

THE FINANCE-GROWTH NEXUS: A MULTIVARIATE VAR ANALYSIS OF A SMALL OPEN ECONOMY

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1. Introduction

Barbados ranks fourth among developing countries in terms of human development, according to the renowned Human Development Index compiled by United Nations Development Programme [see Human Development Report (2000)]. With a stable political environment, sound financial structure, and exemplary levels of literacy and education, Barbados' socio-economic progress stands as a model for other developing countries. Critical to its high level of economic development has been the emergence of a bustling financial services industry. Thus, an examination of whether the demand for financial services has led to economic growth or whether expansion in real economic output has spurred financial activity is important from an economic policy perspective.

The causality issue between financial development and economic growth has proliferated over the last fifty years. Economists have traced the early discussion to Hamilton (1781) and Schumpeter (1911), who argued in favor of the hypothesis that finance leads economic growth. On the contrary, Adams (1819), Robinson (1952) and Hicks (1969) posit that, by and large, growth leads and finance follows. Furthermore, Lewis (1955) and Patrick (1966), postulate that there is a feedback relationship between financial development and economic growth.

Notwithstanding this controversy, the finance-lead hypothesis seems to be the dominant view of most economists, and has, in the 1970s and 1980s, gained further support from liberalisation theorists such as McKinnon (1973) and Shaw (1973) and also international financial institutions like the World Bank. These writers advocate that a "liberalised" financial system mobilises the volume of financial saving and allocates capital to the more productive uses, which enhances the volume and productivity of physical capital and, in turn, contributes to economic growth.

More recently, the "new" growth literature has added support to the finance-lead thesis [see Pagano (1993)], although there are some cases where financial market activity has had negative effects on economic growth [see, for example, Roubini and Sala-i-Martin (1992)]. In addition, a number of these studies have shown two-way causality [Greenwood and Jovanovic (1990); Berthelemy and Varoudakis (1997); Greenwood and Bruce (1997)].

In light of the foregoing, it would appear that the controversy surrounding the causal relationship between financial development and economic growth must be solved empirically, and economic researchers have attempted to do just that starting

with the seminal work of Goldsmith (1969). Again, results from these studies have also been mixed, but have favoured the finance-lead hypothesis [Levine (1997)].

Despite the vast interest in the finance-growth nexus worldwide, only a few writers have investigated this relationship for Caribbean economies [see Modeste (1993); Wood (1994); and Byron (1997)]. Modeste empirically tested three hypotheses in his study: one, that an unrepressed real deposit rate motivates an expansion in economic output; two, whether the rate of savings in the private sector is influenced by the real deposit rate, and; three, whether there is uni-directional causation from financial activity to economic growth. The first two hypotheses are rooted in the works of McKinnon (1973), Shaw (1973) and Fry (1978) on financial repression, and posit that an increase in the real deposit rate induces higher savings, which is likely to lead to more investment through the expansion of the capital stock. These changes are then expected to result in higher real income. The third hypothesis was tested using a pooled annual data set for Barbados (1981-1991), Guyana (1978-1990), Jamaica (1978-1989) and Trinidad and Tobago (1981-1991), respectively. Modeste employed Granger (1969) causality tests and revealed a feedback relationship between financial sector activity and economic growth. Byron, for thirteen small open Caribbean economies, also used standard bivariate Granger causality methods to investigate the link between finance and growth, and, too, found evidence of two-way causality. Wood, using a variation of Granger method due to Hsiao (1979), investigated the causal relationship between financial development and economic growth for Barbados first over the period 1946-1990, and then over two sub-samples, 1946-1968 and 1969-1990, to test Patrick's (1966) hypothesis, which purports that the direction of causality between financial development and economic growth changes as economic development improves. He found that financial development was important for economic growth over the entire sample and during the first sub-sample, but economic growth created demands for financial services during the second sub-sample, the period this paper uses as its focal point. Modeste's and Wood's analyses, in particular, fell short because the data were not rigorously checked for nonstationarity. Furthermore, none of the authors tested for the long-run relationship between finance and growth – that is, cointegration. Moreover, the use of bivariate models suggests that the investigations referred to above may have suffered from omitted variable problems, which can lead to erroneous casual inference [see Lutkepohl (1982) and Caporael and Pittis (1995)].

