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DETERMINANTS OF INVESTMENTS IN THE TRADED AND NON-TRAED SECTORS

BY

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Determinants of investments in the traded and non-traded sectors in Barbados

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Abstract

Modern investment theory suggests that investment is one of the main policy variables to foster economic growth and maintain stability in an economy. It is therefore important to identify the factors affecting sector-specific investments in order to accurately formulate economic policies that aid in the growth of the economy. Considering this, the distinction between investment in the traded and non-traded sectors has to be clearly outlined since the former represents the prospects for foreign exchange. Hence, this paper seeks to identify the key determinants of investment in the traded and non-traded sectors in Barbados, over the period 1976-2009

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JEL Classification:

1.0 *Introduction*

Investment is a central concept in finance and macroeconomic theories and has been widely researched over the past few decades. It may be defined as the process of capital formation where resources are acquired or created for production in an economy. Investment in this regard may be seen as one of the policy variables to increase growth and maintain stability in an economy. However, Griffiths (1998) highlights that it is important to recognize that the rate of a country's development will largely depend on which sector of the economy enjoy the most rapid investment.

In small open and dependent economies, it is important to distinguish between investment in the traded and non-traded sectors as the former allows countries to earn foreign exchange while the latter promotes infrastructural development. It is against this background that this study seeks to determine the factors that drive investment in both sectors in Barbados. Although similar studies exist[1], they lack the more rigorous econometrics techniques in particular, co-integration analysis and reliable data necessary for valid inferences. Therefore, this paper provides empirical estimates of investment functions for the traded and non-traded sectors using dynamic ordinary least squares (DOLS) procedure. The central goal of this paper is to highlight those factors that influence investment in the traded and non-traded sectors which will therefore provide a direction for policy making.

The reminder of the paper is organised as follows: Section 2 provides some stylized facts about the behaviour of investment in Barbados. Section 3 gives a review of the relevant theoretical and relevance of investment theory to small open economies. Section 4 describes the model specification and data used. Section 5 presents the

[1] See James (1999) and Griffith (1998).

estimation procedure and results of the study. Conclusion and possible policy implications are presented in Section 6.

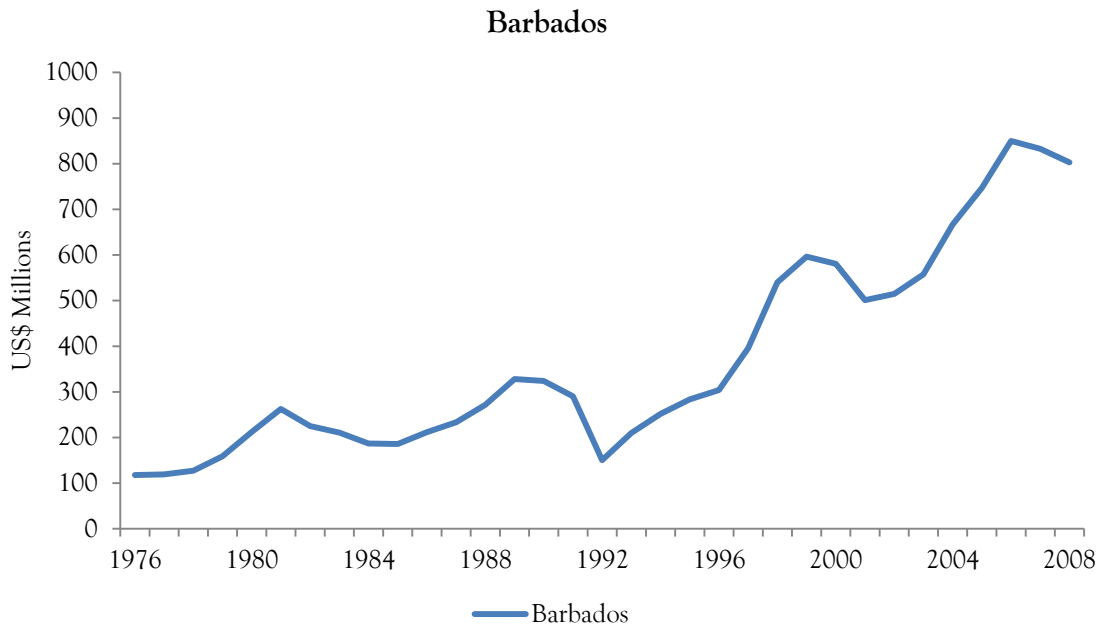
2.0 *Stylized facts about the investment patterns in Barbados*

The following is a concise report that highlights the general patterns of investment in Barbados over the period 1976-2008. The report provides a descriptive analysis for the direct investments (as measured by Gross Capital Formation at current prices, US$) in the traded and non-traded sectors, real GDP and investment to GDP ratios for the three countries.

Prior to the trend analysis, it is useful to broadly define what constitutes adequate levels of investment. Generally, an economy is said to have an adequate level of investment when GCF is able to create conditions of full employment and a reasonable standard of living. It therefore implies that differences in investment rates between countries very often mirror different levels of economic development. Quantitatively, economists define an acceptable level of investment as one equal to 25-30% of total national income or gross domestic product[2]. An examination of nominal investment trends between 1976 and 2008 has shown that investment has largely been on a continuous, increasing path for all three countries (See Figure 1).

