

FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH IN BARBADOS: CAUSAL EVIDENCE*

Anthony Wood

University of the West Indies

Cave Hill Campus, Barbados

1. Introduction

The importance of the relationship between financial development and economic growth has been well recognized and emphasized in the field of economic development. A consensus has emerged from the numerous theoretical and empirical writings on the subject in the last twenty-five years that financial development is important and leads to economic growth – the so-called supply-leading phenomenon [McKinnon (1973), Shaw (1973), Gupta (1984), Bencivenga and Smith (1991)]. However, the reverse relationship can be argued on a priori grounds, namely that economic growth stimulates the development of the financial sector. According to this view, called “demand-following”, as the real side of the economy develops, it generates additional and new demands for financial services which are met rather passively from the financial side [Goldsmith (1969), Woolmer (1977)]. In this view, the lack of financial institutions in some less developed countries (LDCs) is simply a manifestation of the lack of demand for their services.

A natural question thus emerging from the literature concerns the direction of causality between financial development and economic growth. The aim of this paper is to examine the Barbadian data on the causal relationship between financial development and economic growth. The result of a causal relationship from financial development to economic growth provides some justification for the policy of establishing and promoting financial institutions in Barbados (and other LDCs)¹. In this paper we also test the hypothesis of Patrick (1966) that the direction of causality between financial development and economic growth changes over the course of development. In his view, financial development is able to induce real innovation-type investment before sustained modern economic growth gets under way, and “as modern economic growth occurs, the supply-leading impetus gradually becomes less important and the demand-following financial response becomes dominant” [Patrick (1966) p.177]. Unfortunately, there has been very little quantitative evidence on this subject, for both developed and developing countries².

* An early version of this paper was presented at the 24th Annual Conference of the Regional Programme of Monetary Studies in Nassau, Bahamas, October 1992. The author thanks Addington Coppin and Llewyn Rock for valuable comments. All errors remaining are my responsibility.

1. For a detailed discussion on the development of the Barbadian financial system, see Wood (1992 Ch. 4).

2. Besides Patrick's (1966, 1967) analysis for Japan and the United States, Stammer (1972) conducted a case study of Hong Kong and Jung (1986) investigated data for 56 countries, of which 19 are industrial countries. Jung is however unable to investigate how causal patterns evolve over time, owing to inadequate time series data.

The remainder of the paper is organised as follows: Section 2 outlines the statistical methodology; the empirical results are examined in Section 3; and Section 4 presents a concluding summary.

2. Statistical Methodology

The study of causal relationships among variables has been one of the main objectives of empirical economics. For this reason, Granger's (1969) operational definition of causality for temporal systems has received widespread attention from both theoretical econometricians and empirical researchers. Granger's definition of causality is based on the notion that the future cannot cause the past but the past can cause the future³ and relates to dynamic stochastic systems in terms of a predictability criterion. Let R_t be the universe of information up to and including period t . The Granger definition is:

X causes Y , given R_t , if Y_{t+1} can be predicted better (in a mean-square-error sense) using past values of X ($X_s, s \leq t$) than by not using it. That is, compare the forecasting ability of R_t with and without X ; if past values of X significantly contribute to forecasting Y_{t+1} , then X is said to Granger cause Y . Causality from Y to X is similarly defined.

In practice Granger causality is defined relative to some restricted information set. The results reported below check for Granger causality between financial development and economic growth given information on the past financial development measure and growth rates.

The bivariate statistical framework for characterizing the causal relationship between financial development and economic growth involves estimating the following two equations:

$$G_t = \alpha_0 + \sum_{j=1}^r \alpha_{1j} G_{t-j} + \sum_{j=1}^n \beta_{1j} FD_{t-j} + \epsilon_t \quad (1)$$

$$FD_t = \lambda + \sum_{j=1}^p \alpha_{2j} FD_{t-j} + \sum_{j=1}^q \beta_{2j} G_{t-j} + \eta_t \quad (2)$$

3. Granger (1980) also requires that the information set has no redundant information and that all causal relationships remain constant in direction over time.