This paper rectifies these problems by examining the long-run causality between

financial development and economic growth over a longer time frame and in a multi-variate setting by including the real interest rate and real income per capita stock as other explanatory variables, following Luintel and Khan (1999). More specifically, through tests for exact and over-identifying restrictions, the long-run relationship between finance and economic output for Barbados, over the last twenty-five years, is investigated in a cointegrating Vector Autoregressive (VAR) framework. Hall and Wickens (1993) assert that this approach is a "more formal and complete" way of implementing Granger non-causality tests. The findings of this study do not support a bi-directional causal relationship, which was found by Luintel and Khan (1999) in their study of ten developing countries and by the Caribbean researchers mentioned above. Instead, they suggest one-way causality from financial development to economic growth for Barbados over the sample period analysed.

The remainder of this paper is organised into four sections: Section 2 provides a cursory exposition of the theoretical finance-growth relationship; Section 3 details the econometric methodology and data sources; Section 4 presents the empirical results and; Section 5 concludes.

2. Some Theoretical Considerations

In accordance with the theoretical literature on financial development and growth, financial depth is positively influenced by the real interest rate and real income. These propositions are advocated both by the McKinnon/Shaw models and the endogenous growth literature. McKinnon (1973) posits that the relationship between financial development and economic growth is predicated on the notion that investment and growth materialise from an increased mobilisation of savings. Shaw (1973) advocates that through debt intermediation, financial intermediaries enhance the level of investment in the economy, which in turn leads to growth. More specifically, these models propose that a positive real interest rate improves the level of financial development through a higher volume and mobilisation of financial savings, and promotes economic growth via the volume and productivity of capital. In addition, the endogenous growth model of Pagano (1993) purports that financial development influences growth either via an increased proportion of savings feeding into investment, a higher private savings rate or through the marginal productivity of capital. Therefore, the long-run relationship between financial depth and economic

output is not direct, but occurs indirectly via the other economic variables such as the real interest rate and the capital stock. As such, a more accurate test of long-run causality between financial development and economic growth must incorporate these other variables.

3. Econometric Methodology and Data

3.1 *Econometric Methodology*

An inspection of the plots of each raw data series in levels revealed trending, nonstationary variables. Thus, before proceeding with the estimation of the model, each series was tested for unit roots using the Augmented Dickey-Fuller (ADF) test. This test is well known in the time series literature and, therefore, will not be described here. This first step is important because, according to the Granger representation theorem, if the variables under study are integrated of the same order, that is, greater than zero, then there might exist a linear combination of them that is stationary.

Following the test for the order of integration of each data series, the Johansen (1988) procedure was employed to determine whether the variables were cointegrated. Unlike the Engle-Granger (1987) two-step approach, which assumes a unique economic endo-exogenous relationship, the Johansen approach estimates the maximum number of cointegrating relationships (vectors) among economic variables, using VARs, when there is little or no a priori knowledge of their association.

The estimation involves a multivariate VAR that includes the four variables discussed in the previous section, that is, financial development, real income, real capital stock and the real interest rate. This is represented by the following VAR (p) model:

$$Z_t = \mu + \sum_{i=1}^p A_i Z_{t-i} + \epsilon_t \quad (1)$$

where Z_t is a 4x1 column vector comprising the current values of the endogenous variables, μ a column vector of deterministic components, A_i , 4x4 matrices of non-zero coefficients, and ϵ_t , a 4x1 column vector of identically and independently distributed

random errors.

From this VAR, the basic equation of the Johansen procedure can be derived by applying a "cointegrating transformation" and can be expressed as:

$$\Delta Z_t = \mu + \Pi Z_{t-1} + \sum_{i=2}^{p-1} \Gamma_i \Delta Z_{t-i} + \varepsilon_t \quad (2)$$

The Π matrix represents the constant dynamic adjustment of the lagged first differences of the variables on their levels, that is, their long-run (cointegrating) relationship, whereas the Γ matrix captures their short-run adjustment. The significance of the Granger representation theorem is determined by the rank of the coefficient matrix Π . This is because if the Π matrix has reduced rank, that is, greater than zero, but less than four, then an error correction representation of the variables can be formulated and Granger causality is implied in at least one direction.

Formally, the Π matrix can be decomposed into two matrices as:

$$\Pi = \alpha\beta' \quad (3)$$

where $\alpha\beta$ represents the matrix of adjustment coefficients with both α and β being $n \times r$ matrices of rank $r \leq n$. The β matrix is the long-run or cointegrating vectors and the α matrix contains the weighting elements or error correction coefficients, which indicate the speed of adjustment towards long-run equilibrium. However, this interpretation of the error correction coefficients should be adopted with caution when using a system approach. In such situations, Rosanna (1998) suggests that the adjustment effects include both the autoregressive parameters of unobservable shocks as well as the speed of adjustment as a result of (1) using arbitrary statistical normalisation of the cointegrating matrix when the rank is greater than one, and (2) the higher order lags in the VARs.