[2] See Morgenstern (1965). This accepted level using the European Union (EU-27) as the benchmark

Figure 1: Comparison of direct investment (current prices), 1976 - 2008



Source: ECLAC - CEPALSTAT

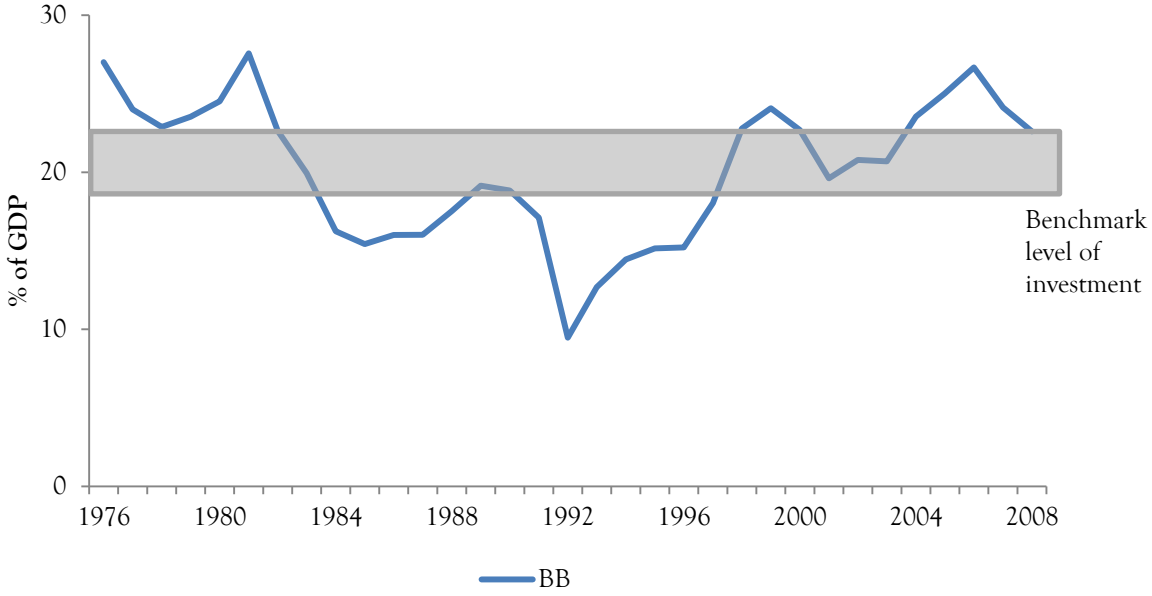
Interesting trend dynamics are revealed when investment is compared to output levels. Investment to GDP ratios are constructed for Barbados (See Figure 2) and were then compared to the aforementioned benchmark. Barbados has shown considerable variation in its investment to GDP ratio over the past few decades but have been, in general, below the threshold. Barbados had adequate levels of investment during the 1970s and early 1980s, which averaged around 25% and 28%[3] respectively.

Thereafter, the rest of the decade and 1990's saw a general decline in the investment to GDP ratio for Barbados. In fact, the investment ratio averaged an estimated 17% between 1985 and 1999, with the lowest recorded share of investment occurring in 1992 (9.5%). This sharp decline was due to the balance of payments crisis and accompanying macro-economic slowdown in 1991. The following decade also had mixed

[3] The WTO reported that Trinidad and Tobago's economy grew rapidly during that period due to the oil boom that resulted in increased foreign investment and consumption.

results as in the early 2000s, the investment ratio for Barbados decreased. As the 2000s drew to a close, there were sharp declines in the investment ratios which may be attributed to the global recession that affected the real sectors of the economies.

Figure 2: Comparison of investment to GDP ratios, 1976-2008



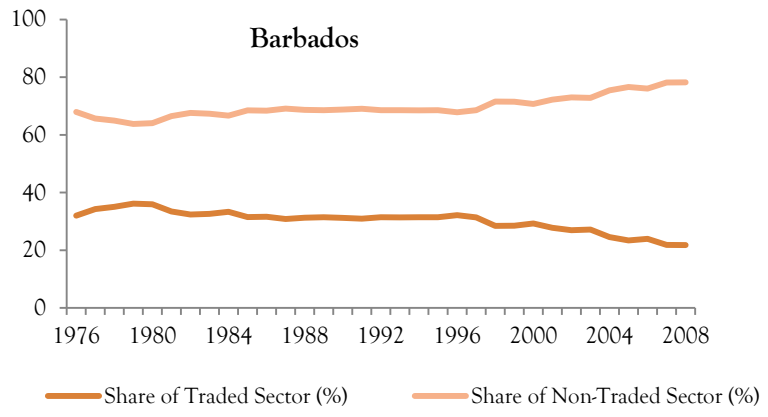
Source: Author's calculations (GCF/GDPm).

