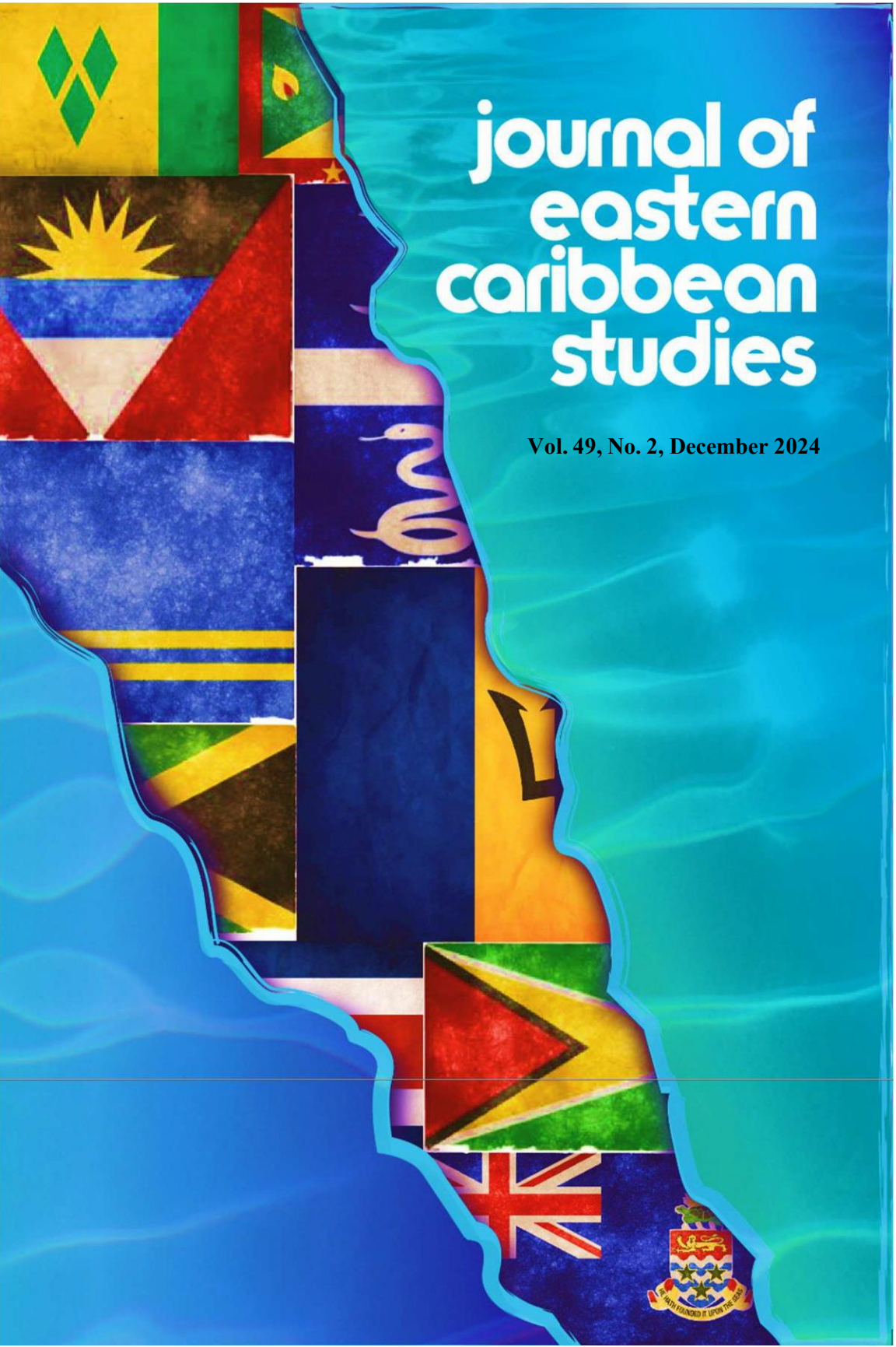

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CONTENTS

Vol. 49, No. 2, December 2024

Articles **Page**

Journal of Eastern Caribbean Studies
Vol. 49, No. 2, December 2024 pp. 1–31

The Impact of Shipping Costs on Inflation: A Case Study of Barbados, 1990Q1-2021Q4[1]

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Abstract

Inflation is an important barometer of the state of the economic health of a nation. In the same vein, knowing the determinants of inflation and their impacts is extremely useful for the conduct of economic policy. Against this background, the present paper investigates the impact of shipping costs on inflation in Barbados in the period from 1990Q1 to 2021Q4. To deal with the query, the paper builds a model with three linked equations. It uses the autoregressive distributed lag (ARDL) model in its error correction model (ECM) form to derive the short-run and long-run impacts of shipping costs, as well as control variables such as import prices, real gross domestic product (GDP), and Barbados output gap. Our findings suggest that overall shipping costs positively and significantly affect retail prices (inflation). In addition, Barbados output gap, real GDP, monetary stance, the Barbados lending interest rate, and import prices and their causal factors such as US (United States) consumer prices (inflation), global fuel prices (inflation), global food prices (inflation) are also important determinants of inflation in Barbados. Furthermore, shipping costs are a moderator variable for the Barbados lending interest rate and real GDP. Concerning policies involving shipping costs to curb prices or inflation, since Barbados cannot influence shipping costs, it pays to build policies around variables whose interactions with shipping costs affect inflation. Monetary policy through the lens of the Barbados lending interest rate is recommended. Moreover, to a certain extent, boosting real GDP can go a long way towards curbing inflation.

Key words: Shipping costs, prices, inflation, autoregressive distributed lag model, cointegration.

[1] We dedicate this paper to the memory of Professor Roland Craigwell. We are grateful to Peggy Craigwell for editing the earlier version of the paper. We also sincerely thank two anonymous referees for helpful comments and suggestions. We are, however, responsible of all remaining errors.

Introduction

The shock to the global economy caused by the COVID-19 pandemic has emphasised how essential maritime container transport is to the global economy. Indeed, more than 80% of goods of the global trade are transported by sea (United Nations Conference on Trade and Development (UNCTAD 2021), principally in 40-foot-long steel containers. All over the world, this pandemic has disrupted supply chains. For instance, there were labour shortages at various ports as many employees contracted COVID-19 and could not work. Moreover, public health regulations prevented truck drivers and ship personnel from traversing borders, leading to delays in customer deliveries and increasing shipping costs. Additionally, companies were unable to meet demand due to prolonged lockdowns and large stimulus programs. In the 18 months that followed March 2020, these difficulties caused a sevenfold increase in the average price of shipping a 40-foot container on the global market and an even greater increase in the cost of shipping bulk commodities (Carrière-Swallow *et al.* 2022b).

The sharp increases in shipping costs continued even during the recovery of economic activity in 2021. For example, international shipping costs, measured by an index of freight rate costs between China and the U.S. West Coast, increased "from an average of $1,331 in the week of February 28th, 2020, to a peak of $11,109 in the week of September 10th, 2021" (Leibovici and Dunn 2022). The disruption in the supply chains has resulted in higher rates of inflation throughout developed countries. Furthermore, health and containment regulations implemented to fight COVID-19 have restricted the number of workers available to process cargo ships in ports and altered the workers' schedules, with the effect of slowing down container processing. This has resulted in firms in developed countries rearranging their production structures to reduce their reliance on international trade for a wide range of essential items (Leibovici and Dunn 2022). Overall, international shipping costs are volatile and positively correlated with international trade volumes (Leibovici and Dunn 2022). It can be noted that while firms in developed countries have the capacity to reduce their reliance on trade in face of rising shipping costs (and, by extension, limit the pass-through of international shipping costs), this is not the case for small island developing states such as Barbados. As is well documented, Barbados' small size, limited resources and limited production mean that the country heavily relies on imports for both production and consumption (Impavido 2018). These characteristics also imply that Barbados is a price taker. Therefore, when there are supply-side disruptions, which cause import prices to rise, Barbados must accept these high import prices. Taken together, most, if not all, of the increased import costs due to global supply chain disruptions are passed on to the consumer, resulting in higher inflation rates. Moreover, higher shipping costs or import costs are also largely passed on to

consumers as Barbados operating under a fixed exchange regime[2] has limited ability to use monetary policy to combat inflation.

Although today's inflation in Barbados is far from the peak reached in 1974 at 38.94%, inflation remains a pressing economic issue given its judged high level (i.e., 11.90% in May 2022) and its dire consequences on cost of living, investment, value of pensions and savings, economic growth, etc.

The objective of this paper is to show whether shipping costs positively and significantly affect inflation in Barbados for the period 1990Q1 to 2021Q4 (using quarterly data). Inflation is examined here not only at the aggregated level (retail prices or retail price inflation) but also at the disaggregated level (import prices or import price inflation and prices/inflation of domestically produced goods and services).

The paper builds a model with three linked equations each estimated using the autoregressive distributed lag (ARDL) framework in its error correction model (ECM) form to derive the short-run and long-run estimate impacts of shipping costs and control variables such as real GDP, Barbados output gap, global food prices, global oil prices, and the Barbados lending interest rate. To justify somewhat the model – since shipping costs affect Barbados' headline inflation directly through import price inflation and indirectly through domestic price inflation, and apart from the main equation linking retail price inflation to import price inflation and domestic price inflation – the two other equations are at the very least useful to show the impact of shipping costs to Barbados retail price/inflation. Indeed, one of the equations links import price inflation to its determinants, and the other one connects domestic price inflation to its determinants.

While several authors have dealt with the determinants of inflation in Barbados and found more importantly that import prices in addition to global food prices, global energy prices, and interest rate are key determinants of inflation in Barbados (see, for example, Downes 1985; Cumberbatch 1995; Downes *et al.* 2020; Impavido 2018), no author has examined, so far, the impact of shipping costs on inflation in Barbados. Thus, as its first contribution, this paper attempts to show that shipping costs positively and significantly affect inflation in Barbados. Second, although a meager amount of literature dealing with the issue of the impact of shipping costs on inflation exists elsewhere (see, for example, Attinasi, Bobasu

[2] We refer to the pegging of the Barbados dollar to the U.S. dollar at an exchange rate of approximately Bds $2.00 to US $1.00.

and Gerinovics 2021; Carrière-Swallow *et al*. 2022a), our study differs from those mentioned at the methodological level. Indeed, while most of them use a VAR-type methodology or SUR methodology, we exploit the autoregressive distributed (ARDL) lag framework to cointegration in the context of linked equations with the advantages that the ARDL used in each equation deals adequately with the issues of mixed integration of variables, endogeneity of variables and small sample size. The results obtained hopefully can be valid for similar small open countries, particularly Caribbean economies.