G_t and FD_t are economic growth and financial development, respectively, for the sample $t = 1, 2, \dots, T$, while ϵ_t and η_t are white-noise error processes and r, n, p, q denote the number of lagged growth and financial development variables in the regression. The Granger causality-testing procedure is based on ordinary least squares estimates of equations 1 and 2 and the conventional Fisher-Snedecor F-test of joint statistical significance⁴. In particular, uni-directional causality from financial development to growth exists if the group of estimated coefficients on the lagged values of financial development in equation 1 is significantly different from zero and the coefficients on the lagged values of growth in equation 2 are (jointly) insignificantly different from zero. If, as a group, the estimated coefficients on lagged growth in equation 2 are statistically different from zero and the coefficients on the lagged financial development variable in equation 1 are not statistically different from zero, then causation is from growth to financial development. Bi-directional causality is indicated when the set of coefficients on the lagged financial development variable and growth in equations 1 and 2, respectively, are both statistically different from zero. When financial development does not cause growth and growth does not cause financial development, growth and financial development are either statistically independent or only related contemporaneously.

The statistical methodology employed in this paper focuses on the lag-length parameterization of the individual time series. Usually, lag-length selection is done in an ad hoc manner and all variables are constrained to the same lag length. Hsiao (1979, 1981) argued that an ad hoc choice of lag length is problematic because the test on the significance of the coefficients is quite sensitive to lag selection⁵. He proposed a test procedure that combines Akaike's (1969 a, b) financial prediction error (FPE) and Granger's (1969) definition of causality to determine the optimum lag for each variable and the causal relationships⁶.

4. Other methods of testing causality in temporal systems based on OLS estimates and the F-test have been suggested by Sims (1972), Pierce and Haugh (1977) and Geweke (1981). Guilkey and Salemi (1982) and Geweke, Meese and Dent (1983) have shown that the Granger (1969) test outperforms the other methods in both large and small samples.

5. This is amply demonstrated in a study by Frederiksen and LaCivita (1987). They found no statistically significant relationship between economic growth and defense spending when both variables were entered with a lag of four. However, when the lag on both variables was set at two, they found that growth causes defense. See also Geweke (1984) and Nakhaeizadeh (1987).

6. Thornton and Batten (1985) found Hsiao's method to be superior to both arbitrary lag-length selection and several other systematic procedures for determining lag length. Recent studies investigating causal relationships between money and income [Craigwell and Leon (1990)], defense spending and economic growth [LaCivita and Frederiksen (1991)] and investment and economic growth [Wood (1992)] have utilized Hsiao's procedure.

The first step in Hsiao's procedure is to perform a series of autoregressive regressions on the dependent variable, beginning with one lag and adding one more lag in each succeeding regression. That is, for the growth variable we estimate M regressions of the form:

$$G_t = \emptyset + \sum_{j=1}^m \alpha_{t-j} G_{t-j} + \epsilon_t \quad (3)$$

where the value of m ranges from 1 to M , M being the maximum lag length. For each regression we compute the FPE in the following manner:

$$FPE(m) = \frac{T+m+1}{T-m-1} \times \frac{SSE(m)}{T} \quad (4)$$

Where T is the sample size, and $FPE(m)$ and $SSE(m)$ are the final prediction error and the sum of squared errors, respectively. The optimal lag, m^* , is the lag length which produces the lowest FPE. Secondly, treat G as the only output of the system and assume financial development (FD) as the manipulated (input) variable which controls the outcome of G . With the order of the autoregression of growth determined (from step one), regressions are estimated with the lags on the financial development variable added sequentially in the same manner used to determine m^* . Thus we estimate S regressions of the form:

$$G_t = \emptyset + \sum_{j=1}^{m^*} \alpha_{t-j} G_{t-j} + \sum_{j=1}^s \beta_{t-j} FD_{t-j} + \epsilon_t \quad (5)$$

where s ranges from 1 to S , S being the maximum lag length. Computing the final prediction error for each regression as

$$FPE(m^*, s) = \frac{T+m^*+s+1}{T-m^*-s-1} \times \frac{SSE(m^*, s)}{T} \quad (6)$$

we choose the optimal lag length for FD, s^* , as the length which produces the smallest FPE.