Given equation (3), a more compact specification of equation (2) can be expressed as:

$$\Delta Z_t = \mu + \alpha (\beta' Z_{t-1}) + \sum_{i=1}^{p-1} \Gamma_i \Delta Z_{t-i} + \eta_t \quad (4)$$

with $\beta' Z_{t-1}$ representing the lagged error correction terms. With respect to the rank of the Π (4x4) matrix, three scenarios can be postulated:

- (1) Π has full rank and all the variables are stationary. Therefore, a VAR in levels can be estimated.
- (2) Π has rank of $0 < r < 4$, and there are r cointegrating vectors among the variables. In this case, a vector error correction (VEC) is estimated.
- (3) Π has zero rank and there are no cointegrating vectors. The variables are stationary in first differences and an unrestricted VAR can be estimated without loss of relevant information.

The trace and maximum eigenvalue test statistics were used to check for the rank of the Π matrix. These tests involve sequentially testing the null hypotheses of no cointegrating equations to $n-1$ cointegrating equations all against the alternative of full rank until the null can no longer be rejected. Again, these tests are standard and merit no further explanation. The minimum Schwarz Bayesian Criterion (SC) was utilized to determine the optimum lag length to be included in the VAR.

Strictly speaking, unless the rank of the Π matrix is unique, then the long-run relationships, which are captured in the cointegrating matrix, cannot be properly identified. This is because in a multivariate setting, it is possible that any linear combination of cointegrating vectors can themselves form another linear stationary relationship [see Johansen (1991) and Pesaran and Shin (1994)]. Therefore, to avoid this indeterminacy and to adequately identify the long-run relationship(s) between financial development and economic output, other parametric restrictions, motivated by economic theory, were imposed on the cointegrating matrix. The first cointegrating vector was normalised on financial development, and the second cointegrating vector, on real economic growth. These normalisation restrictions are straightforward, given the stated aim of the paper. The other restrictions can be better discerned by isolating the long-run relationship from equation (4).

Assuming two cointegrating relations among the variables gives the following structure of the long-run relationship:

$$\begin{pmatrix} \Delta FD_t \\ \Delta LRPCG_t \\ \Delta LPGCF_t \\ \Delta RIR_t \end{pmatrix} = \begin{pmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \\ \alpha_{31} & \alpha_{32} \\ \alpha_{41} & \alpha_{42} \end{pmatrix} \begin{pmatrix} 1 & -\beta_{12} & 0 & \beta_{14} \\ 0 & 1 & -\beta_{23} & -\beta_{24} \end{pmatrix} \begin{pmatrix} FD_{t-1} \\ LRPCG_{t-1} \\ LPGCF_{t-1} \\ RIR_{t-1} \end{pmatrix} \quad (5)$$

where $\beta_{11}=1$ and $\beta_{22}=1$ are the normalising restrictions on financial development and economic growth, respectively; $\beta_{13}=0$ because, theoretically, there is no direct effect of the capital stock on financial development; β_{14} is constrained to a small, positive value to capture the long-run effect of the real interest rate on financial development. The final restriction, $\beta_{21}=0$ since economic theory postulates that financial development does not impact directly on growth, but indirectly through the sources of growth.

The acceptance of these restrictions is only a sufficient condition for successful identification of an economically meaningful cointegrating vector because the error correction coefficient associated with a particular cointegrating vector must also be negative and significant [Wickens (1996)]. Therefore, in terms of the first cointegrating vector, α_{11} must be negative and significant, and, similarly, α_{22} for the output relationship. With this in mind, the error correction coefficients were each tested for zero restrictions – that is, the test for weak exogeneity. If the null hypothesis of $\alpha_{11}=0$ cannot be rejected, then the financial development vector is weakly exogenous with respect to the output vector and output does not have causal predominance over financial development in the long run. Similarly, the failure to reject the null of $\alpha_{21}=0$ implies that the output vector is weakly exogenous with respect to the financial development vector and, financial development does not cause output in the long run. The existence of a feedback relationship between financial development and economic output is determined if the null hypothesis of $\alpha_{11}=0$ and $\alpha_{22}=0$ cannot be rejected.

3.2 Data

The frequency of the data employed in this study are annual observations over the sample period 1974-1998. Although the data set only covers twenty-five years, it

In the case of the first cointegrating vector, the real interest rate exerted a positive effect on financial development, but was insignificant. Moreover, the test of the parametric restriction on real per capita income (that is, $\beta_{12}=0$) in the first cointegrating vector was accepted, indicating that the coefficient on the real income per capita variable was zero. This showed that economic output does not impact on financial development in the long run. The error correction coefficient associated with this identified vector was insignificant and positive, implying that an economically meaningful long-run financial development relationship was not represented by the data. Thus, financial development was not weakly exogenous with respect to long-run economic output.