The paper proceeds as follows. Section two deals with the literature review on inflation. Section three presents some statistical facts concerning the inflationary process in Barbados as well as the trend in import prices and shipping costs during the period of investigation. Section four develops data and methodology. Section five contains the empirical results of model estimation and their interpretations and concluding remarks are found in Section six.

Literature Review

The present literature review concerns the determinants of inflation with a focus on the impact of shipping costs on inflation. To explain, although our paper centres around the impact of shipping costs on inflation, ultimately it must consider other influencing factors of inflation to avoid omitted variables bias. Precisely, the literature review targets empirical research works related to the determinants of inflation in Barbados inclusive of the impact of shipping costs on inflation.

Empirical Determinants of Inflation in Barbados

The relationship between inflation and its determinants has been well-researched from theoretical and empirical points of view. At the theoretical level, a couple of theories have been advanced to explain inflation. These include cost-push inflation due to increases in costs of wages and raw materials, demand-pull inflation characterised by excess demand generating inflation, monetarist theory of inflation as a monetary phenomenon, structuralist (institutional) inflation theory with its emphasis on deficient structures, and the Scandinavian model of inflation. At the empirical level, a substantial body of research has been developed all over the world. Below is a selected set of studies on Barbados.

Downes (1985) was among the first econometric studies on the inflationary process in Barbados and covers the period 1960-1977. His model, essentially a cost-push model, studied the relationship between the consumer price index and a few variables such as import price index, credit cost, lagged wage, and tax rates. A carefully executed OLS estimation yields the following impactful variables by decreasing order: import price index, lending interest rate, and lagged price.

Holder and Worrell (1985) examined the factors driving inflation in Barbados, Jamaica and Trinidad and Tobago in the period from 1963 to 1980. They used a simultaneous equations model to explain domestic prices. The authors found that import prices, trade protection, and the domestic interest rate significantly affect domestic prices.

The study by Downes, Holder and Leon (1991) was the first on inflation in Barbados that used the techniques of cointegration and error correction model. Using the period 1958/1960 to 1984, the results of estimation indicate the following inflation causal variables by order of importance (in absolute value): wages, productivity, price of tradeable, and unemployment in the long run as well as wages, productivity, price of tradeable, import prices and unemployment in the short run.

Likewise, the study by Downes, Maynard and Worrell (1992) used the cointegration and error correction framework to model the relationship between domestic inflation and its determinants: domestic currency per US exchange rate, US dollar prices, actual money supply, lending rate or cost of holding money, labour productivity, and a vector of other causal factors of domestic inflation. This study covered the period 1970 to 1991 and focused on three countries: Barbados, Jamaica and Trinidad and Tobago. For Barbados, in the short run, the domestic currency per US exchange rate, the US dollar prices, the lending interest rate, labour productivity and lagged price were the important determinants of domestic price. In the long run, the same variables were important in addition to wages.

Cumberbatch (1995) built a model of inflation in Barbados for the period 1961-1993. Like the previous studies the author used cointegration and ECM to examine the inflationary process in Barbados. The estimation results indicated import prices were the leading determining factor of inflation in Barbados. Apart from this factor, unit labour cost, the consumer credit rate and real national income were explanatory factors of inflation.

Greenidge and DaCosta (2009) examined the determinants of inflation in selected Caribbean countries (Barbados, Guyana, Jamaica and Trinidad and Tobago) over the period 1970-2006 using the unrestricted error correction model derived in the context of general to specific as well as Pesaran, Shin and Smith (2001) bounds test for cointegration. Concerning Barbados, both external and internal factors are important in explaining inflation in Barbados. Precisely, in the short run, these factors are oil inflation, excess money supply, interest rate, unemployment rate and in the long run they include oil inflation, interest rate and unemployment rate. In addition, the authors noted some inertia in the inflation process that seemed to

capture inflation expectations. The paper, however, did not uncover any significant impact of world price inflation.

Impavido (2018) studied the short-term inflation determinants in Barbados. His inflation model linked domestic inflation to inflation expectations, external determinants (import deflator, price of oil energy, and US inflation), and domestic determinants (output gap and monetary stance). The model is estimated by OLS, SUR system and constrained SUR system. Oil prices, inflation expectations, output gap, import prices, monetary stance, and US inflation positively affect Barbados' inflation. Although oil prices are the key determinant of inflation in Barbados, inflation expectations and domestic factors do also matter (Impavido 2018, 20-21). The question is what happens in the long run?

Downes *et al.* (2020) modeled the inflationary process in Barbados by emphasising the impacts of international commodity prices such as those captured by food and energy prices. Apart from these two variables, the model used two other variables: GDP and lending interest rate. Using quarterly data from 1985 to 2015 and a vector error correction model coupled with generalised impulse responses and variance decompositions as methodology, the study found a "low speed of adjustment of domestic retail prices from disturbances away from equilibrium." In addition, while in the long run, international energy prices have a faster rate of pass-through in comparison to international food prices, the tendency is reversed in the short run.

So far, no paper has alluded to the role of shipping costs in shaping domestic prices or inflation. Yet, shipping costs are, indeed, a determinant of inflation particularly at the period of global supply side disruptions. That is, even though international shipping costs are not typically found in import price indices, there is the pass-through effect where importers pass on changes in shipping costs to consumers resulting in an aggregate rise in price (Herriford *et al*. 2016). There is thus a need to examine the impact of shipping costs on inflation.

Shipping Costs and Inflation

It can be noted that only recently have a couple of papers directly focused on the impact of shipping costs on consumer inflation. Herriford *et al.* (2016) quantified the impact of shipping costs on core personal consumption expenditure (PCE) inflation in the United States using monthly data from January 2001 to September 2016. They employed a structural vector autoregressive (SVAR) model. They found that shipping costs, captured by the Harper-Peterson Charter Rate Index, have a statistically significant but small effect on core inflation. A 15% increase in shipping costs causes only a 0.10%-point increase in core inflation after one year.

This year-long delay speaks to the fact that usually shipping services ordered today will deliver goods in months' time and businesses may require additional time to adjust their prices in response to rising costs.

Attinasi *et al.* (2021) used the same approach (SVAR model) as Herriford *et al.* (2016) to estimate the impact of shipping costs on inflation in the U.S. The authors report that the impact of shipping costs using the Harper index on PCE inflation is also limited. An annual increase of the Harper Index of 50% raises by 0.25% after a year the annual PCE inflation. The reason the size of the impact is quite minimal is because international shipping costs are only a small share of the final cost of manufacturing output.

Consumer inflation, through freight costs, increased during 2021, due to supply-side disruptions. Michail, Melas and Cleanthous (2022) looked at the relationship between the shipping freight costs and inflation in the Euro Area by employing a Vector Error Correction Model, using disaggregated quarterly data from January 2009 to August 2021 along with both constant tax and the standard price indices. They found that when there is more than $1,300 and $1,500 increase per day in freight rates, there is a rise in the sensitivity of inflation to freight changes after employing a threshold regression method. In addition, UNCTAD (2021), simulated the elasticities between shipping freight rates and CPI in developing and developed countries. It was established that if in 2021 container freight rates were still at a high level, global consumer prices will be 1.5% higher than they would have been if the freight rate surge had not occurred. Furthermore, the impact of container freight prices on import prices in SIDS was more than twice the impact in developed countries in 2019. The effect in SIDS was around 79% whereas the impact in developed countries was approximately 24%.

Carrière-Swallow *et al.* (2022a) took a different approach and used Jordà's local projection method (Jordà 2005) to estimate the impact of shipping costs on inflation. They chose this method because it avoids the dynamic constraints inherent in vector autoregressive or autoregressive distributed lag specifications. In fact, the strength and sequence of the transmission of global shipping cost shocks are felt through import prices, producer prices, and into headline and core inflation. Their basic model is as follows:

$$\pi_{i,t+h} = \alpha_i^h + \sum_{j=1}^{m} \beta_i^h \pi_{i,t-j} + \sum_{j=0}^{m} \gamma_i^h s_{i,t-j} + \sum_{j=0}^{m} \delta_i^h R_{i,t-j} + \varepsilon_{i,t}^h \quad (1)$$

where i is country index, t is time index, j captures lag, h represents the h-step response horizon in months, π is domestic inflation defined as the year-over-year log change in a price index for a given country i, s is the month-to-month

percentage change in global shipping costs in month *t*, *R* is a set of control variables including the global output gap for country *i*, global oil inflation (monthly growth rate of global oil price), and global food inflation (monthly growth rate of global food price). Carrière-Swallow *et al.* (2022a) noted that the inclusion of control variables allows to control or capture global demand affecting shipping costs.

The above model and its variants were estimated using a sample of 46 countries with data covering the period between February 1992 and December 2021. The results indicated that the rise in global shipping costs had a statistically significant, non-negligible and persistent impact on domestic inflation. Over a 12-month period, a one-standard deviation (21.8 percentage points) rise in global shipping costs typically raises domestic headline inflation by 0.15 percentage point. This impact grew steadily and peaked after 12 months before reverting 6 months later. Additionally, it was noticed that headline inflation had a greater impact on countries with a larger share of imported final consumption. Furthermore, the results for headline inflation were very similar to core inflation. The only difference was that the impact on core inflation was about one-third of the impact on headline inflation.

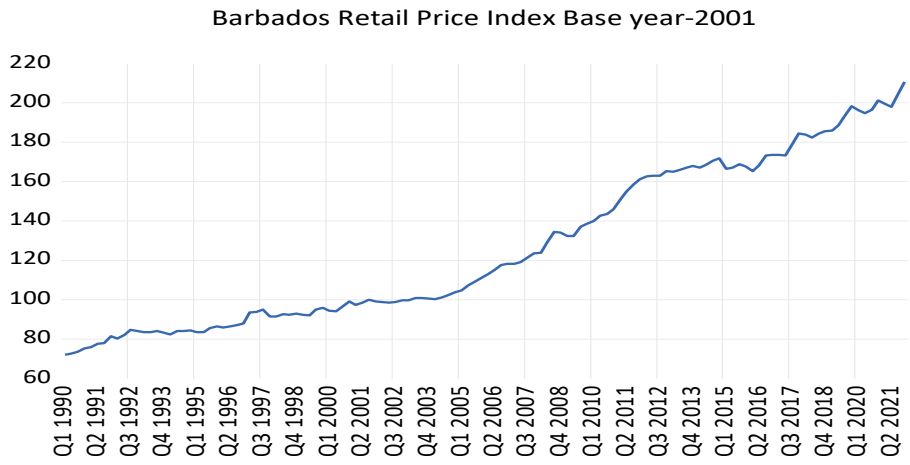
The literature above has shown that shipping costs positively affect inflation. Since, to the best of our knowledge, there is no paper focusing on the impact of shipping costs on consumer price inflation in Barbados, let alone the Caribbean, the present paper attempts to fill the gap.