To test for causality, the FPEs from steps one and two are compared. If FPE (m^*) is less than FPE (m^*, S^*), a uni-dimensional autoregressive representation for growth is used, and it is said that financial development does not Granger-cause growth. If the converse is true, then financial development causes growth. Once the test has been performed with economic growth as the output variable, a similar test for financial development – treating growth as the manipulated variable – is undertaken.

3. Data and Empirical Results

The data used are annual observations spanning the period 1946 to 1990, and were obtained from various issues of the Central Bank of Barbados, *Annual Statistical Digest* and *Economic and Financial Statistics*. Quantitative measures of the financial development of an economy are bound to be imperfect since financial development is multi-dimensional and highly qualitative. The measure of financial development employed is the ratio of M2, a broad definition of money, to gross domestic product (GDP), which is widely regarded as a monetization variable⁷. The monetization variable is designed to show the real size of the financial sector in a growing economy. An increase in the M2/GDP ratio reflects a higher degree of division of labour and specialisation in both real and financial sectors [see Jung (1986) p. 336]. A cursory look at the data for Barbados shows that the ratio increased during the post-independence period⁸. Real economic growth in the exercise is measured by the growth of real gross domestic product in 1974 prices.

The empirical analysis is conducted in two parts. First, using Hsiao's procedure, we investigate the causal relationships between financial development [proxied by the monetization variable (MV)] and economic growth (GR) for the entire sample period, 1946-1990. Second, in order to test Patrick's hypothesis that the supply-leading effect dominates during the early stage of development and as the modern sectors of the economy develop, the demand-following financial response becomes dominant, we conduct the causality testing on two subsamples. The choice of subsamples was determined largely by developments in the real sector of the economy. Specifically, during

7. Specifically speaking, M2 is M1 (the sum of currency plus demand deposits) plus quasi money. The latter includes time and saving deposits at commercial banks and other financial institutions. The ratio of M2 to GDP is used as a measure of monetization by McKinnon (1973) and Shaw (1973), among others.

8. Barbados gained political independence from the United Kingdom on 30 November 1966.

the first subsample (1946 to 1968), the Barbadian economy was heavily dependent on the agricultural sector, particularly sugar. The agricultural sector accounted for about 31 percent of real domestic output and 64 percent of foreign exchange earnings, on average, between 1950 and 1968⁹. The second subsample (1969-1990) covers the period in which the Barbadian economy underwent structural transformation, with manufacturing and services, particularly tourism, becoming important growth centres.

The contribution of manufacturing to real domestic output, which was 4.5 percent during the early 1960s, increased to a yearly average of around 11.0 percent during the 1980s; and for tourism the corresponding figures were 4.2 percent and 12.8 percent, respectively. Thus, in the context of Patrick's analysis, we test for changing direction of causality over the two subsamples.

To determine the lag orders of the uni-dimensional autoregressive processes for the financial development measure (MV) and economic growth (GR) for the entire sample, equations were estimated with an upper bound of 8 on the lag structure of each variable, while for the subsamples we choose a maximum lag length of 5 for the variables¹⁰. The final prediction errors (FPEs) of these uni-dimensional series for the varying sample periods are reported in Tables 1-3, respectively¹¹. By fixing each variable (controlled) at the lag obtained from the uni-dimensional autoregressive search and sequentially varying the number of lags on the other manipulated (input) variable in the causal regression, we compute the FPEs for different combinations, as the orders of the manipulated variable are varied from 1 to 8 in the case of the entire sample period, and 1 to 5 with the subsamples. The specifications that produce the smallest FPEs are presented in Tables 1 (a) - 3 (a), respectively.