The trend of investment in Barbados can further be examined by decomposing the investment in the traded and non-traded sectors. Since foreign exchange is important to small open economies such as Barbados sectors are grouped according to those which are net earners of foreign exchange (traded) and those which are net users of foreign exchange (non-traded)[4]. Figure 3 illustrates that the share of investment in the non-traded sector for Barbados, has significantly contributed more to overall investment than investment in the traded sector for the period, 1976 - 2008. In particular, the non-traded sector has contributed on average, over 50% to total investment and its portion has

[4] For this reason, investment in traded sectors is considered to be more productive (since it earns foreign exchange) than investment in the non-traded sectors (since it utilizes foreign exchange).

generally been increasing over time for Barbados. It is important to highlight that since investment in the non-traded sector is considered less productive (since it utilizes foreign exchange) then when investment in this sector increases relative to the traded sector, output of the non-traded sector also grows which results in a rise in import demand. More foreign exchange is therefore required to meet this increased demand placing a burden on the balance of payment accounts in each country[5]. It is important to highlight that there is a large disparity between the share of investment in the traded and non-traded sectors in Barbados.

Figure 3: Categories of investment (% share of GCF) in Barbados



Source: Author's calculation.

[5] This may be a contributing factor to the balance of payment difficulties that permeated Caribbean countries during the 1990's.

3.0 *Literature Review*

Since Keynes' (1936) seminal proposal of the theory of investment, several other theories have emerged to model investment behaviour. This section presents an outline of the empirical studies of investment in developed countries and the Caribbean. Also, a discussion of the usefulness of modeling investment in the traded and non-traded sectors to small open economies is presented in this section.

3.1 *Theoretical Overview of Investment*

The Keynesian theory of investment is derived from the neoclassical school of thought. Overall, Keynes illustrates that investment is negatively related to interest rates and asserts that as investment increases, the marginal efficiency of investment declines. Keynes' model however, only accounts for the supply side analysis of investment.

The accelerator principle, proposed by Clark (1917), builds on the Keynesian model by linking investment to the rate of change in income/output. The prinicple states that induced investment is driven by changes in consumption and national income. In other words, investment is a partial or complete adjustment of real capital stock since the adjustment coefficient is taken to be unity so that actual capital is equal to desired capital and net investment is proportional to the change in desired capital. Therefore, the interplay between these mechanisms may, in principle, yield fluctuations in economic activity. For example, the principle asserts that an increase in government expenditure increases national income, which in turn raises investment. However, Jorgenson (1971) reports that this model specification (that the adjustment coefficient is equal to unity) was rejected in tests by Chenery (1952), Koyck (1954) and Hickman (1957). Furthermore,

Tinbergen (1938) concludes that the accelerator principle is not very helpful in the explanation of the details in real investment fluctuations and St. Cyr and Ramlogan (1991) suggest that the accelerator model fits data poorly.

The flexible accelerator model is the alternative to the accelerator model, which focuses on the time structure of the investment process. In other words, it models actual capital as a weighted average of all past levels of desired capital (distributed lag function). Tinbergen (1938) proposes an addition to the flexible accelerator model which suggests that investment depends on the level of profits. It was subsequently developed by Klein (1950). Within this framework of the flexible accelerator model, all three determinants of investment; output, internal funds and the cost of external finance may be included as determinants of the desired level of capital. While this model accounts for the change in capital stock, it does not consider gross investment which includes replacement investment or depreciation which is often a dominant factor in investment according to the accounting definition. Therefore, the flexible accelerator model may be transformed into a complete theory of investment behaviour by adding a specification of the desired level of capital and a model of replacement investment (Jorgenson, 1971).

Other developments in investment theory build on the neoclassical framework to include adjustment costs both internal and external[6]. One of the most common among these developments includes Tobin's Q theory of investment proposed by Tobin (1969). He posits that investment is determined by the ratio of the market value of a firm's asset

[6] See Eisner and Strotz, (1963) and Lucas (1967) for internal adjustment cost and Foley and Sidrauski (1970) for external adjustment costs.

and its replacement value. The problem with this approach is that the variables used are very difficult to measure[7].

The empirical failures of these traditional views of investment[8] have led to the emergence of a new view of investment in the last few decades that emphasizes three important features of most investment decisions overlooked by the conventional approach (Dixit and Pindyck, 1994). First, most fixed capital investments are partly or completely irreversible (the initial cost of investment is at least partially sunk)[9]. Second, investment decisions are affected by uncertainty about future returns. Bernanke (1983) extends this idea to the role of uncertainty in delaying investment decisions. He argues that the best investors can do is attach probabilities to possible outcomes where the expected severity of future bad news matters for the decision whether to invest today and good news does not matter at all. Third, investors can control the timing of investment, and postpone it in order to acquire more information about the future. These three facts constitute the so-called "option approach" that views an investment opportunity as an option to purchase an asset at different points in time (Servèn, 1997). The optimal investment policy balances the value of waiting for new information with the cost of postposing the investment in terms of forgone returns[10]. Hence, if the future is uncertain, additions to productive capacity (capital stock) today may be costly to reverse in the future. Uncertainty may therefore be a powerful deterrent for even risk-neutral investors. This

[7] See Abel (1980), Hayashi, (1982) and Precious (1985).
[8] See Abel and Blanchard (1986).
[9] Investment irreversibility problems under certainty was first proposed by Arrow (1968) using a deterministic model. The problem is formulated in continuous-time with a deterministic interest rate and profit function which does not incorporate uncertain economic shocks.
[10] The optimal irreversible investment policy of a firm facing uncertainty was first analysed by Bertola (1988) and Pindyck (1988).

implies that uncertainty, like interest rates, may be a relevant investment determinant variable.