Inflation in Barbados: **The Statistical Facts**

Inflation as the persistent rise in the price level of goods and services, for a given period, is an important issue that any government must deal with as it negatively affects individuals' purchasing power, monetary value of pensions, investments, and likely economic growth, among others.

Figure 1 plots the quarterly retail price index for Barbados from 1990 to 2021. As can be seen from the graph, prices have generally trended upward since the 1990s. However, price increases over the review period have not been steady and were quite volatile, as shown in Figure 2, which plots the corresponding quarterly inflation rate from 1990 to 2021.

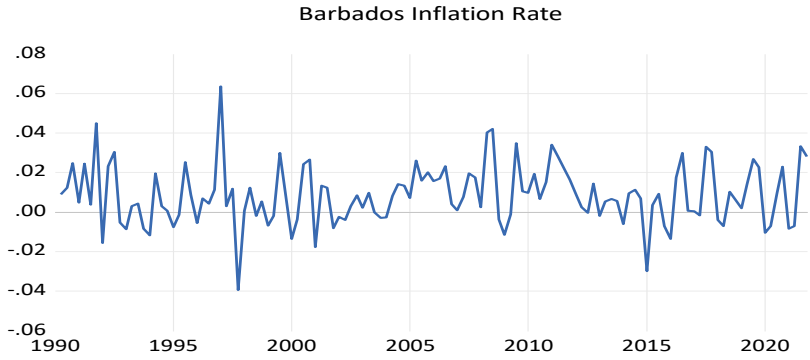
Figure 1: Barbados Retail Price Index, Base Year 2001



Source: Central Bank of Barbados (n. d)

As mentioned in the literature review, much of Barbados' inflation is imported. Thus, most of the spikes observed in Figure 2 can be explained by external forces such as global oil prices and global food prices. The literature on inflation in Barbados also suggests that domestic factors (such as changes in taxes and interest rates) also play a role, though to a much smaller extent.

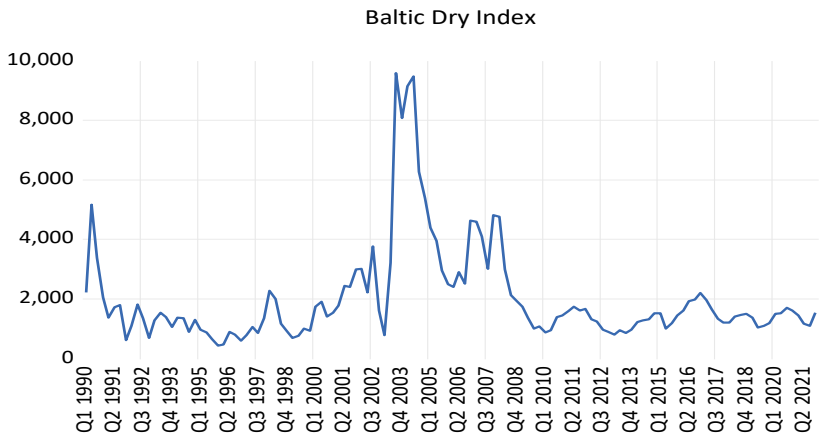
Figure 2: Barbados Inflation Rate (Quarterly Change in %)



Source: Central Bank of Barbados (n. d)

We have just pointed out that inflation, or its associated retail price index, can be explained by external and internal factors. The question is whether shipping costs are indeed part of the story. We use the Baltic Dry Index (BDI) to measure international shipping costs. The BDI calculates the average cost of transporting dry bulk materials over more than 20 oceanic shipping routes. It is shared daily by the Baltic Exchange in London. The BDI is highly correlated to the other similar indices (Carrière-Swallow *et al*. 2022a). In addition, transporting dry bulk materials accounts for approximately half of world trade (UNCTAD 2015). Figure 3, related to the BDI, seems to indicate that over the period 1990-2021 the BDI behaved like a stationary series. Apart from the peak in 2003, it can be noticed that the index does not seem to pick up the last increases in shipping costs during COVID-19 period.

Figure 3: Baltic Dry Index



Source: Bloomberg (n. d)

True, Barbados' retail prices consist of import prices and domestic prices. Also true, in this small open economy, inflation occurs mainly through imports. The BDI directly affects import prices and there is a pass-through effect where importers pass on changes in shipping costs to consumers that can cause an increase in the prices, contributing to inflation. Figure 4 indicates that the import price index displays some volatility. The import price index peaked between 2007 and 2008 and again in 2011. Furthermore, there were drastic drops in these prices in 2016 and 2020. The slump in 2020 was due to the COVID-19 pandemic.

Figure 4: Import Price Index, Base Year 2012

Source: Central Bank of ``Barbados (n. d) a

The quest of this paper is to determine whether shipping costs (shipping cost inflation) positively and significantly affect inflation in Barbados.

Data and Methodology

Data

The quarterly time series data for this study concerns Barbados from 1990Q1 to 2021Q4 and include the following variables: Retail Price index (*RPI*), Shipping Costs (*SC*) captured by the Baltic Dry Index (*BDI*), Global Food Price Index (*Food*), Global Fuel Price Index (*Fuel*), Import Price Index (*IMP*), Barbados Lending Interest Rate (*BIR*), US Retail Price Index (*US*) that stands for world price index, US Output Gap (*USROG*) that represents world output gap, Real Gross Domestic Product (GDPR), Barbados Output Gap (*BOGR*), Monetary Stance (*MST*), and Unemployment Rate (*UN*). Since the published *RPI* has been rebased three times, the splicing technique was used on both historical inflation and food prices. In addition, for the *RPI*, the indices for the two periods (April 2020 and February 2021) were missing so we interpolated between the periods before and after. Global food price index was compiled in the form of annual data but then converted to quarterly data using EViews software procedure. Of note, with the exceptions of variables expressed in percent (*UN*, *BIR*) and those in deviation to

the trend (*BOGR*, *USROG* and *MST*), all other variables were transformed into logarithm form (see Table A1 in the Appendix).

Methodology

Model

As outlined in some papers (Carrière-Swallow *et al*. 2022a, 7; Eatwell, Llewellyn and Tarling 1974, 20), the retail price index[3] (*RPI*) consists of price index of domestically produced goods and services (*PD*) and IMP:

$$RPI_t = PD_t^{1-\alpha} IMP_t^{\alpha} \tag{2}$$

where α is the share, and *t* represents time index.

The logarithm form of Eq. (2) yields:

$$LRPI_t = (1-\alpha)LPD_t + \alpha\, LIMP_t \tag{3}$$

where $LRPI_t = Log\ RPI_t,\ LPD_t = Log\ PD_t\ and\ LIMP_t = Log\ IMP_t$. Note that *LPD*, being unavailable in our dataset, is derived as residual from Eq. (3) with a constant term.

Lagging Eq. (3) once and deducting the outcome from Eq. (3) yields

$$\Delta LRPI_t = (1-\alpha)\,\Delta LPD_t + \alpha\,\Delta LIMP_t \tag{4}$$

where Δ is the first difference operator.

Eq. (4) is the inflation form of the retail price equation that states that inflation is the sum of domestically produced goods price inflation and import price inflation.

Definitional equations such as Eq. (3) and Eq. (4) are not often interesting in themselves. To make them more valuable to policy makers, for example, there is a need to transform them into behavioural equations. This is done, among others, in the first instance, by exploiting the dependence of one or the two right-hand side variables of Eq. (3) or Eq. (4) on some other variables, and in the second instance, by using two major add-ons. The first add-on is the inclusion of an error variable in those equations to capture phenomena such as explanatory variables measured with errors, presence of pure noise, and aggregation error. The second add-on is

[3] Price index is used interchangeably with prices or price. Thus, retail price index can be read as retail prices, etc.

the use of a constant term in those equations to essentially capture the average effect of omitted variables in the behavioural equations.

We posit thus a basic model, which combines cost-push inflation, demand-pull inflation and the Scandinavian model approach, with three equations to explain retail prices/inflation. The three equations consist of retail prices/inflation equation, import prices/inflation equation and the prices (inflation) of domestically produced items equation:

$$LRPI_t = c + a_1 Lsc_t + a_2 LIMP_t + a_3 LGDPR_t + a_4 BOGR_t + a_5 MST_t +$$

$$a_6 BIR_t + a_7 UN_t + a_8\,(Lsc_t * LGDPR_t) + a_9\,(Lsc_t * BIR_t) + a_{10}\,trend + e_{1t} \quad (5)$$

$$LIMP_t = c + \beta_1\, Lsc_t + \beta_2\, LGDPR_t + \beta_3\, LUS_t + \beta_4\, USROG_t + \beta_5 Lfuel_t +$$

$$\beta_6 Lfood_t + \beta_7 (Lsc_t * LGDPR_t) + \beta_8\ trend + e_{2t} \quad (6)$$

$$LPD_t = c + \gamma_1\, Lsc_t + \gamma_2 LGDPR_t + \gamma_3 BOGR_t + \gamma_4\, MST_t + \gamma_5 BIR_t +$$

$$\gamma_6\, UN_t + \gamma_7\,(Lsc_t * LGDPR_t) + \gamma_8\,(Lsc_t * BIR_t) + \gamma_9\, trend + e_{3t} \quad (7)$$

where the variables are defined as in Table A1, *c* is the constant term, *trend* captures omitted variables, the $\alpha's, \beta's\ and\ \gamma's$ are parameters of interest, "*" is a multiplication sign here and the *e*'s represent the error variables in the equations.

Before explaining the model equation by equation, a remark is in order. The key independent variable of the model is the shipping costs. To underline its importance for the model, the variable enters the three equations additively and multiplicatively. Given the scope of the study, entering additively the three equations means the variable is most likely an exogenous core variable. In fact, theoretically, shipping costs affect retail prices (inflation) through mainly their direct effect on the import prices and indirectly through the prices for domestically produced goods and services (Carrière-Swallow *et al.* 2022a, 7). Entering the equations multiplicatively means that shipping costs behave at least statistically as a moderator variable.

That said, Eq. (5) originates from Eq. (3) with the particularity that *LPD* has been replaced by its determining factors to avoid perfect multicollinearity. Eq. (5) is the key equation that expresses the relationship between shipping costs and retail prices in Barbados with control variables. According to the literature, shipping costs positively affect prices (inflation) (Carrière-Swallow *et al.* 2022a; Herriford *et al.* 2016; and Attinasi *et al.* 2021).

Real GDP impact on price/inflation is ambiguous. Indeed, it is known that real GDP affects price through aggregate supply. In the context of cost-push inflation, holding other factors constant, as prices rise, more output is produced. Thus, real GDP has a positive impact on price/inflation. It is also the case that if indeed an increase in output decreases the demand pressures in the economy, then inflation decreases (see Laryea and Sumaila 2001, 8). Some authors acknowledge the presence of real *GDP* or output in an inflation model through output gap, which is the difference between the output and its potential. While a positive *BOGR* yields an increase in prices, a negative *BOGR* generates a decrease in prices.

