0.25	1.02	0.51	0.85	0.69	0.37	0.74
Portugal	1.01	5.02*	1.06	0.89	0.49	1.06	0.25	0.06	0.66	1.48

Notes: AR (4) is a Lagrange Multiplier test for serial correlation up to the fourth order in the residuals, NORM is the Jarque-Bera test for normality of the residuals. For the Philippines the order of the VAR is 3. An asterisk indicates that the test is significant at the 5 % level.

Table 4. (Continued) *p*-values for misspecification tests for the VAR (K), $K = K^*$

Countries	ARCH (4)				
	Income	Capitalisation	Value Traded	Credit	Deposit
Argentina	1.38	3.12	0.58	1.23	0.78
Chile	0.04	0.23	0.14	0.79	0.11
Greece	0.54	0.69	0.08	0.64	0.43
Korea	0.05	0.26	0.66	0.36	0.04
Malaysia	0.55	0.23	0.48	0.51	0.63
Philippines	1.02	0.05	0.38	0.67	0.23
Portugal	0.88	0.16	0.84	0.34	0.93

Notes: ARCH (4) is the Engle (1982) test for the null hypothesis that the residuals do not have an ARCH structure. An asterisk indicates that the test is significant at the 5 % level.

Table 5 presents the results of the Wald tests for financial development, economic growth, and stock market development. The null hypothesis is that there is no causality among the variables. We find that the domestic credit ratio has a causal impact on economic growth in four cases (Greece, Korea, Philippines, and Portugal). Economic growth has a causal influence on domestic credit in four cases (Chile, Korea, Malaysia and Philippines). As for the causality relationship between bank deposits and economic growth, it appears that bank deposits have a causal effect on economic growth in three cases out of six (Greece, Korea, and Portugal), whilst in three cases economic growth seems to have a causal influence on bank deposits (Korea, Malaysia, and Philippines). Wald tests in a trivariate system also detect a causal link running from market capitalisation in four cases (Chile, Greece, Malaysia, and Philippines).

Turning to the second stock market development measure, the value traded ratio, causality tests indicate that it has a causal effect on economic growth in five cases at the 5 per cent significance level (Chile, Greece, Korea, Malaysia, and Philippines). Wald tests were also carried out to test the null hypothesis of non-causality between financial development and stock market development. A causal link between market capitalisation and both bank deposits and domestic credit is only found in one case out of seven (Malaysia). A causal link between value traded and both bank deposits and domestic credit appears to exist only in Argentina, where value traded appears to affect domestic credit at the 5 per cent significance level.

Thus, we find a robust relationship between stock market development measured by share value traded ratio (i.e., market liquidity) and economic growth. The results confirm the findings by Levine and Zervos (1998) and Rousseau and Wachtel (2000) that there is a significant relationship between stock market development and economic growth. Unlike the study by Levine and Zervos (1998), our contribution indicates that there exists a causal relationship between the two variables, namely stock market development and economic growth.