3.2 *Relevance of Investment Theory to Small Open Economies*

The investment theories outlined above have been questioned in terms of their applicability to small developing economies[11]. Griffith (1997) posits that the lack of well-functioning markets and the enormous role of government in capital formation in dependent economies (resulting in distortions) make the specification of these models inappropriate for describing investments decisions in these smaller economies. Other studies[12] note that accelerator or neoclassical framework requires data which are either unavailable or difficult to obtain for small open economies. Specifically, while output, capital stock, user cost of capital, interest rates and retained profits are the most significant variables found to explain investment behavior (James, 1999).. However, developing countries often lack comprehensive data for these variables, capital stock in particular, making it virtually impossible to observe the stock adjustment mechanism. Worrell (1992) puts the point well, noting that although the accelerator theory is the standard approach to the determinants of investment used in the analysis of developed countries, it may not be the most useful for small open economies. The accelerator, which finds the motive for investment in the growth of income in previous periods, is only important for the non-traded sector of open economies and therefore, an increase in non-tradable output will stimulate growth, but at the cost of worsening structural disequilibrium in the balance of payments. As a result of these limitations, the focus of

[11]See Cummins *et al* (1994), Jorgenson (1996) and Hubbard (1997)
[12] See Haque *et al* (1994), Khan (1988) and Blejer and Khan (1984).

studies on small open economies, Caribbean economies in particular, has focused less on capital stock dynamics and much more on the tradable and non-tradable dichotomy in explaining/determining investment.

Nevertheless, there is still a dearth of studies on the determination of investment in the traded and non-traded sectors in the Caribbean. Worrell (1990) discusses the various motives for investment by foreigners, investment in the non-tradable sector and investment by domestic investors in the tradable sector. He employs a methodology similar to that used by Blejer and Khan (1984) but uses interest rates to measure the financial constraint and introduces a relative price to capture the competition for investment funds between exports and non-tradables. Additionally, in the absence of a measure of comparative after tax rate of profit, Worrell (1990) uses the relative prices of tradables and non-tradables as a proxy. His results imply that overinvestment in the non-tradable sector has the same effects as overconsumption[13] and that investment in the non-tradables increases national output in the short run but output is likely to contract as a result of deflationary devaluation once foreign reserves are depleted. Although Worrell's study provides useful suggestions for the direction of policy, his model may still be impractical for many small economies due to the lack of availability of data which is needed for a more disaggregated analysis of investment.

Griffith (1998) is the first study to empirically investigate trends of investment from a sectoral perspective in the region. She determines the factors driving investment in the traded and non-traded sectors in the Barbadian economy. Griffith proposes two separate equations for modeling investment in the traded and non-traded sectors in

[13] Overconsumption includes increasing imports, exhaustion of foreign exchange reserves, devaluation of the currency and inflation.

Barbados. She hypothesizes that investment in the traded sector is a function of changes in the terms of trade; the index of the real exchange rate[14]; government investment to GDP ratio and the lagged ratio of external debt service payments to exports of goods and services. Similarly, investment in the non-traded sector is a function of the index of real exchange rate; government investment to GDP ratio; the lagged debt service ratio as well as the lagged rate of real output growth and the real change in domestic credit. Her results from the Engle-Granger two-step estimation reveal that for the non-traded investment model government investment, interest rates and debt service ratio were significant with the debt service ratio having the correct sign. Griffith's results imply that in the long run, an increase of one percentage point in the debt service ratio leads to a decline in the rate of investment in the non-traded sector by about 0.2 percentage points. On the other hand, a similar increase in the rate of government investment and interest rate impacts positively on the investment rate to the magnitude of 0.78 and 0.5 percentage points respectively. However, she reports that the positive sign on the interest rate variable was opposite to what was expected on *a priori* basis. This contradicts the Keynesian theory of investment which posits an inverse relationship. Griffith refers to Galbis (1976) and Fry (1980) who found a similar relationship, to confirm her result that a direct relationship between investment and interest rate is possible within a low interest rate range (typically observed in many developing countries). She finds less success with the model for the traded sector since two of the variables carried the wrong sign and magnitude.

Overall, Griffith reports that it is premature to draw conclusions from the results of her study since her models may be mis-specified due to unavailability of data and

[14] The real exchange rate is measured as the relative price of non-tradables to tradables.

insufficient number of observations. Therefore, she posits that it is reasonable to say that the model for investment in the non-traded sector is plausible in the long-run but not in the short-run while her model for investment in the traded sector requires more research as there suspicion of omitted variable bias.