Monetary stance is assumed to positively affect prices or inflation. Barbados lending interest rate (*BIR*) negatively impacts inflation. The unemployment rate (*UN*) is assumed to be negatively linked to inflation. Nevertheless, the possibility of a positive relationship between the two variables is real and can be explained. The presence of interaction terms allows us to verify whether *LSC* can also act as moderator variable, at least statistically. In this connection, our determination of "moderator variable" mainly follows an atheoretical approach. (See, for critique, Cooley and LeRoy 1985). That is, statistical significance is the key element of choice of moderator. In any case, the fact that *LSC* affects *LGDPR* and both variables impact *LRPI*/inflation indicates that shipping costs and real GDP can possibly interact in the equations. Moreover, the fact that *LSC* strongly impacts inflation and that the latter is highly linked to interest rate raises the prospect of *LSC* being a moderator for the relationship between interest rate and inflation.

Eq. (6) models the determinants of import prices/imported inflation. *LSC* is expected to significantly and positively affect *LIMP*/imported inflation and so are other variables too: *LGDPR, LUS, LROG, LFUEL*, and *LFOOD*. *LSC* is suspected to be a moderator variable with the key question of whether its presence impacts the relationship between *LGDPR* and *LIMP*.

Eq. (7) models the determinants of *LPD*. This is really a subset of Eq. 5. There is nothing more to add on the expected signs of determinants.

As they are, the three equations can belong to the class of systems of simultaneous equations (*SES*), seemingly unrelated regressions (*SUR*), or simply a set of multiple equations (*SMES*). Either way, these equations are naturally linked.

Given the time series nature of the data, the issues of non-stationarity[4] of variables and their cointegration need to be examined as they may affect the validity of the methods of estimation and their attendant results. That said, the degree of integration of variables[5] is examined owing to the now standard test called Augmented Dickey Fuller (ADF) *t* test. Several scenarios can emerge from the results of the ADF *t* tests. The most interesting case is that for which some variables are non-stationary (here, integrated of order one), and the rest, stationary or integrated of order zero. We anticipate dealing with the latter situation. The popular model or estimation method that adequately handles this mixture of integration of variables is the autoregressive distributed lag (ARDL)[6] approach to cointegration initiated by Pesaran *et al.* 2001. Indeed, this framework allows us to test for cointegration or long-run relationship between essentially non-stationary variables as well as to generate short-run estimates. Note that if variables are cointegrated then a corresponding error correction model (ECM) or vector error correction model (VECM) can be generated.

Going back to our set of equations (5, 6, and 7), each equation is transformed into an ARDL model in which the error correction form reads as follows:

$$\Delta Y_{it} = \boldsymbol{c} + \boldsymbol{\lambda_i}\, \boldsymbol{COINTEQ_{i,t-1}} + \sum_{\boldsymbol{j=1}}^{\boldsymbol{P}} \boldsymbol{a_j} \Delta \boldsymbol{Y_{i,t-j}} + \sum_{\boldsymbol{j=0}}^{\boldsymbol{Q}} \boldsymbol{b_j}\, \Delta \boldsymbol{LSC_{t-j}} + \sum_{\boldsymbol{j=0}}^{\boldsymbol{Q}} \boldsymbol{d_j} \Delta \boldsymbol{X_{i,t-j}} + \boldsymbol{v_{i,t}} \quad (8)$$

where i represents any equation of the set (5,6,7) presented in ARDL error correction form (ARDL-ECM), t as subscript is time index, Y is the dependent variable in the equation i, LSC stands for log of shipping costs, X stands for control variables in equation i, including the product variables, Δ is the first difference operator, $COINTEQ_{it-1}$ is the lagged error correction term[7] in equation i, $\boldsymbol{\lambda_i}$ is the speed of adjustment in equation i, $v_{i,t}$ represents the error variable from equation i. The variables in differences provide short-run estimates while the long-run estimates are derived from the error correction term.

[4] A stationary series can be understood as a mean reverting series.
[5] Here, the number of times to difference a variable to make it stationary.
[6] The ARDL model expresses a dependent variable as a function of its own past(s), the present of another variable or other variables and the past of the latter.
[7] The error or equilibrium correction corrects for period's deviation from a long-run equilibrium.

In Eq. (8), the question of optimality of lag lengths for the dependent and independent variables p and q, respectively, is "solved" by using the Akaike Information Criterion (AIC).

The next step is to test for cointegration. This is done by deriving an F statistic that tests for the null of no long-run relationship between the level variables vs the presence of their long-run relationship (cointegration). This F does not follow an F distribution but rather another distribution with lower bounds and upper bounds. Cointegration exists between the level variables if F calculated is greater than the upper bound. In this connection, there is a role for the t-statistic of the speed of adjustment. If the speed of adjustment has a negative value and is, in absolute value, less than one and in addition, its associated t statistic, in absolute value, is greater than the upper bound, then cointegration is confirmed; otherwise, it is rejected or inconclusive (see Pesaran *et al.* 2001 especially for the bounds).

Understandably, the ARDL model needs to pass a battery of tests to confirm its validity. The tests include the serial correlation test, the heteroscedasticity test, the misspecification test, the normality test, and the test for stability.

While the ARDL approach is appropriate under the conditions described above, it is not necessarily the case for the Johansen approach, the SUR, the VAR and derivatives that require, at the very least, the variables be of the same order of integration.[8] The Jordà's local projection method (Jordà 2005) is not pursued here either because it suffers from the same ills outlined above and its superiority to VAR namely is not fully established yet (see, for example, Li, Plagborg-Moller and Wolf 2022,33).

The Results

Summary Statistics

Table 1 indicates that *UN*, *BIR*, *MST*, *LFUEL* and *LSC* display greater variability. Table 2 shows that shipping costs are positively linked to real *GDP*, import prices and global fuel prices and negatively correlated to global food prices. Retail prices are highly positively linked to US consumer prices, global fuel prices, global food prices and import prices, and negatively associated to the Barbados lending interest rate and monetary stance. Import prices are positively correlated to global fuel prices, global food prices, US consumer prices, real *GDP*, retail prices, and shipping costs and negatively correlated to the Barbados lending interest rate and monetary stance.

[8] If all variables are I(1), then they must be transformed into I(0). In case of I(1) variables, cointegration can be entertained.

Table 1: Some Summary Statistics of Variables

Variable	Mean	Std. dev	Min	Max
LRPI	4.790	0.318	4.275	5.350
IMP	4.216	0.322	3.634	4.863
LSC	7.388	0.610	6.061	9.168
LGDPR	7.530	0.100	7.286	7.689
BOGR	-0.000	0.041	-0.147	0.116
BIR	9.569	2.353	5.685	15.200
MST	-1.03E-09	1.548	-5.671	4.413
UN	17.310	5.360	9.507	24.400
LFUEL	3.690	0.622	2.533	4.820
LFOOD	4.479	0.176	4.206	4.829
LUS	4.404	0.211	3.989	4.766
USROG	-2.81E-05	0.010	-0.083	0.023

Note:see Table A1 for the meaning of the acronyms.

Table 2: Some Correlations between Variables

	LRPI	LIMP	BOGR	LGDPR	BIR	MST
LRPI	1.000	0.636	-0.001	0.477	-0.953	-0.008
LIMP	0.636	1.000	0.056	0.582	-0.600	-0.142
BOGR	-0.001	0.056	1.000	0.447	0.002	-0.073
LGDPR	0.477	0.582	0.447	1.000	-0.445	-0.051
BIR	-0.953	-0.600	0.002	-0.445	1.000	0.020
MST	-0.008	-0.143	-0.073	-0.051	0.020	1.000
LSC	-0.085	0.157	-0.012	0.325	0.023	0.007
LFUEL	0.767	0.974	0.040	0.625	-0.723	-0.110
LFOOD	0.805	0.730	0.026	0.337	-0.778	0.016
USROG	0.004	0.215	0.369	0.200	0.004	-0.209
LUS	0.978	0.675	0.012	0.594	-0.933	-0.004

	LSC	LFUEL	LFOOD	USROG	LUS
LRPI	-0.085	0.767	0.805	0.004	0.978
LIMP	0.157	0.974	0.730	0.215	0.675
BOGR	-0.012	0.040	0.026	0.369	0.008
LGDPR	0.325	0.839	0.836	0.199	0.594
BIR	0.023	-0.723	-0.778	0.004	-0.933
MST	0.008	-0.110	0.016	-0.157	-0.004
LSC	1.000	0.144	-0.170	0.054	0.036
LFUEL	0.144	1.000	0.776	0.189	0.801
LFOOD	-0.170	0.776	1.000	0.070	0.760
USROG	0.074	0.170	0.049	1.000	0.012
LUS	0.036	0.801	0.760	0.015	1.000

Note: see note to Table 1.

Non-Stationarity of Variables

We use a 10% level of significance throughout the paper. Table 3 provides us with the ADF test results for the levels and the first differences. We find that *LRPI*, *LIMP*, *LFOOD*, *LFUEL*, *LGDPR*, *LPD* and *LUS* are all I(1) following the behaviours of the p-values of their ADF *t*-statistics, and, on the contrary, *LSC* and all non-logged variables except for *UN* are I(0) or stationary. No variable is I(2). As said above, among others, the mixed integration of variables justifies the use of the ARDL framework for further regression investigation.

Table 3: ADF Test Results based on ADF regressions

	ADF regression: level		ADF regression:1st difference	
Acronym	t-value	p-value	t-value	p-value
LRPI	0.245	0.947	-8.900	0.000
LSC	-3.307	0.017		
LIMP	-1.709	0.424	-9.762	0.000
LFOOD	-2.080 c,t	0.552	-11.221	0.000
LFUEL	-2.540 c,t	0.308	-9.939	0.000
LGDPR	-2.096	0.247	-30.472	0.000
LUS	-2.648 c,t	0.260	-7.878	0.000
LPD	-2.207 c,t	0.482	-10.042	0.000
BOGR	-8.345	0.000		
BIR	-5.414 c,t	0.000		
MST	-6.860	0.000		
USROG	-7.376	0.000		
UN	-1.543	0.509	-14.995	0.000

Note: Variables are defined as in Table A1. ADF regressions (available upon request) are of interest; c, t: ADF regression with constant and trend.

Estimation Results

This subsection presents the estimation results and the associated discussions. It starts by exploring the cointegration results for the three equations of the model in error correction forms. Afterwards, it explores the results dealing with the determinants of retail price index/inflation including some results of the two other equations (import price equation and domestic price equation) where necessary.