Table 5. Trivariate Causality Tests

Countries	Credit ⇒ Income	Income ⇒ Credit	Deposit ⇒ Income	Income ⇒ Deposit	Capitali-sation ⇒ Credit	Capitali-sation ⇒ Income	Capitali-sation ⇒ Deposit	Value Traded ⇒ Credit	Value Traded ⇒ Income	Value Traded ⇒ Deposit
Argentina	1. 46	0. 29	1.47	0.29	2.59	0.28	4.46	4.04	0.31	7.89*
	(0.48)	(0.86)	(0.47)	(0.86)	(0.77)	(0.86)	(0.10)	(0.13)	(0.85)	(0.01)
Chile	0.85	6.19*	1.24	5.97*	0.20	5.54*	1.66	0.82	5.34*	0.60
	(0.77)	(0.01)	(0.26)	(0.01)	(0.64)	(0.01)	(0.19)	(0.36)	(0.68)	(0.43)
Greece	18.64*	0.65	17.72*	2.53	0.53	17.19*	0.76	0.92	9.27*	1.49
	(0.01)	(0.72)	(0.00)	(0.28)	(0.76)	(0.00)	(0.68)	(0.63)	(0.01)	(0.47)
Korea	6.30*	7.08*	7.31*	6.03*	1.20	1.35	0.71	0.92	6.71*	0.28
	(0.04)	(0.29)	(0.02)	(0.04)	(0.54)	(0.50)	(0.69)	(0.62)	(0.35)	(0.86)
Malaysia	1.56	6.86*	1.61	6.51*	10.40*	5.43*	9.97*	0.03	6.14*	0.93
	(0.45)	(0.03)	(0.44)	(0.03)	(0.05)	(0.48)	(0.07)	(0.98)	(0.56)	(0.62)
Philippines	7.87*	8.48*	2.68	16.58*	0.68	10.58*	2.87	0.74	9.63*	0.74
	(0.19)	(0.14)	(0.26)	(0.00)	(0.71)	(0.05)	(0.26)	(0.68)	(0.08)	(0.68)
Portugal	10.25*	3.58	4.81*	3.32	0.42	0.54	0.23	1.56	1.09	0.49
	(0.06)	(0.16)	(0.90)	(0.19)	(0.80)	(0.76)	(0.89)	(0.45)	(0.57)	(0.78)

Note: An asterisk indicates significance at 5% level.

The estimated model in the bivariate VAR is:

$$Z_t = \begin{bmatrix} x_t \\ y_t \end{bmatrix} = \beta + \beta_1 t + \sum_{i=1}^{k+1} A_i + Z_{t-i} + E_t \qquad A_i = \begin{bmatrix} \alpha_{11}\alpha_{12} \\ \alpha_{21}\alpha_{22} \end{bmatrix}$$

The estimated model in the trivariate VAR is:

$$Z_t \equiv \begin{bmatrix} x_t \\ y_t \\ w_t \end{bmatrix} = \beta + \beta_1 t + \sum_{i=1}^{k+1} A_i + Z_{t-i} + E_t \qquad A_i = \begin{bmatrix} \alpha_{11}\alpha_{12}\alpha_{13} \\ \alpha_{21}\alpha_{22}\alpha_{23} \\ \alpha_{31}\alpha_{32}\alpha_{33} \end{bmatrix}$$

The results are also consistent with the argument put forward by Levine and Zervos (1998) and Rousseau and Wachtel (2000) that market liquidity is related to economic growth more significantly than market size. One might argue that the value traded ratio, which measures the value of shares traded as a ratio to national output, should be expected to have a significant relationship with economic growth. A country could have a relatively large stock market in terms of size, yet this might constitute a small proportion of its GDP. Increases in liquidity are important in emerging markets as they

restore the confidence of investors in the value of information associated with trading (Rousseau and Wachtel (2000)). As investors are encouraged by high market liquidity to invest in equities, increasing the flow of venture capital, such moves would efficiently allocate resources and hence enhance economic growth in the long run. One of the important roles that a stock market plays is to re-channel the unused funds by financial intermediaries to productive and innovative investments. The results suggest that a stock market can effectively mobilise funds that have been not fully absorbed by financial intermediaries into productive investments and hence spur economic growth.

However, the interplay between stock market and financial development is supported by our findings. The linkage between financial development and economic growth on one hand, and stock market development and economic growth on the other, could be due to the use of an incomplete system. When allowing for the stock market to enter the regression along with financial development, a strong causal relationship between stock market development and economic growth is found.

It is interesting to compare the bivariate and the trivariate results in order to see how the dynamic properties of the system, and therefore causality inference, have changed. In general, one can notice that the necessary condition for the third variable to be relevant is fulfilled, in the sense that stock market development and financial development both cause economic growth. It is also clear that the causality structure of the system is much more complex than suggested by the bivariate system. For instance, the bivariate result that domestic credit causes economic growth holds also in a trivariate context in the case of Greece, Korea, and Philippines (though not of Chile, and Portugal). Similarly, the bivariate result that income affects bank credit is confirmed by the trivariate analysis in the case of Chile, Korea, Malaysia, and Philippines.