James (1999) extends Griffith's (1998) study by incorporating additional variables to identify the determinants of non-traded and traded investment in Barbados over a longer time span, 1964-1997. The additional variables include real wages, an uncertainty factor and the real interest rate. James also included both price of non-traded and traded capital goods and the real exchange rate while Griffith uses the relative price of non-tradables to tradables as a proxy for the real exchange rate. James employs the theoretical framework of Fielding (1998) as justification for the use of the above-mentioned variables. The inclusion of an uncertainty/risk factor is justified based on the uncertainty investment theory[15]. It also represents the level of stability of an economy. Like Griffith, James estimates two functions for the non-traded and traded investment. She employs the two-step method of Engle and Granger (1987) and finds that there is a cointegrating relationship among the variables in both the non-traded and traded sectors. Specifically, she finds that non-traded investment is positively related to traded investment and the price of tradables as well as negatively correlated to its own price and real exchange rate. However, the impact of the regressors in the traded sector is stronger. Evidence also indicates that Barbados may be interest rate constrained as opposed to being credit constrained.

Both Griffith (1998) and James (1999) use *a priori* approach to investigate the determinants of non-traded and traded investment in Barbados. Using this approach has it

[15] See Bernanke (1983).

merits however, it appears to limit the factors of investment determination. In other words, more sector-specific factors and not enough open-economy factors were employed in both studies. Nonetheless, the studies are both important and prove to be a sound foundation on which to base more comprehensive analysis. This paper attempts to take a step towards that goal using a more comprehensive econometric methodology by employing a general-to-specific approach. This approach starts from a general dynamic model of investment which captures the essential characteristics of aggregate investment in an open economy for Barbados over a longer time span.

4.0 Model specification and Data

4.1 *Model specification*

The model specification for the determinants of investment in the traded and non-traded sectors in the CARICOM countries Barbados, Jamaica and Trinidad and Tobago is based on the above discussion. Fielding (1998) provides an additional justification for the use of the models (1) and (2) within the context of a developing country. Empirically testable functions of the determinants of investment in the traded and non-traded sectors are therefore specified as:

$$I_t^r = f\left(I_t^n, I_t^g, Y_{t-1}, PSC_t, \sigma_t, P_t, r_t, DSR_{t-1}\right) \ldots\ldots\ldots\ldots\ldots (1)$$

$$I_t^n = f\left(I_t^r, I_t^g, Y_{t-1}, PSC_t, \sigma_t, P_t, r_t, DSR_{t-1}\right) \ldots\ldots\ldots\ldots\ldots (2)$$

where I_t^r is investment in the traded sector and I_t^n is investment in the non-traded sector. I_t^g is public investment which in this study is proxied by capital expenditure. Y_{t-1} is the lagged rate of real output growth. PSC_t is domestic credit to private sector measured as a percentage of GDP and σ_t is the level of uncertainty that represents a measure of

economic uncertainty/volatility. P_t is the relative price of tradables to non-tradables, r_t is the real interest rate and DSR_t is the lagged ratio of external debt service payments to exports of goods and services.

The effect of traded investment on non-traded investment and *vice versa* is ambiguous as it depends on the marginal product of capital (Fielding, 1998). To illustrate this, consider the simple case when capital stock is low, the marginal product of capital will be high, and therefore non-traded investment will increase (positive). On the other hand, if the marginal product is high, it reduces capital stock which results in a fall in investment. Therefore, the relationship will be negative.

Changes in private sector credit and real growth are expected to have positive effects on investment in the non-traded sector. Likewise, the former should have a positive impact on investment in the traded sector but it is anticipated that its effect will be negligible. At this stage, using general-to-specific modeling facilitates the inclusion of the real growth rate as a variable although it is believed that there is little accelerator effect in Caribbean economies[16].

Most public sector investment or capital expenditure is in non-traded capital goods such as expenditure on social infrastructure but this is largely a public good. Therefore, this kind of investment may be financed by borrowing or taxation. If the government chooses to incur debt, the amount of credit available to finance other investment projects will be reduced which may result in a decline in investment in the traded and non-traded sectors. Alternatively, capital expenditure creates new

[16] See Worrell (1990).

infrastructure which may result in an increase in investment in the traded and non-traded sectors. Thus, the overall impact of capital expenditure is ambiguous[17].

The impact of economic uncertainty and the real interest rate on investment in the traded and non-traded sectors are theoretically negative as noted by Fielding (1998) and Keynes (1936) respectively. In this study, economic uncertainty is the risk factor that may matter either because investors are risk averse or because investment decisions are irreversible. Fielding notes that there is an opportunity cost associated with investment decisions. Therefore, an increase in economic uncertainty is expected to reduce investment in both sectors. Keynes asserts that interest rate represents the cost of financing and as this cost increases the returns from investment will fall which discourages further investments in the traded and non-traded sectors. Also, it is anticipated that there will be a smaller interest rate effect on the non-traded sector as there are alternatives to borrowing. Specifically, the non-traded sector may receive government subsidies and grants to offset rising costs.