On Cointegration

Table 4 presents the ARDL-ECM results for retail price inflation from Eq. (8) derived from Eq. (5). This is the key equation of the model. The tests of heteroscedasticity and autocorrelation are satisfied with $p > 0.10$. The estimates are stable. The functional form misspecification test is not passed at the 0.10 level. Like in Pesaran *et al.* (2001, 313-314), the failure can be due to the absence of some other non-linear effects. Using the central limit theorem, we can bypass the issue of non-normal errors.[9]

Table 4: ARDL (4,0,0,0,3,4,2,2,0,2) of Cointegration and Long-run for log Retail Price Index (LRPI)

Dep. Var.: D(LRPI)	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ	-0.083	0.010	-8.300	0.000
D(LRPI(-1))	-0.133	0.078	-1.705	0.091
D(LRPI(-2))	-0.251	0.073	-3.438	0.001
D(LRPI(-3))	-0.227	0.078	-2.910	0.004
D(LGDPR)	-0.052	0.024	-2.167	0.030
D(LGDPR(-1))	-0.141	0.024	-5.875	0.000
D(LGDPR(-2))	-0.056	0.024	-2.333	0.023
D(MST)	-0.001	0.002	-0.500	0.607
D(MST(-1))	-0.000	0.002	-0.145	0.886
D(MST(-2))	-0.001	0.002	-0.500	0.668
D(MST(-3))	-0.005	0.001	-5.000	0.000
D(BIR)	0.042	0.013	3.231	0.001
D(BIR(-1))	-0.061	0.012	-5.083	0.000
D(LSC)	0.255	0.036	7.083	0.000
D(LSC(-1))	-0.095	0.018	-5.278	0.000
D(BIR*LSC)	-0.006	0.002	-3.000	0.001
D(BIR(-1)*LSC(-1))	0.009	0.002	4.500	0.000
C	-1.435	0.182	-7.885	0.000
@TREND	0.001	0.000	7.827	0.000

[9] We could not advocate the theorem without testing first for normality of errors, following the norm.

Adjusted R-squared	0.441	Akaike info criterion	-5.972
F-statistic	6.384	P(F)=0.000	
Cusum Test	Stable	CF=5.742	Ct=-1.967
HET=21.694	P(.)=0.753	AUT=0.563	P(.)=0.755
RR=6.306	P(.)=0.014	JB=5.837	P(.)=0.000

Dep. Var.: LRPI Long-run Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LIMP	0.506	0.250	2.024	0.046
BOGR	3.270	1.745	1.874	0.064
UN	-0.006	0.009	-0.667	0.463
LGDPR(-1)	1.445	2.900	0.498	0.619
MST(-1)	0.024	0.020	1.200	0.224
BIR(-1)	0.898	0.540	1.663	0.099
LSC(-1)	3.541	3.461	1.023	0.308
LGDPR*LSC	-0.319	0.406	-0.786	0.434
BIR(-1)*LSC(-1)	-0.117	0.070	-1.671	0.098

Notes: ARDL-ECM (8) based on Eq. (5). D=first difference operator. Primary variables are explained in Table A1 in the appendix. Numbers in parentheses in the ARDL represent the lag structure of the variables. The first part of the table essentially regroups short-run estimates. Long-run estimates come from COINTEQ or error correction term. HET is the Breusch-Pagan-Godfrey LM test for heteroscedasticity; AUT is the Breusch-Godfrey LM test for autocorrelation; RR is the Ramsey reset F test for misspecification; JB is the Jarque Bera test for normality; Cusum test is the test for stability of estimates; Stable here means that the estimated line for stability is within the bounds. CF is the cointegration F and Ct is the cointegration t. P(.) is the p-value of an appropriate test. Prob. is the p-value associated to a t-statistic.

Cointegration is uncovered as the *F*-statistic value (5.742) is greater than the upper bound (3.240), at the 10% level of significance. The cointegration finding is not replicated by the behaviour of the cointegration *t*-statistic (-1.967), which, in absolute value, is below the lower bound (-3.130). However, the *t*-value (-8.300) of the adjustment speed being in absolute value greater than the *t* upper bound (-3.130) confirms cointegration. According to the size of the adjustment coefficient (see the coefficient of COINTEQ), only 8% of disequilibrium is eliminated in one quarter. The coefficient of lagged inflation is -0.13. This means that a 1% increase

in inflation in a given quarter leads to a 0.13% decrease in inflation in the following quarter. This is more likely because of inflation expectations, be they adaptative or rational.

Table 5 presents the ARDL-ECM results for import price inflation from Eq. (8) derived from Eq. (6). The model passes all tests of interest (heteroscedasticity, autocorrelation, misspecification, and normality) except for stability test that indicates a small instability of estimates. Cointegration is not uncovered as the *F*-statistic value (2.221) is lesser than the lower bound (2.380), at the 10% level of significance. No firm conclusion from the cointegration *t*-statistic as its value (-4.040) is within the bounds: -3.130 and -4.530. The same observation is borne out of the behaviour of the *t* of the speed of adjustment (-4.348). We cast doubt about cointegration. From now on, for Table 5 we only interpret the short-run estimates.

Table 5: ARDL(2,2,0,1,1,1,0,0) of Cointegration and Long-run form of Log Import Price Index (LIMP)

Dep. Var.: D(LIMP)	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ	-0.233	0.054	-4.315	0.000
D(LIMP(-1))	0.056	0.032	1.750	0.086
D(LUS)	1.410	0.687	2.052	0.042
D(LUS(-1))	-1.767	0.669	-2.528	0.009
D(LFUEL)	0.566	0.021	26.952	0.000
D(LFOOD)	0.121	0.050	2.420	0.017
D(LGDPR)	0.312	0.068	4.588	0.000
C	-3.087	0.710	-4.348	0.000
@TREND	-0.003	0.001	-3.000	0.000

Adjusted R-squared	0.945	Akaike Information Criterion	-4.574
F-statistic	268.513	P(F)=0.000	
Cusum test	Unstable	CF=2.221	Ct=-4.040
HET=21.870	P(.)=0.111	AUT=1.088	P(.)=0.581
RR=0.255	P(.)=0.062	JB=2.830	P(.)=0.237

Dep. Var.: LIMP Long-run Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LUS(-1)	1.835	0.842	2.179	0.031
USROG	0.950	1.108	0.857	0.393
LFUEL(-1)	0.520	0.043	12.093	0.000
LFOOD(-1)	0.131	0.120	1.092	0.278
LGDPR(-1)	0.998	1.536	0.650	0.517
LSC	1.267	1.570	0.807	0.421
LGDPR*LSC	-0.166	0.208	-0.798	0.425

Notes: ARDL-ECM (8) based on Equation (6). For other details, see notes to Table 4.

Table 6 contains the results of estimation of the ARDL-ECM model (8) derived from Equation (7). The results of the diagnostic tests suggest, through the sizes of the different p-values, that the model passes the tests for heteroscedasticity and autocorrelation, and the cusum test for stability. The Ramsey reset F test for misspecification is not satisfied at the 10% level of significance. Although normality is not satisfied, as pointed out above the central limit theorem allows us to discard the issue. The results of cointegration tests can now be interpreted. The *F*-statistic for cointegration with a value of 4.490 attests cointegration as this value is greater than the upper bound, 3.340 at the 10% level of significance. Nevertheless, the associated *t*-statistic with a value of -4.364 is within the bounds, -3.310 and -4.6802 at the 10% level of significance. There is thus indeterminacy about cointegration. However, the *t*-value (-6.533) of the speed of adjustment is large enough to confirm cointegration at the usual levels of confidence. There is therefore the presence of a long-run relationship between *LPD* and its explanatory variables. With a statistically significant speed of adjustment of -0.196, it can be said that the disequilibrium is eliminated at the rate of 19.6% per quarter.

Table 6: ARDL (1,3,0,2,0,1,4,1,0) of Cointegration and Long-run form of Log Prices of Domestically Produced Goods and Services (LPD)

Dep. Var.: D(LPD)	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ	-0.196	0.030	-6.533	0.000
D(BOGR)	9.523	4.281	2.225	0.028
D(BOGR(-1))	-13.652	4.303	-3.173	0.002
D(BOGR(-2))	-1.465	0.359	-4.081	0.000

D(LGDPR)	-7.254	5.215	-1.391	0.167
D(LGDPR(-1))	11.151	4.241	2.629	0.010
D(BIR)	0.243	0.055	4.418	0.000
D(LSC)	2.108	2.354	0.896	0.373
D(LSC(-1))	-0.028	0.041	-0.683	0.495
D(LSC(-2))	-0.039	0.042	-0.923	0.358
D(LSC(-3))	0.088	0.040	2.200	0.031
D(LGDPR*LSC)	-0.224	0.310	-0.723	0.473
C	-68.446	10.374	-6.598	0.000
@TREND	0.005	0.001	5.000	0.0000

Adjusted R-squared	0.3604	Akaike info criterion	-1.013
F-statistic	4.769	P(F)=0.000	
Cusum test	Stable	CF=4.490	Ct=-4.364
HET=21.769	P(.)=0.413	AUT=0.287	P(.)=0.866
RR=4.895	P(.)=0.010	JB=54.516	P(.)=0.000

Dep. Var.: LPD Long-run Estimates

Variable *	Coefficient	Std. Error	t-Statistic	Prob.
BOGR(-1)	26.268	7.419	3.541	0.001
UN	0.012	0.032	0.375	0.697
LGDPR(-1)	44.873	16.961	2.646	0.009
MST	0.104	0.048	2.167	0.033
BIR(-1)	1.528	0.780	1.959	0.053
LSC(-1)	51.986	17.555	2.961	0.004
LGDPR(-1)*LSC(-1)	-6.645	2.255	-2.947	0.004
BIR*LSC	-0.196	0.107	-1.832	0.069

Notes: ARDL-ECM(8) based on EQ. (7). For other details, see notes to Table 4.

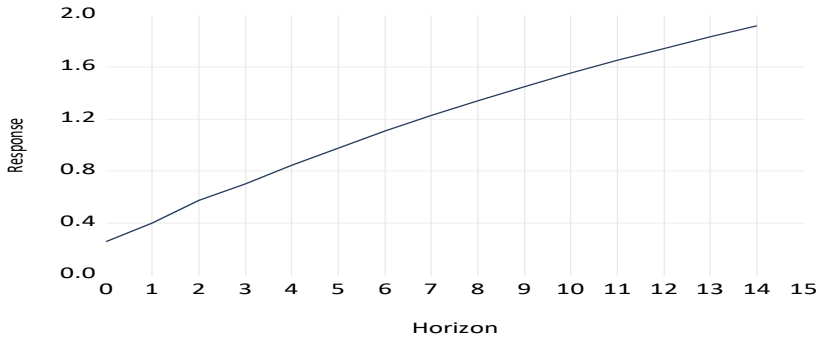
Shipping Costs and Retail Price Index/Inflation

At the outset, the results of Table 4 can be interpreted without reference to other results given the properties of the ARDL model. In fact, following the declared objective of the study each equation is a stand-alone equation with the particularity that the RPI equation is the key equation.