As regards causality between bank deposits and economic growth, the bivariate tests detect causality running from bank deposit to income in only two cases (Korea, and Portugal). In the trivariate system, causality is also detected in the case of Greece and the Philippines.

5. CONCLUSION

This paper has investigated the important role that well-functioning stock markets can play in promoting long-run economic growth. We have argued that earlier studies not including stock market development as a variable might have produced misleading results, as the omission of a relevant variable from a system might invalidate causality inference (see Caporale and Pittis (1997)). In the empirical analysis we have considered seven countries, and used an appropriate econometric technique to test for the causality linkage between stock markets and economic growth even in the presence of unit roots (see Toda and Yamamoto (1995)).

In order to stress the difference in results that might follow from incorporating a previously omitted variable we first performed causality tests in a bivariate context,

looking for causal links between the commonly used proxies for financial development (domestic credit and prevalence of bank deposits) and economic growth. On this basis we found little evidence of causality. Between domestic credit and economic growth we found evidence of causality in only two countries out of seven; when testing for causality between bank deposits and economic growth we found evidence for three countries.

This is scarcely strong support for the hypothesis that there is a causal link between finance and economic growth. But since these findings might be biased owing to the omission of an important variable from the system, we also tested for causality in a trivariate context, in order to model the dynamic interactions between financial development, stock market development, and economic growth. The picture changes dramatically. Causality between financial development and economic growth was found in five cases out of seven but the measure of financial development, which produces this result, is stock market development. This result is consistent with the findings by Levine and Zervos (1995) and the argument by Demirguc-Kunt (1994) that stock markets can give a big boost to economic development. Comparing the bivariate and the multivariate results shows that the necessary condition for the third variable to be relevant is fulfilled. Causality between domestic credit and economic growth was also found in Greece, Korea, and Philippines when we carried out the trivariate tests. Economic growth was also found to cause domestic credit in Chile, Korea, Malaysia, and Philippines in the context of a trivariate system. The trivariate system also detected that causality runs from bank deposits to economic growth in Greece. Clearly, inference in the bivariate system was affected by the omission of a stock market variable. Its inclusion in the model avoids the misleading results from earlier causality tests.

REFERENCES

Alonso-Borrego, C., and M. Arellano (1999), "Symmetrically Normalized Instrumental Variable Estimation Using Panel Data," *Journal of Business and Economic Statistics*, 17, 36-49.

Arellano, M., and S. Bond (1991), "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies*, 58, 277-297.

Arellano, M., and O. Bover (1995), "Another Look at the Instrumental-Variable Estimation of Error-Components Models," *Journal of Econometrics*, 68, 29-52.

Atje, R., and B. Jovanovic (1993), "Stock Markets and Development," *European Economic Review*, Vol. 37, 632-640.

Beck, T., and R. Levine (2003), "Stock Markets, Banks, and Growth: Panel Evidence," *Journal of Banking and Finance*, forthcoming.

Beck, T., R. Levine, and N. Loayza (2000), "Finance and the Sources of Growth," *Journal of Financial Economics*, 58, 261-300.

Bekaert, G., C.R. Harvey, and C. Lundblad (2003), "Does Financial Liberalization Spur Growth?" Working Paper, Fuqua School of Business, Duke University, Durham, NC, USA.

Bernanke and Gertler (1990), "Financial Fragility and Economic Performance," *Quarterly Journal of Economics*, Vol. 55, 87-114.

Calderon, C., A. Chong, and N. Loayza (2000), "Determinants of Currenr Account Deficits in Developing Countries," World Bank Research Policy Working Paper 2398.

Caporale, G.M., and N. Pittis (1997), "Causality and Forecasting in Incomplete Systems," *Journal of Forecasting*, Vol. 16, 425-437.

_____ (1999), "Efficient Estimation of Cointegrating Vectors and Testing for Causality in Vector Autoregressions," *Journal of Economic Surveys*, 13, 1-32.