The impact of the relative price of tradables to non-tradables on investment in the traded and non-traded sectors is difficult to determine *a priori* as its impact depends on several interpretations of the variable. The impact of price of non-traded consumer goods may depend on the relative capital intensities of the different sectors of the economy. Fielding (1998) hypothesized that if the exports and non-traded goods sectors are relatively capital intensive (in a Heckscher-Ohlin sense), then increases in the price of non-tradables will increase demand for capital goods which will increase investment in traded and non-sectors. An alternative interpretation of the relative price of tradables to

[17] See Rama (1993).

non-tradables is to define it as the real exchange rate[18]. A rise in the real exchange rate (devaluation) makes imports and saving less attractive, reducing investment in the non-traded sector and stimulating investment in the traded sector. An appreciation of the exchange, *ceteris paribus* should have the opposite effect. One can also interpret this variable based on the assumption of whether traded and non-traded investments are substitutes or complements. Given that the traded and non-traded investments are substitutes, the price of non-tradables is expected to have a negative impact on non-traded investment but a positive impact on traded investment. Alternatively, if the two are complements then the price of non-tradables is expected to have an impact on both traded and non-traded investments.

The impact of the debt service ratio on investment in the traded and non-traded sectors is ambiguous as large debt service payments restrict investment in the traded and non-traded sectors of the economy while a reduction in debt service payments as a result of forgiveness or relief may increase public expenditures which in term may cause increases in investment.

4.2 *Data*

The data for exports/imports of goods and services and gross domestic product for the calculation of the export/import ratio, trade openness, real GDP and economic uncertainty were retrieved from the UN National Accounts database for all three countries. Economic uncertainty is captured by the volatility of economic growth and is calculated using a 5-year rolling standard deviation of real GDP growth. Capital

[18] See James (1999), Fielding (1998), and Griffiths (1998).

expenditure for Barbados is obtained from the Central Bank of Barbados Economic and Financial Statistics (various issues

Domestic credit to private sector is taken from the World Bank, World Development Indicators database and is given as a percentage of GDP. Data for the calculation of the relative price of tradables to non-tradables and investment in the traded and non-traded sectors were sourced from ECLAC, Economic Indicators and Statistics for. The traded sectors include agriculture, manufacturing and tourism.. It is important to note that in this study, investment in these sectors were calculated using the sum of the share of GDP for the respective sectors over total real GDP multiplied by measured investment (gross capital formation). The above data are used to estimate the investment equations specified in (1) and (2). This estimated model uses annual data, 1976-2008 for Barbados.

5.0 *Estimation Procedure*

The econometric methodology consists of three main steps. First, a battery of unit root tests is used to determine the order of integration for each series. The details of these tests are briefly outlined in the next section and the results are presented in the Appendix. Univariate residual unit root tests are then used to determine the existence of unique cointegration relationships within equations (1) and (2) if the residuals from both equations are stationary[19]. Finally, the long-run cointegrating equations are estimated using Stock and Watson (1993) Dynamic Ordinary Least Square (DOLS) this method is used primarily because it allows for the derivation of estimates among variables of

[19] The residuals from equations (1) and (2) are obtained by estimating the long run equilibrium relationship for each model using ordinary least squares (OLS).

different orders of integration and produces unbiased and asymptotically efficient estimates of long-run relationships.

5.1 *Unit Root Tests*

The battery of unit root tests employed in this study includes the Augmented Dickey-Fuller (ADF)[20] and the Phillips-Perron (PP) tests where the null hypothesis is an individual unit root process. The Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test is also used. This test is unique in that the null hypothesis is that an observable series is trend stationary (stationary around a deterministic trend). In cases where the ADF, PP and KPSS gave conflicting results, unit root tests with structural breaks are constructed in JMulti[21] which then determines the order of integration. The overall analysis of these test conclusively show that real interest rates and real GDP growth are stationary, $I(0)$ in levels. The remaining variables are non-stationary, $I(1)$ except for capital expenditure and economic volatility which are both stationary in levels in the models for Jamaica an Trinidad respectively (see Table 1 in Appendix).

5.2 *DOLS Estimation*

Given that the variables are integrated of different orders, the DOLS method proposed by Stock and Watson (1993) is used to estimate the long run effects of the models specified in (1) and (2). The DOLS is different from other cointegration approaches in that it approximates the long coefficients first then the short run model is

[20] For the ADF test, the optimal lag length is found by starting with the lag length, n and paring down based on the statistical significance of the last lag. This is the minimum lag necessary for white noise residuals.
[21] JMulti is an interactive software for econometric analysis, specialized in univariate and multivariate time series analysis.

formulated separately. This method accounts for possible issues of small sample bias, autocorrelation and endogeneity of the regressors by including leads and lags of the first difference of *I*(1) variables such that the long-run coefficients of the determinants of sector-specific investment is based on the following equation:

$$LOGINV'_t = \emptyset_0 + \beta X_t + \sum_{j=-k}^{k} \lambda'_j \, \Delta x'_{t-j} + \xi_t \qquad (3)$$

where $LOGINV'_t$ denotes the disaggregation of the log of investment in the traded and non-traded sectors, X_t is the set of investment regressors identified in Equations (1) and (2), β is the vector of long-run coefficients and x' is a subset of *I*(1) variables contained in X. Including$\Delta x'_{t+j}$, will account for possible endogeneity of *x* while $\Delta x'_{t-j}$ rectifies the issue of autocorrelation. The equation is estimated using OLS and because of the small sample size the usual *k*=2 (for annual data) could not be used. As such, equation (3) is estimated using *k*=1. A 'general-to-specific' procedure is then applied to reduce the model to a more parsimonious congruent specification where only significant variables are retained[22]. Robust standard errors are derived via the procedure recommended by Newey and West (1987).