As expected, according to the results of Table 4 the short-run impact estimate of shipping costs index is positive and statistically significant in the retail price inflation equation. A 1% increase in change in shipping costs (*BDI*) brings about a 0.26% increase in retail price inflation. The interim shipping costs impact is -0.09%; that is, the one-period dynamic multiplier is -0.09%. The question of whether shipping costs a moderator variable are finds its answer. The results indicate that shipping costs negatively affect the zero-period (contemporaneous) relationship between change in the Barbados lending interest rate and retail price inflation; precisely, the impact is -0.006%. Furthermore, shipping costs positively influence the one-period relationship between change in the Barbados lending interest rate and retail price inflation; the impact is 0.009%. Combining the effects of the main variable and the interaction variables yields an impact of *LSC* on *LRPI* of the order of 0.20%.

In the long run, although the one-period dynamic multiplier is big (3.54%), the impact is null since it is not statistically significant. As for the short run, *LSC* is only a moderator variable for *BIR*. Indeed, shipping costs positively influence the one-period relationship between the Barbados lending interest rate and retail price index; the one-period dynamic multiplier is -0.117%. There is a suspicion of multicollinearity here, namely between *LGDPR* and *LIMP* and between *BIR* and *LIMP*.

Figure 5: Cumulative Dynamic Multiplier: LSC on LRPI
Shock Evolution



Note: Figure derived from the original version of ARDL of ARDL-ECM (8) (Table 4).

The examination of the cumulative dynamic multiplier of shipping costs (see Figure 5) provides us with more insights into the persistence of the impact of shipping costs on retail price index/inflation. To a 1% permanent shock to shipping cost index, retail price index/inflation responds by an increase of 0.40% after one quarter, 0.85% after one year and 1.9% after 3 years and a half.

What about the impact of shipping costs on the two main components of retail prices/inflation: import prices/inflation (*IMP*) and prices of domestically produced goods and services (*PD*)? Table 5 reveals that contrary to our expectations shipping costs do not affect the import price index, at least in the short run. In the long run, its positive impact (1.267%) is not statistically significant and cointegration is not valid. Table 6 reveals that in the short run, a 1% increase in shipping costs yields a three-period dynamic multiplier of 0.09%; that is, a 0.09% increase in price inflation of domestically produced goods and services (PD). *LSC* is not a moderator variable, in the short run, as its interaction with *LGDPR* is statistically null. In the long run, a 1% shock to shipping costs raises the prices of domestically produced goods by a massive 51.99%. Note, however, *LSC* affects the relationship between *BIR* and *LPD* and between *LGDPR* and *LPD* with -0.20% and -6.65%, respectively. *LSC* is thus a moderator variable. The overall effect (direct and interactions) of shipping costs on LPD in the long run is only 0.073%. In general, the small size response of price inflation to shipping costs predominates in the literature: Herriford *et al.* (2016), Attinasi *et al.* (2021) and to some extent Carrière-Swallow *et al.* (2022a). For example, Carrière-Swallow *et al.* (2022a) using a sample of 46 countries found that a one standard deviation increase in global shipping costs increases headline inflation by approximately 0.15 percentage point. Herriford *et al.* (2016) examined the impact of shipping costs on core PCE inflation in the USA and found that a 15% increase in shipping costs only yields a 0.10% increase in core inflation after one year.

Control Variables and Retail Price Index/Inflation

Real Gross Domestic Product (GDPR) and Retail Price Index/inflation. Table 4 indicates that the short-run impact of real *GDP* growth on retail price inflation is negative (-0.05%) and statistically significant. The negative impact can be explained through the channel of the interest rate.

From the results of Table 5, in the short run, a 1% shock to real *GDP* growth leads to a 0.31% increase in import price inflation. From Table 6, it can be inferred that in the short run a 1% increase in real *GDP* growth raises *PD* inflation by 11.15% one quarter later. In the long run, the real *GDP* impact on *PD* is 44.87%. Under the Phillips curve scenario, there is a chance of observing an increase in real output

leading to a decrease in the unemployment rate and further generating a price increase or inflation. Cumberbatch (1995) and Coppin (1993) found that real income is a contributing factor to inflation in Barbados.

Barbados Output Gap (BOGR) and Retail Price Index/Inflation. Following Table 4, in the long run, a 1% shock to *BOGR* raises retail price index by 3.27%. The positive impact is due to high demand for goods and services resulting in high labour costs and prices of goods and services, at least according to one author.

Table 6 uncovers a significant short-run positive impact of change in *BOGR* on *PD* inflation (9.52%). The interim impacts are negative: -13.65% at lag 1 and -1.47% at lag 2. The positive impact increased several folds in the long run with 26.27%.

In any case, Impavido (2018) uncovered the positive impact of *BOGR* in the short term with a small size (0.046). The main issue with the output gap is that there is no consensus on how to measure output potential.

Import Price Index/Inflation and Retail Price Index/Inflation. According to Table 4, import price index/inflation positively affects retail price index/inflation in the long run (0.51%). The positive impact of import prices has also been found by Downes, Holder and Leon (1991) and Impavido (2018) in the short run, Downes (1985) in the long run, Downes, Maynard and Worrell (1992) implicitly in both runs, and Cumberbatch (1995) in both runs.

The behaviour of import price inflation itself (see Table 5) can be explained by the positive short-run impact of US consumer price inflation (1.41% and -1.77% at lag 1), global fuel price inflation (0.57%), global food price inflation (0.12%), and real GDP growth (0.31%). That is, these variables indirectly affect retail price index/inflation in our model.

Unemployment Rate and Retail Price Index/Inflation

According to the results of Table 4, in the short run and in the long run, there is no discernible significant direct impact of unemployment rate on retail price index/inflation.

Monetary Stance and Retail Price Index/Inflation

According to Table 4, a 1% increase in monetary stance growth generates, 3 quarters after, a decrease of 0.005% in retail price inflation. Greenidge and DaCosta (2009) note that excess money supply is a significant short-term determinant for inflation in Barbados. Impavido (2018) also pointed out the

monetary stance as a significant determinant of inflation for Barbados in the short run. According to Table 6, in the long run, a 1% increase in monetary stance yields a 0.10% increase in PD.

Barbados Lending Interest Rate (BIR) and Retail Price Index/Inflation

Table 4 indicates that in the short run a 1% increase in the Barbados lending interest rate growth yields a 0.04% increase in retail price inflation. Nevertheless, the one-period dynamic multiplier is negative (- 0.06%). In the long run, a 1% increase in the Barbados lending interest rate leads to a 0.90% increase in retail price index. The same odd positive impact (1.53%) is obtained with the *PD* regression (see Table 6) in the long run. Taken literally, Monetary theory does not seem to work here, at least through the interest rate channel. Holder and Worrell (1985) found that the interest rate negatively affects inflation in Barbados. Greenidge and DaCosta (2009) derived opposite results for Barbados: positive (1.32%) in the short run and negative (-2.47%) in the long run. According to them, the positive impact can be explained by the "tardiness of persons to immediately adjust their consumption patterns accordingly" (Greenidge and DaCosta 2009, 388). The impact in the long run turns out to be negative as the people fully match their spending patterns to the cost of borrowing. Note, however, some negative impacts of BIR on prices are reached through the interaction variable (BIR * LSC) (see Table 4 and Table 6).

Conclusion

This paper investigates the impact of global shipping costs on inflation in Barbados during the period 1990Q1 and 2021Q4. One model with three linked equations consists of retail prices (inflation), import prices and prices of domestically produced goods and services as dependent variables and shipping costs as the key explanatory variable as well as the retail price inflation equation as the main equation. The model is further transformed into an ARDL-ECM to deal adequately with the issues of mixed integration of variables, endogeneity of variables and small sample size. Given the properties of the ARDL model, each equation can be considered either a stand-alone equation or a part of a set.

Using the stand-alone equation approach, this paper shows that, in the short run, change in shipping costs has a positive and statistically significant impact on retail price inflation. Although the short-run estimate impact, amounting to 0.26%, is not impressive, shipping costs are statistically the dominant determinant of retail price inflation, leave aside the behaviour of variables in the long run and the two other equations. In the long run, the impact of shipping costs although big, is not

statistically significant. Nevertheless, shipping costs are a moderator variable for the relationship between change in the Barbados lending interest rate and retail price inflation with a negative impact of – 0.117%. Overall, to a 1% permanent shock to shipping cost index, retail price index/inflation responds by increases of 0.40% after one quarter, 0.85% after one year and 1.9% after 3 years and a half.

Surprisingly, the impact of shipping costs on import prices index/inflation is statistically null. On the contrary, the positive impact of shipping costs on *LPD* is statistically significant in both runs. In addition, in the long run, shipping costs are a moderator variable for LGDPR and *BIR*.

In any case, other variables which justify retail price inflation include in the short run: lagged retail price inflation, real *GDP* growth, and lagged monetary stance growth with negative impacts as well as the Barbados lending interest rate growth with positive effect on retail price inflation. In the long run, there are: *LIMP* and *BOGR*. Another impact is implicitly obtained through import price inflation determinants: by decreasing order, there are US consumer price inflation, global fuel price inflation, real GDP growth, and global food price inflation with positive effects on import price inflation in the short run. Moreover, there are also the Barbados output gap growth, the real GDP growth, and change in the Barbados lending interest rate that in both runs positively and significantly affect the prices of domestically produced goods and services impacting indirectly retail price inflation.

At this juncture, the question is whether some policies can be built around shipping costs to curb inflation. Since Barbados cannot influence shipping costs, it pays to build policies around variables whose interactions with shipping costs affect prices or inflation as well as variables that are predominantly “domestic” or “internal”. Interest rate and real GDP are such variables. A monetary policy instrument in the form of an increase in interest rate results in a decrease in money supply that leads to a decrease in prices or inflation. Real GDP as one of the tools of supply-side policies can indeed be a useful instrument for curtailing inflation.

The key message is thus although the part of overall inflation due to high shipping costs cannot be controlled by the government, the remainder can largely be contained by judicious policies with sound “domestic” or “internal” foundation.