Cho, Y.J. (1986), "Inefficiencies From Financial Liberalisation in the Absence of Well-Functioning Equity Markets," *Journal of Money, Credit, and Banking*, Vol. 18, 191-199.

Dailami, M., and M. Atkin (1990), "Stock Markets in Developing Countries: Key Issues and A Research Agenda," *Policy Research and External Affairs Working Papers*, The World Bank.

Demetriades, P., and K. Hussein (1996), "Does Financial Development Cause Economic Growth: Time-Series Evidence from 16 Countries," *Journal of Development Economics*, Vol. 51, 387-411.

Demirguc-Kunt, A. (1994), "Developing Country Capital Structure and Emerging Stock Markets," *Policy Research Working Paper*, WPS 933, July.

Demirguc-Kunt, A., and R. Levine (1995), "Stock Markets, Corporate Finance, and Economic Growth: An Overview," Working Paper, *World Bank*, No 1389.

EMDB (1998), "Emerging Markets Data Base," *International Finance Corporation* (IFC), Washington D.C.

Engle, R.F. (1982), "Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation," *Econometrica*, 50, 987-1008.

Goldsmith, R.W. (1969), "Financial Structure and Development," New Haven, Yale University Press.

Gurley, J., and E. Shaw (1955), "Financial Aspects of Economic Development," *American Economic Review*, Vol. 45, 515-537.

International Financial Statistics (1998), "International Financial Statistics Year Book," *International Monetary Fund* (IMF), Washington D.C.

Kumar, M.S., and R. Feldman. (1995), "Emerging Equity Markets: Growth, Benefits, and Policy Concerns," Working Paper, *World Bank*, Vol. 10, 181-200.

Levine, R., and S.J. Zervos (1993), "What We have Learned about Policy and Growth from Cross-country Regressions?" *American Economic Review*, Vol. 83, 426-430.

_____ (1995), "Stock Market Development and Long-Run Growth," *World Bank Economic Review*, Vol. 82, No. 4, 942-963.

_____ (1998), "Stock Markets, Banks, and Economic Growth," *American Economic*

Review, 88, 537-558.

Mankiw, N.G. (1995), "The Growth of Nations," *Brookings Papers on Economic Activity*, 1, 275-310.

McKinnon, R. (1973), *Money and Capital in Economic Development*, Washington, D.C.: Brookings Institution.

_____ (1986), "Financial Liberalisation in Retrospect: Interest Rate Policies in LDCs: In the State of Development Economics," New York: Blackwell.

_____ (1989), "Financial Liberalisation in Retrospect: Interest Rate Policies in LDCs: In the State of Development Economics," New York: Blackwell.

Mirakhor, S., and R.M. Lillanueva (1990), "Market Integration and Investment Barriers in Emerging Equity Markets," *World Bank Discussion Paper*, No. 216, 221-255.

Rousseau, P.L., and P. Wachtel (2000), "Equity Markets and Growth: Cross-country Evidence on Timing and Outcomes, 1980-1995," *Journal of Banking and Finance*, 24, 1933-1957.

Sims, C.A. (1972), "Money, Income and Causality," *American Economic Review*, 62, 540-52.

Sims, C.A, J.H. Stock, and M.W. Wallace (1990), "Inference in Linear Time Series Models with Some Unit Roots," *Econometrica*, 58, 1, 113-44.

Stiglitz, J.E., and A. Weiss, (1981), "Credit Rationing in Markets With Imperfect Information," *American Economic Review*, Vol. 71, 393-410.

Stock, J.M. (1994), "Unit Roots, Structural Break and Trends," in *Handbook of Econometrics*, eds. by R.F. Engle and D. McFadden, North Holland, 2738-841.

Toda, H.Y., and P.C.B. Phillips (1993), "Vector Autoregression and Causality," *Econometrica*, 61, 6, 1367-1393.

Toda, H.Y., and T. Yamamoto (1995), "Statistical Inference in Vector Autoregressions with Possibly Integrated processes," *Journal of Econometrics*, Vol. 66, 225-250.

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