The short-run dynamics of the models for investment in the traded and non-traded sectors are derived from the most parsimonious model of equation (3) to formulate a general error correction model of the form:

[22] See Campos *et al* (2005) for detailed explanations on the general-to-specific approach to econometric modelling.

$$\Delta INV'_t =$$

$$\sum_{j=1}^{p} \gamma_j \Delta INV'_{t-j} + \sum_{j=0}^{p} \varphi'_j \Delta x'_{t-j} + \sum_{j=0}^{p} \theta'_j Z_{t-j} + \delta_j \sum_{j=1}^{p} (INV'_{t-1} - \beta X^*_{t-1}) + \varepsilon_t$$

(4)

Equation (4) specifies the logged changes in sector-specific investment as a function of lagged values of the first difference of itself and the non-stationary variables; lagged values of the level-stationary variables and a stationary linear combination of the non-stationary variables. This stationary combination represents the error correction mechanism (ECM) for the DOLS approach to co-integration analysis. It measures the long-run speed of adjustment at which prior deviations from equilibrium investment are corrected and is represented by δ in equation (4). The long-run estimates among the variables are captured in the vector β and X^* are those variables to survive the reduction process of equation (3).

5.3 ***Results***

A battery of post diagnostics tests were performed on both the general and reduced equilibrium models to assess the robustness and to ensure that they satisfy all the classical linear assumptions for times series data. These tests include normality of residuals, Breusch-Pagan (B-P) test of homoscedasticity, serial correlation, model misspecification and parameter stability.

Barbados

Table 2 shows the estimated coefficients from the reduced form DOLS models for investment in the traded and non-traded sectors. The models satisfy all diagnostic tests

and have reasonably good fits, explaining between 69% and 99% of the total variation observed in sector-specific investments over the sample period. The results reveal that in the long-run, investment in the traded sector is positively influenced by private sector credit, capital expenditure and real growth in GDP. Despite being highly significant, the magnitudes of these variables accounts for minute changes in investment in the long run. Specifically, in the long run, positive growth in real GDP increases investment in the traded sector by 4%. Likewise, an increase in capital expenditure and private sector credit increase investment in the traded sector by 0.5% and 0.3% respectively and by 0.2% and 0.9% respectively in the non-traded sector. The results also show that in the long-run investment in the traded sector is negatively determined by economic uncertainty, the relative price of tradables to non-tradables and debt service ratio. The sign and magnitude of the coefficient estimate for the relative price of tradables to non-tradables indicate that investment in the traded sector will fall by 2.4% when the relative price of tradables to non-tradables increases. This confirms the result of James (1999) who also found this inverse relationship, suggesting that investment in the traded and non-traded sectors are substitutes. This made more evident since an increase in the relative price effect decreases investment in the non-traded sector by 3.4%.

As it relates to the short-run determinants of sector specific investment, the findings indicate that some of the long-run determinants of investment are also important for explaining the short-run dynamics of sector-specific investment. Furthermore, the short-run coefficients have the same expected signs and are of slightly higher magnitudes. Real growth in GDP has both a contemporaneous and lagged impact on investment in the traded and non-traded sectors. Interestingly, the lagged effect of real

growth in GDP has negative impacts on investment in that, an increase in real GDP growth in the previous period decreases current investment in the traded and non-traded sectors by 3% and 4% respectively. The sign and significance of real interests (in both short-run sector models) are in accordance with the Keynesian investment theory which posits an inverse relationship between investment and interest rates. This indicates that real interest is a measure of financial constraint in small open economies such as Barbados that determines the level of investment in each sector. Worrell (1990) explains that the mobility of funds to finance investment in these sectors I rationed only by the interest rate. This finding contradicts that of Griffith (1998) who found a positive relationship for Barbados. The conflicting results may be due the differences in the methodology employed and a longer time period.