In accordance with theoretical predictions, the coefficients on real income per capita and the real interest rate, in the second cointegrating vector, were positively related with output in the long run, but both were insignificant. However, the error correction coefficient on the output vector was negative and significant, indicating a meaningful long-run association of economic output with capital stock per capita and the real interest rate for the sample period. Notwithstanding the observation made by Rosanna (1998), the speed of adjustment to long-run equilibrium for this relationship was found to be 20% in one year. In addition, the test for zero restrictions on the adjustment coefficient indicated that output was weakly exogenous to financial development. Thus, there is some evidence to support that financial development Granger causes economic growth in Barbados.

5. Conclusions

This paper has empirically investigated the long-run causality between financial development and economic output for Barbados over the last twenty-five years. The estimation of a multivariate VAR, consisting of financial development, real income per capita, real capital per capita and the real interest rate, revealed two cointegrating relationships among these four variables. Employing tests for just-identifying and over-identifying restrictions, uncovered an economically meaningful long-run output relationship that suggested uni-directional causality from financial development to economic growth for Barbados over the sample period. This finding is not in accordance with previous studies for the Caribbean or the work of Luintel and Khan for other developing countries, which found two-way causality between financial

development and economic output. This paper also provides a basis for further research into the finance-growth nexus for the other Caribbean countries using a cointegrating VAR approach. In addition, time spans of the data sets in these future studies must be extended so as to adequately capture the long-run effects of financial development on growth or vice-versa.

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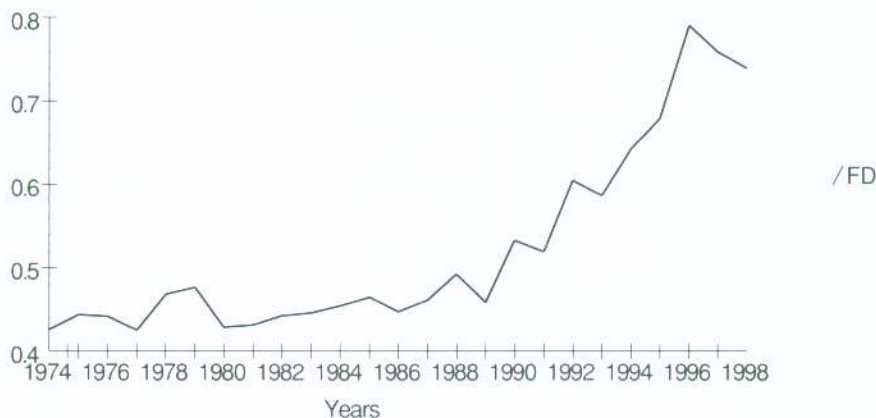
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Table 1 *Johansen Cointegration Tests: 1974 – 1998*

Trace Statistics $H_0: \text{rank} = r$				Maximum Eigenvalue Statistics $H_0: \text{rank} = r$			
$r = 0$	$r = 1$	38.83	(27.42)	$r = 0$	$r = 1$	78.56	(48.88)
$r \leq 1$	$r = 2$	25.68	(21.12)	$r \leq 1$	$r = 2$	39.74	(31.54)
$r \leq 2$	$r = 3$	14.06	(14.88)	$r \leq 2$	$r = 3$	14.06	(17.86)
$r \leq 3$	$r = 4$	0.004	(8.07)	$r \leq 3$	$r = 4$	0.004	(8.07)

Notes: Cointegration test with unrestricted intercepts and no trends in the VAR.
The figures in parentheses are the 95% critical values

Chart 1**Financial Development in Barbados: 1974-1998**

Abstract

This paper examines the long-run causality between financial development and economic growth in a multivariate setting using the cointegration vector autoregressive framework. The findings support one-way causality from financial development to economic growth and not the feedback relationship found by previous researchers.

Résumé

LA CAUSALITÉ ENTRE FINANCES ET CROISSANCE: UNE ANALYSE MULTIVARIÉE DE VECTEUR D'AUTOREGRÉSSION (VAR) APPLIQUÉE À UNE PETITE ÉCONOMIE À MARCHÉ OUVERT.

Cet article examine la causalité à long terme entre le développement financier et la croissance économique d'une petite économie à marché ouvert dans le contexte d'un vecteur autorégressif co-intégré. Les résultats de l'étude indiquent l'existence d'une causalité à sens unique allant du développement financier à la croissance économique, et ce-ci, contrairement aux études antérieures concernant les économies des Caraïbes, qui ont trouvé une causalité à double sens entre les deux variables d'intérêt.