A comparison of the results in Tables 1 and 1 (a) reveals that financial development, proxied by the monetization variable, Granger-causes economic growth. Similarly, a test of the causal relationship from growth to financial development indicates that growth

9. Source: Central Bank of Barbados, Annual statistical Digest, various issues; and Balance of Payments, various issues.

10. Although the Hsiao procedure eliminates potential misspecification bias by determining a specific lag structure, some bias may still remain as the maximum lag length (M) is chosen arbitrarily. M should be as large as possible consistent with the sample size and the underlying economic process. In the cases where the optimum lag structure (m) was found to be the chosen maximum, we tested with a lag structure of $m + 1$ to determine if $FPE(m + 1) < FPE(m)$. In all cases, $FPE(m)$ was preferred.

11. The results were obtained using the 640K version DATAFIT now MICROFIT-statistical program.

Granger-causes financial development. Thus, for the Barbadian evidence over the longer period, a bi-directional causal relationship exists between financial development and economic growth, supporting the mid-way position suggested in Gurley and Shaw (1967).

The results in Tables 2 and 2 (a) indicate a uni-directional causal relationship from economic growth to financial development during the early stages of development. The absence of a supply-leading relationship, that is, a causal relationship from financial development to economic growth, suggests that the financial sector was not an important link in the saving-investment process. This observation corroborates the claim of regional commentators [for example, Thomas (1965) and McClean (1975)] that the structure and operation of financial entities in Barbados (and the wider Caribbean) did not promote economic growth during the colonial period.

The results obtained for the second subsample (Tables 3 and 3 (a)) indicate a supply-leading relationship. This suggests that the Barbadian financial sector constituted a leading sector in the transformation process, and confirms the recent finding of Codrington and Coppin (1989), attained through a casual inspection of the evidence, that "there were clear cases where the expansion of the financial sector served to improve the rate of economic growth". Jung (1986) and St. Hill (1992) also found evidence that financial development (proxied by the monetization variable) leads economic growth for a sample of developing countries. The results obtained for the second subsample also show a reverse causal relationship from economic growth to financial development, thereby indicating the importance of economic growth in stimulating the development of the Barbadian financial sector.

Table 1

FPE OF ONE-DIMENSIONAL AUTOREGRESSIVE PROCESS FOR MV AND GR: 1946-1990

Order of Lags	FPE of MV	FPE of GR
1	0.002886	34.367
2	0.002740	34.469
3	0.002717	35.766
4	<u>0.002108</u>	35.514
5	0.002179	36.642
6	0.002208	37.732
7	0.002219	28.875
8	0.002248	<u>27.291</u>

Note: The underlined values indicate the lowest of the FPE.

Table 1 (a)

THE OPTIMAL LAG OF "MANIPULATED" AND FPE OF "CONTROLLED" VARIABLES

Controlled Variable ^a	Manipulated Variable	Optimal Lag	FPE
MV (4)	GR	5	0.00184
GR (8)	MV	3	26.786

^a Values in brackets indicate the order of the AR operator for the control variable.

Table 2

FPE OF ONE-DIMENSIONAL AUTOREGRESSIVE PROCESS FOR MV AND GR: 1946-1968

Order of Lags	FPE of MV	FPE of GR
1	0.002966	58.535
2	0.002775	59.093
3	0.002484	62.804
4	<u>0.001434</u>	63.971
5	0.001520	<u>58.328</u>

Note: The underlined values indicate the lowest of the FPE.

Table 2 (a)

THE OPTIMAL LAG OF "MANIPULATED" AND FPE OF "CONTROLLED" VARIABLES

Controlled Variable ^a	Manipulated Variable	Optimal Lag	FPE
MV (4)	GR	5	0.000485
GR (5)	MV	4	63.750

^a Values in brackets indicate the order of the AR operator for the control variable.

Table 3

FPE OF ONE-DIMENSIONAL AUTOREGRESSIVE PROCESS FOR MV AND GR: 1969-1990

Order of Lags	FPE of MV	FPE of GR
1	0.003251	13.555
2	0.003325	14.799
3	0.003559	13.613
4	<u>0.003054</u>	13.741
5	0.003317	<u>13.475</u>

Note: The underlined values indicate the lowest of the FPE.