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Appendix

Table A1: list of transformed variables, with time period: 1990Q1-2021Q4

Variable	Description	Source of Raw Data
LRPI	Logarithm of the Barbadian retail price index	Central Bank of Barbados (n.d)
LFOOD	Logarithm of Global Food Price index	Food and Agricultural Organization of the United Nations (n.d)
LFUEL	Logarithm of Global Fuel Price Index	US Energy & Information Administration (n.d)
LSC (LBDI)	Logarithm of Shipping costs (Baltic Dry Index) (see p. 14 here for information)	Bloomberg (n.d)
LIMP	Logarithm of Import price index	Central Bank of Barbados (n.d) a
LUS	Logarithm of US consumer price index	World Bank (n.d)
LGDPR	Logarithm of Barbados real GDP	Central Bank of Barbados (n.d) b
BOGR	Barbados Output gap: Real GDP-trend (potential output using HPF)	Computed by us from data above.
USRGDP	US real GDP	World Bank (n.d) a
USROG	US Output gap: US real GDP-trend (potential output using HPF)	Calculated by us.
MB	Monetary Base	Central Bank of Barbados (June 2022)
MST	Monetary stance: Base Money -trend (Base money using HPF)	Calculated by us.
BIR	Barbados Lending interest rate (%)	Central Bank of Barbados (n.d) c
UN	Barbados unemployment rate (%)	Central Bank of Barbados (July 2022)

Note: Sources concern raw data. HPF: Hodrick-Prescott Filter.

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An Investigation into The Relationship between Employee Anxiety and Depression as Predictors of Engagement in The Oil and Gas Sector: The Moderating Role of Job Demand

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Abstract

Purpose: Employee mental health remains an international priority with significant implications for the workplace. This study investigates the relationship between two dimensions of mental health, namely anxiety and depression, and its relationship to employee engagement within the oil and gas sectors of Trinidad, Guyana, and Suriname. The moderating role of job demand in the relationship between these dimensions of mental health and engagement is also investigated.

Design/methodology/approach: Quantitative data via an online web-based survey were collected from a sample of 210 employees within the oil and gas sectors, across the countries of Trinidad, Guyana, and Suriname. Multiple hierarchical regression analysis was performed to test the research relationships.

Findings: The findings provide support for the propositions that employee anxiety and depression negatively impact work engagement. However, job demand did not moderate the relationship between anxiety and work engagement or depression and work engagement.

Originality: This study addresses clear gaps as limited research have examined the relationships of anxiety and depression with work engagement, and even fewer studies have investigated the moderating role of job demand in these relationships. Therefore, this study contributes to understanding relatively under-explored relationships between employee mental health, work engagement and job demand.

Key Words: Employee mental health, anxiety, depression, engagement, job demand, Caribbean

Introduction

Poor mental health can lead to mental illness (Manwell *et al.* 2015). Around 13% of the world's population (971 million individuals) suffer from mental illnesses each year (James *et al.* 2018). This accounts for 7.4% of the worldwide disease burden (Smith 2020), with costly implications for global workplaces. In the Caribbean, research further indicates that more than 60% of people with diagnosable mental illness in the region receive no treatment (Robinson, Lambert and Allwood 2021). Traditionally in the Caribbean, poor mental health and expressing emotions has broadly been culturally and socially stigmatised, associated with shame, personal weakness, and a lack of commitment to God (Maynard 2013; Stephenson and Persadie 2023).

Employee mental health is characterised by several dimensions, which include anxiety, depression, trauma, stress, loneliness, schizophrenia, alcoholism, burnout, isolation, suicidal thoughts and impulses, and other forms of psychological distress (Qui *et al.* 2020). Of these dimensions, anxiety and depression are two prevalent core distress symptoms that manifest themselves both psychologically and physically (Mirowsky and Ross 1989).

Existing research suggests that anxiety and depression account for $1 trillion in lost productivity annually to the worldwide economy (Sime 2019). For instance, the annual cost of lost productivity and absenteeism to the economy of the United States is estimated at upwards of $40 billion for anxiety and $51 billion for depression (Greenberg *et al.* 2015). Moreover, employee anxiety and depression also detrimentally impact physical health, resulting in an increase in hypertension, cardiovascular disease, diabetes, and stroke (Blagoev *et al.* 2018). Poor physical health further affects an individual's mental ability to effectively execute their duties, roles, and responsibilities. Interestingly, countries in the Caribbean spend only 4.3% of the healthcare budget on mental health, without recognising its importance and linkage to physical health (Doshi 2017) as well. In fact, mental health issues continue to be viewed as taboo even as suicide rates associated with anxiety and depression continue to be high. For example, in Trinidad, Guyana and Suriname, Camacho and Sukhram (2024) note that suicidal behaviours include suicidal ideation (the thought of planning or attempting suicide), non-fatal suicide attempts (where an individual does not lose their life), and fatal suicide attempts (where an individual loses their life) were among the highest rates in the Caribbean.

High levels of anxiety and depression negatively affects employees' communication, cooperation, and teamwork with coworkers, as well as their job performance and productivity, (Lee and Raschke 2016; Shkoler and Kimura 2020), and perhaps their work engagement as well. Engaged persons are psychologically involved, completely present, focused, immersed, and committed in their work roles (Kahn 1990). While there is a myriad of existing literature on the positive outcomes of engagement, less research has explored its possible predictors. Emerging research suggests that various aspects of poor employee mental health can adversely affect work engagement as well (Shkoler and Kimura 2020). Empirical research is limited on such relationships between employee anxiety, depression, and work engagement. Instead, previous research has focused more on mental health as outcomes of various workplace and employee conditions without recognising that employee anxiety and depression can also potentially shape or predict important employee attitudes such as engagement. Existing research also suggests that job demand can affect engagement and that developing and retaining engaged employees continue to be a challenge for all organisations with only 20% of employees globally reporting active engagement in their jobs (Harter 2022). While assessing the effect of job demand on anxiety and depression are important for employees in a variety of sectors, they may be especially relevant to those in high stress, high demand professions. Further, although research suggests that job demand can serve as potential stressors (Demerouti and Bakker 2011), limited research has assessed its moderating role in employee engagement relationships, and its potential impact on the anxiety-engagement and depression-engagement relationships.

The current study aims to address two (2) key research gaps, through the following research objectives:

1. To assess the relationship between two mental health dimensions (anxiety and depression respectively), and employee engagement.

2. To assess the moderating role of job demand on the anxiety-employment engagement and depression-employee engagement relationships.

The proposed research model is illustrated in Figure I.

The research model is assessed using a sample of employees from the oil and gas sectors within the countries of Trinidad, Guyana, and Suriname. These three countries are considered leaders in the energy sector in comparison to others within the West Indies.

Notably, the oil and gas industry contribute significantly to revenue and employment in these three countries. For example, in Trinidad, oil and gas typically accounts for roughly 40% of GDP, 80% of exports and approximately 5% of total employment (Moody's Analytics 2022). Guyana's GDP grew by 43.5% in 2020 despite the pandemic, by 20% in 2021 and 49% in 2022, as oil reserves and production increased (Smith 2022; IMF 2022a). As of January 2024, more than 6,000 Guyanese nationals were employed in its oil/gas sector, with more than 1,600 expected to be employed in the 2024-2026 period (OilNow 2024). Suriname's GDP was worth US$3.81 billion dollars in 2020 (World Oil 2021), and its GDP for 2022 grew by 1.5% (IMF 2022b). Employees of the oil/gas sector from these three countries were selected as the target sample given the reliance of all three countries on energy resources with similar ethnic compositions, where employee mental health issues such as anxiety and depression were noted in previous research (e.g., Camacho and Sukhram 2024), and where attempts are being made to enhance employee engagement. Further, this study did not aim to provide a comparative assessment across the countries.

Indeed, employee engagement is important for organisations seeking to acquire a competitive advantage, especially within developing oil and gas markets (Ogbu, Ozowe and Ikevuje 2024). Further, while evaluating the effect of job demand on anxiety, depression, and employee engagement are important for employees in a variety of sectors, they may be especially relevant to those in high stress, high demand professions like oil and gas services. Contextually, no research has been conducted on the relationships between mental health, employee engagement and job demand within the oil and gas sectors in the West Indies region. Theoretically, this study advances research on understanding whether anxiety and depression reduce the engagement of employees in their jobs, and further, assesses whether job demand strengthens or weakens the relationship between anxiety, depression, and employee engagement.

Literature Review

Employee Mental Health: Anxiety and Depression

Mental health is "a dynamic state of internal equilibrium which enables individuals to use their basic cognitive and social skills to recognise, express and modulate one's own emotions, as well as empathise with others" (Galderisi *et al.* 2015, 231). Bloom *et al.* (2011) describe employee mental health as an individual's emotional, psychological, and social well-being which impact how they feel, think, and react in the workplace. Anxiety is described as excessive fear, worry, or avoidance of perceived threat (Craske and Stein 2016). It is an emotional and functional state

defined by cognitive, physical, emotional, and behavioural factors which combine to produce an unpleasant feeling of nervousness, apprehension, fear, and worry (Ahmed *et al.* 2009). Depression can be defined as "a mood disorder characterised by an overwhelming sense of sadness along with inactivity, difficulty in thinking straight, uneven appetite, sleep disturbances, and feelings of dejection and hopelessness" (Shally-Jensen 2019, 105). It is characterised by feelings of sadness, despair, or anger that interferes with an individual's daily activities (Marcus *et al.* 2012). Consequently, disruptions in one's mental health can have a significant and deep-rooted impact on the ability to perform in the workplace. In fact, the Caribbean Public Health Agency (CARPHA 2022) notes that the rising prevalence of mental health conditions in the Caribbean is a public health concern since mental well-being do not only have a health impact, but also impacts workplace productivity and hence overall economic development.

Employee Engagement

Kahn's pioneering research defined engagement as the "harnessing of organisation members selves to their work roles" (Kahn 1990, 694); and that, engaged employees exhibit themselves "physically, cognitively, and emotionally during role performances" (Kahn 1990, 694). Schaufeli *et al.* (2002, 74) later built on this definition by describing employee engagement as "a positive, fulfilling, work-related state of mind, characterised by vigour, dedication, and absorption." Vigour signifies a strong level of energy, perseverance, and mental fortitude, together with a willingness to go above and beyond (Saks and Gruman 2014). Dedication describes strong feelings of purpose, inspiration, passion, and challenge whereas absorption involves being completely focused and absorbed in work (Saks and Gruman 2014). An engaged employee can therefore fulfil their aims at work, mitigate the negative impacts of high demands, and participate in their competency and development (Demerouti *et al.* 2001). Existing research supports positive relationships between higher employee engagement, improved productivity, and positive employee outcomes (Bakker, Demerouti and Sanz-Vergel 2014; Mokhtar *et al.* 2020, Ibrahim *et al.* 2020), since extremely engaged employees are willing to invest more time and effort into their jobs, thereby assisting organisations to achieve their goals (Rich, Lepine and Crawford 2010).