The dynamics for the short-run model for the non-traded sector is more interesting as the lagged effect of capital expenditure and the debt service ratio have opposite signs despite being highly significant. The results reveal that an increase in capital expenditure in the previous period decreases current period investment in the non-traded sector by approximately 0.2%. Conceptually this implies that in the short-run if the cost of government financing a project is relatively high (incurs debt) then the amount of credit available to finance investment in the following period will decrease. It is normally the case for private investors to mainly invest in non-tradables. It therefore suggests that if the government expenditure has intertemporal impacts in that if government utilizes the liquidity credit in previous periods then this tends to crowd out private investment in the non-traded sector in the following period. Debt servicing has the opposite effect on investment in non-traded sector in the short-run. The estimated coefficient implies that an

increase in debt servicing obligations by government in the previous period, increases current investment in the non-traded sector by approximately 4.1%. A possible explanation for this may be due to the construction of the variable. In this study, the capacity for a government to service its debt is constructed as a ratio of external debt service payments to exports of goods and services. This suggests that an increase in the debt service ratio may be due to a fall in exports thus making investment in the traded sector less attractive. Since traded and non-traded investments are substitute goods then the increase in the debt service ratio (as a result of a fall in exports) may increase investment in the non-traded sector in the following period.

The estimated coefficients of the error correction terms for both investment models are highly significant and have the correct signs indicating the existence of a stable cointegrating relationship between investment traded and non-traded sectors and their long-run determinants for Barbados. The coefficients of these terms are -0.43 and -0.67 for the traded and non-traded sectors respectively. This suggests that approximately 43% and 67% of any deviation from the long-run equilibrium consumption path is corrected annually. Therefore, it takes Barbados between one and half to little over two years to restore to equilibrium after a shock to investment in traded and non-traded sectors respectively.

Table 1: Determinants of Investment in the Traded and Non-Traded Sectors in Barbados

Variables	Coefficients DOLS	
Long-run multipliers	***Traded Sector***	***Non-traded Sector***
Private Sector Credit	0.0032***	0.0093***
Expenditure	0.0048***	0.0024**
Real GDP	0.0378***	0.0407***
Economic uncertainty	-0.1391***	-0.1927***
Relative price effect	-2.4100***	-3.3517***
Debt service ratio	-8.5304	-11.1848
Adjusted R^2	**0.9668**	**0.9864**

Short-run Dynamics	***Traded Sector***	***Non-traded Sector***
Rgdp	0.0457***	0.0451***
$rgdp_{t-1}$	-0.0304**	-0.0398***
Δvol	-0.0239**	-0.0777**
Δpt_pn	-2.0439***	-3.0263***
Δpt_pn_{t-1}	-	-1.3878**
Rint	-0.0118*	-0.0135**
Δexp_{t-1}	-	-0.0024**
Δdsr_{t-1}	-	4.0806***
ECM_{t-1}	-0.4346***	-0.6705***
Adjusted R^2	**0.6913**	**0.8158**

Notes: ***, **, and * indicate that the coefficient is statistically significant at the 1%, 5% and 10% level respectively. Estimated lags and leads are not reported since they are considered nuisance regressors.

6.0 *Conclusion and Policy Implications*

This study aims to identify the key determinants of investment in the traded and non-traded sectors in Barbados over the period 1976-2006. General approaches for modeling investment in both sectors are used to capture the essential characteristics of aggregate investment in an open economy such as Barbados. Dynamic OLS is therefore used to estimate sector-specific investment functions. The results reveal that a cointegrating relationship existed among the variables in both the traded and non-traded sector models. Specifically, debt service ratio and the relative price effect have the most significant impact on investment in the traded and non-traded sectors in the long-run. However, in the short-run, the relative magnitudes of the determinants have less impact on sector-specific investment.

The results further suggest that government spending in Barbados tends to crowd out private investment in the non-traded sector in the long-run. Interest rates have negative and significant short-run impacts on sector-specific investment which suggest that Barbados may be interest rate constrained. These findings have inferences for policy and future research can be drawn from this.

The present study gauges the importance of adequate implementation of policies that establish appropriate preconditions for investment in the traded and non-traded sectors. Preconditions such as maintaining economic stability and instigating measures to divert private investors from non-tradables are important especially since overinvestment in the non-traded sector has the tendency to exhaust foreign exchange reserves. Since any shortage in foreign exchange earnings can impede a nation's growth and overall development, it is of paramount importance that investment in the traded sector (the

sector that earns foreign exchange) not lag behind the sector that uses it (the non-traded sector). Thus, a balance between investment in the traded and non-traded sectors is needed as a possible stimulus for growth in the Barbadian economy.

For future empirical work, the use of a better proxy variable to capture the contemporaneous effect of investment in the traded and non-traded sectors should be explored.

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Table 2: Unit Root Test Results

Variables	**ADF**	**PP**	**KPSS**
Investment in the	I(1)	I(1)	I(1)

Traded Sector			
Investment in the Non-traded Sector	I(1)	I(1)	I(1)
Private Sector Credit	I(1)	I(1)	I(1)
Capital Expenditure	I(1)	I(1)	I(1)
Real GDP Growth	I(0)	I(0)	I(0)
Economic Uncertainty	I(1)	I(1)	I(1)
P_t/P_n	I(1)	I(1)	I(1)
Real interest rates	I(0)	I(0)	I(0)
Debt-service ratio	I(1)	I(1)	I(1)
Number of Observations	33	33	33

Notes: ADF, PP and KPSS correspond to the Augmented Dickey-Fuller, the Phillips-Perron and the Kwiatkowski-Phillips-Schmidt-Shin unit root test respectively. The level of integration for each variable is indicated by *I*().