Table 3 (a)

THE OPTIMAL LAG OF "MANIPULATED" AND FPE OF "CONTROLLED" VARIABLES

Controlled Variable ^a	Manipulated Variable	Optimal Lag	FPE
MV (4)	GR	4	0.002872
GR (5)	MV	4	8.466

* Values in brackets indicate the order of the AR operator for the control variable.

The results for the subsamples thus provide no support for Patrick's hypothesis which essentially suggests that financial intermediation "causes" economic growth at the early stage of development, while development of the modern sectors of the economy result in a demand-following financial response.

Finally, a few caveats are in order. First, the Granger notion of causality is not equivalent to many philosophical notions of causation.¹² Second, the results are conditional on the information set utilized and may have missing-variable bias. If the information set contains expectations on the future movement in a variable, it is conceivable that the direction of causality may be affected. Third, the test of whether financial development causes growth (and vice versa) will fail to detect the effect on growth of contemporaneous innovations in financial development (and vice versa).

12. See Hicks (1979) and Zellner (1979) for a discussion of this point.

4. Conclusion

In this paper we investigated the causal relationship between financial development and economic growth for Barbados. Using Hsiao's testing procedure we found evidence of a supply-leading causality pattern (for the entire sample period and the second subsample), emphasizing the importance of financial development in the Barbadian economy. Also, there is considerable evidence of a demand-following financial response. However, the empirical results provide no support for Patrick's hypothesis that the direction of causality between financial development and economic growth changes over the course of economic development.

References

- Akaike, H. (1969a). "Statistical Predictor Identification", *Annals of the Institute of Statistical Mathematics*, Vol. 21, pp. 203-217.
- , (1969b). "Statistical Autoregressions for Predictions", *Annals of the Institute of Statistical Mathematics*, Vol. 21, pp. 243-247.
- Bencivenga, V. and Smith, B. (1991). "Financial Intermediation and Endogenous Growth", *Review of Economic Studies*, Vol. 51, pp. 393-414.
- Central Bank of Barbados, *Annual Statistical Digest*, various issues.
- Central Bank of Barbados, *Economic and Financial Statistics*, various issues.
- Codrington, H. and Coppin, A. (1989). "The Financial Structure and the Allocation of Credit in Barbados, 1977-1987", *Social and Economic Studies*, Vol. 38, No. 4, pp. 165-179.
- Craigwell, R. and Leon, H. (1990). "Causality Testing and Sensitivity to Detrending: The Money-Income Relationship revisited", *North American Review of Economics and Finance*, Vol. 1, pp. 117-133.
- Frederiksen, P. and LaCivita, C. (1987). "Defense Spending and Economic Growth: Time Series Evidence on Causality for the Philippines, 1965-1982", *Journal of Philippine Development*, Vol. 14, pp. 354-360.
- Geweke, J. (1981). "A Comparison of Tests of the Independence of Two Covariance-Stationary Time Series", *Journal of the American Statistical Association*, Vol. 76, pp. 363-373.
- , (1984). "Inference and Causality in Economic Time Series Models", in Griliches, Z. and Intriligator, M. (eds), *Handbook of Econometrics*, Amsterdam: North Holland.
- , Meese, R. and Dent, W.T. (1983). "Comparing Alternative Tests of Causality in Temporal Systems: Analytical Results and Experimental Evidence", *Journal of Econometrics*, Vol. 21, pp. 161-194.
- Goldsmith, R. (1969). *Financial Structure and Development*, New Haven: Yale University Press.
- Granger, C. W. (1969). "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods", *Econometrica*, Vol. 37, pp. 424-438.
- , (1980). "Testing for Causality: A Personal Viewpoint" *Journal of Economic Dynamics and Control*, Vol. 2, pp. 329-352.

-
- Guilkey, D.K. and Salemi, M.K. (1982). "Small Sample Properties of Three Tests for Granger-Causal Ordering in a Bivariate Stochastic System", *Review of Economics and Statistics*, Vol. 64, pp. 668-681.
- Gupta, K.L. (1984). *Finance and Economic Growth in Developing Countries*, London: Croom Helm.
- Gurley, J. and Shaw, E. (1967). "Financial Development and Economic Development", *Economic Development and Cultural Change*, Vol. 15, pp. 257-265.
- Hicks, J.R. (1979). *Causality in Economics*, London: Blackwell.
- Hsiao, C. (1979). "Autoregressive Modelling of Canadian Money and Income Data", *Journal of the American Statistical Association*, Vol. 74, pp. 553-560.
- , (1981). "Autoregressive Modelling and Money-Income Causality Detection", *Journal of Monetary Economics*, Vol. 7 pp. 85-107.
- Jung, W.S. (1986). "Financial Development and Economic Growth: International Evidence", *Economic Development and Cultural Change*, Vol. 34, pp. 333-346.
- LaCivita, C. and Frederiksen, P. (1991). "Defense Spending and Economic Growth: An Alternative Approach to the Causality Issue", *Journal of Development Economics*, Vol. 35, pp. 117-126.
- McClean, A.W. (1975). *Money and Banking in the East Caribbean Currency Area*, Institute of Social and Economic Research, UWI, Jamaica.
- McKinnon, R. (1973). *Money and Capital in Economic Development*, Washington, D.C.: Brookings Institute.
- Nakhaeizadeh, G. (1987). "The Causality Direction in Consumption-Income Process and Sensitivity to Lag Structures", *Applied Economics*, Vol. 19, pp. 829-838.
- Patrick, H. (1966). "Financial Development and Economic Growth in Underdeveloped Countries", *Economic Development and Cultural Change*, Vol. 14, pp. 174-189.
- , (1967). "Japan", in Cameron, R. (ed), *Banking in the Early Stages of Industrialization*, New York: Oxford University Press.
- Pierce, D. and Haugh, L. (1977). "Causality in Temporal Systems: Characterizations and a Survey", *Journal of Econometrics*, Vol. 5, pp. 265-293.
- Shaw, E. (1973). *Financial Deepening in Economic Development*, New York: Oxford University Press.
- Sims, C. (1972). "Money, Income and Causality", *American Economic Review*, Vol. 62, pp. 540-552.
- Stammer, D. (1972). "Financial Development and Economic Growth in Underdeveloped Countries: Comment", *Economic Development and Cultural Change*, Vol. 20, pp. 318-329.
- St. Hill, R. (1992). "Stages of Banking and Economic Development", *Savings and Development*, Vol. 16, No. 1, pp. 5-21.
- Thomas, C.Y. (1965). *Monetary and Financial Arrangements in a Dependent Monetary Economy*, Institute of Social and Economic Research, UWI, Jamaica.
- Thornton, D.L. and Batten, D.S. (1985). "Lag-Length Selection and Test of Granger-Causality Between Money and Income", *Journal of Money, Credit and Banking*, Vol. 17, pp. 164-178.
- Wood, A.P. (1992). "An Analysis of Savings, Investment and the Financial System in Barbados: 1965-1990", Unpublished Doctoral Dissertation, University of Cambridge.
-

-
- Woolmer, K.J. (1977). "The Financial System and Economic Development in Nigeria, 1950-1971", in Newlyn, W.T. (ed), *The Financing of Economic Development*, Oxford: Clarendon Press.
- Zellner, A. (1979). "Causality and Econometrics", in Brunner, K and Meltzer, A. (eds), *Three Aspects of Policy and Policy Making: Knowledge, Data and Institutions*, Amsterdam: North Holland.

Abstract

The financial development - economic growth causal relationship is examined using the Hsiao (1979) causal testing method. We find that, for the Barbadian data over the 1946-1990 period, a bi-directional causal relationship exists between financial development and economic growth. However, the results provide no support for Patrick's hypothesis that the supply-leading effect dominates during the early stage of development and as the modern sectors of the economy develop, the demand-following financial response becomes dominant.