The Relationship between Anxiety, Depression and Employee Engagement

Everyone encounters anxiety and the increased attentiveness and agitation can help employees perform better. Anxiety becomes a mental disorder when it is severe and interferes with a person's regular functioning (Yip *et al.* 2020). Innstrand, Langballe and Falkum (2011) in a longitudinal study, provide support for the idea that lower levels of anxiety positively affect the energy and drive of employees. Conversely, employees with higher levels of anxiety are less energic and driven,

which are associated with less vigour and dedication, and hence, lower work engagement. For many years, research has suggested that extreme anxiety can cause employees to frequently lose enthusiasm in work and social activities, and their sense of employee engagement may decrease as a result (Billings and Moos 1983). More recently, research supports the idea that anxiety induced through emotional anxiety, autonomous physiological activity, and worrying, have stronger negative associations with employee engagement (Lau 2020). Either way, employees who do struggle with anxiety may experience emotional exhaustion, which limits their capacity to devote high amounts of effort to their work (McCarthy, Trougakos and Cheng 2016), thereby reducing engagement.

Employee depression may also hamper engagement since such employees may retain, assess, or remember information about their jobs in a troubled manner, resulting in lower levels of employee engagement. In fact, Lau (2020) reveal that depressive symptoms can make it more challenging to participate in tasks since depression is linked to sad moods, a lower ability to appreciate and enjoy activities, and negative rumination. Thus, depressed employees are less capable to engage in work with energy, enthusiasm, and absorption. Depressed individuals also experience feelings of sadness, hopelessness, and resentment, which interfere with proactive behaviours and enthusiasm at work, thus resulting in low levels of engagement (Rasool *et al.* 2021).

While studies show that individuals' engagement at work depends on job resources, the question of whether work engagement may be shaped by the depletion of personal resources as well is less studied. High levels of anxiety and depression may be associated with a state of personal resource depletion. Personal resources may be described as tangible, social, psychological or symbolic assets that are valued by a person, (Lin 2017) which are directly available to improve effective functioning in specific domains. Anxiety as a mental disorder can deplete the psychological assets of such employees, resulting in a reduced sense of significance, enthusiasm, inspiration, and personal pride (Chen and Fellenz 2020), and hence reduced engagement in the work domain. Further, when employees are depressed, they may become challenged in managing their personal resources since their social and psychological resources may be depleted due to their associated feelings of sadness, hopelessness, and resentment (Hobfoll 2002). Accordingly, employee engagement can decrease when employees are experiencing high levels of anxiety and depression or resource depletion, which limits employee dedication and vigour in the work domain as well. Given these theoretical arguments and research, the following hypotheses are proposed:

H1: There is a significant negative relationship between anxiety and employee engagement.

H2: There is a significant negative relationship between depression and engagement.

Job Demand: The Moderating Role in the Mental Health- Employee Engagement Relationships

Job demand is described as the persistent physical and/or mental effort required to complete certain job duties such as workload, time constraints and the obstacles of the physical work environment (Crawford, LePine and Rich 2010). Early research describes decision authority, rigid deadlines, and intellectual strain as elements of job demand (Karasek 1979). More recent research suggests that the demands of role ambiguity, role conflict, role stress, stressful situations, workload, and job pressure have the greatest impact on employees (Bakker and Demerouti 2014).

Job demand that necessitates immense effort and persist for long periods of time can add fuel to burnout, diminished work quality, and mental health issues (Nelson and Simmons 2003). Several studies suggest that anxiety symptoms are aggravated by demanding work situations such as rigid deadlines, ambiguous job responsibilities and difficult work activities (Day, Crown and Ivany 2017). Consequently, when employees are already faced with extreme anxiety which depletes their personal resources, high job demand can become an added hindrance by straining job resources, and further affecting the relationship between anxiety and employee engagement. Excessive job demand may further deplete the energy level in the human body causing it to work harder than usual. This results in reduced energy, dedication, and engagement levels when completing daily tasks since personal resources are already strained from high anxiety (Schaufeli and Taris 2013). When job demand is high, the negative relationship between anxiety and employee engagement can therefore be strengthened.

High job demand has also been linked to employee depression (Melchior *et al.* 2007), mental distress and mental pressure (Purnami and Handoyo 2018). Furthermore, studies have found that an increase in job demand can indeed deplete an employee's mental resources, triggering further depression (Bakker and Demerouti 2008; Rai 2018; Bakker and Oerlemans 2016; Bakker and Costa 2014). Since depressed employees are already low on personal resources, further job demands such as administrative hassles, role uncertainty, and role overload can also drain job resources, thereby leading to a stronger negative relationship between employees who are already drained of mental resources and the energy to dedicate to work engagement (Crawford, LePine and Rich 2010).

Recent studies such as Chen and Fellenz (2020) and the previous work of Hobfoll (2002) recognise that the theoretical logic of the conservation of resources theory can also be reconceptualised to recognise that employee engagement can be directly reduced by high levels of anxiety and depression respectively through depleted social, psychological, mental, and hence personal resources, but that high job demands may also deplete job resources, thereby strengthening the already existing negative relationships between anxiety, depression and employee engagement.

Given these theoretical arguments, the following hypotheses are proposed:

H3: Job demand moderates the relationship between anxiety and employee engagement, such that the negative relationship between anxiety and employee engagement is stronger, when job demand is higher.

H4: Job demand moderates the relationship between depression and employee engagement, such that the negative relationship between depression and employee engagement is stronger, when job demand is higher.

Methodology

Research Participants and Procedure

Data was collected through a web-based online survey over a three-week period in February and March 2022 among employees across levels within the oil/gas sector. A convenience sampling approach was used. Ethics approval was granted from The Ethics Review Committee, The University of the West Indies, St. Augustine Campus, to conduct this study. Informed consent, anonymity, confidentiality and principles of ethical research were adhered to before, during, and after the completion of the study. The final sample considered all job levels/positions and included 210 employees across the three countries (Trinidad: n=103, 49%; Guyana: n=56, 26.7%; Suriname: n=51, 24.3%). 127 males (60.5%) and 83 females (39.5%) were surveyed, ranging from ages 21–30 (n=70, 33.3%), 31–40 (n=92, 43.8%), 41–50 (n=43, 20.5%) and 51–60 (n=5, 2.4%). Most of the participants possessed at least a Bachelor's degree (n=132, 62.9%), followed by a Master's degree or higher (n=45, 22%), and the remaining participants possessed at least a high school education (n=32, 15.2%). Most participants had a job tenure of between 0–5 years (n=103, 49%), followed by 6–10 years (n=56, 26.7%), and the remaining participants were employed for at least 11 and more years (n=51, 24.5%). Most employees were permanent/full time (n=167, 19.5%), and the remaining participants were employed on a contractual basis (n=43, 20.5%).

Measures

Anxiety

Anxiety was measured using the Generalised Anxiety Disorder (GAD) scale, developed by Spitzer, Kroenke, Williams and Löwe (2006). This 7-item scale was assessed on a 4-point Likert scale, ranging from 1–4, with 1 being "Not at all" and 4 being "Nearly Every Day." Sample items included: "Feeling nervous, anxious or on edge" and "Not being able to stop or control worrying."

Depression

Depression was measured using Radloff's (1977) 20-item scale. Responses were anchored on a 4- point Likert scale, ranging from 1–4, with 1 being "Rarely or None of the Time" and 4 being "Most or All of the Time." Sample items included: "I was bothered by things that usually do not bother me" and "I have trouble keeping my mind on what I was doing."

Employee Engagement

Employee engagement was assessed using the Utrecht Work Engagement scale developed by Schaufeli *et al.* (2002), which is comprised of 17 items (6 items assessed vigour, 5 items assessed dedication, and 6 items assessed absorption). The items were anchored on 7- point Likert scales, ranging from 0–6, with 0 being "Never" and 6 being "Always". Sample items included: "At my work, I feel bursting with energy." and "At my job, I am very resilient, mentally."

Job Demand

Job demand was measured using the job demand subscales of the Copenhagen Psychosocial Questionnaire (Kristensen *et al.* 2005). The subscales included 15 items, which were anchored on 5-point Likert scales ranging from 1–5, with 1 being "Always" and 5 being "Never or Hardly ever." Sample items included: "Do you have enough time for your work tasks?" and "Do you have to work very fast?"

Control Variables

Age (in years), gender (male, female, other), level of education (by levels), and organisational tenure (in months) were used as control variables since research suggests that such demographics may covary with the employee attitudes and cognitions examined in this study. 'Country' was also assessed as a control variable to rule out any potential country-specific differences.

Data Analysis Approach

Prior to the regression analysis, a four-factor measurement model was examined. This model included anxiety, depression, employee engagement, and job demand. The results of this measurement model are summarised in Table I, along with three alternative models, which supported the empirical distinction of the study variables. The four-factor model fit the sample data best, in comparison to the alternative models which were generated (Satorra-Bentler χ^2 (913) = 1,435.84, p < 0.01, CFI = 0.96, RMSEA = 0.058, SRMR = 0.068). The average variance extracted by each scale and factor loadings for the variable items are summarised in Table II. Each of the reduced scales were reliable with Cronbach's alpha values of > 0.7 (See Table III).

To test the research hypotheses, multiple hierarchical regression analysis was used. In all the analyses, the independent variables were centred to reduce the effects of non-essential ill conditioning by having the mean represent a meaningful zero point for better result interpretation (Cohen *et al.* 2003). The control variables were first entered in the regression equation in Step 1. In Steps 2(a) and 2(b), each of the main effect relationships between anxiety and employee engagement, as well as depression and engagement were evaluated individually. In Step 3, interaction terms were created with the centred variables as well to test the moderation effects of job demand. Regression analysis was deemed acceptable and robust to assess the moderating effect since the study only tested a single moderator.

Results

Table III displays the means, standard deviations, and inter-correlations between all the main study variables and the controls.

The correlation results indicated a significant negative relationship between anxiety and employee engagement (r = -0.374, p < 0.05). A significant negative correlation between depression and employee engagement (r = -0.490, p < 0.05) was also indicated. Further, a negative relationship between engagement and job demand (r = -0.139, p < 0.05), a positive relationship between anxiety and job demand (r = 0.397, p < 0.05) and a positive relationship between depression and job demand (r = 0.370, p < 0.05) were each supported. Anxiety and depression significantly correlated with each other (r = 0.746, p < 0.05).

In the regression model, the control variables accounted for 5% of the variance in employee engagement in Step 1. In Step 2, when anxiety was added, an additional 14% of the variance in employee engagement was predicted (R^2 = 0.140, F (1,208)

= 33.743, $p < 0.05$). Depression contributed to a further 24% of variance in engagement ($R^2 = 0.240$, $F(1,208) = 65.702$, $p < 0.05$). The interaction effect of job demand in Step 3, did not explain a significant percentage of variance in the anxiety- employee engagement (1%) or the depression- employee engagement (0.2%) relationships. The results of the regression model are summarised in Table IV.

Hypotheses 1 and 2 were supported by the sample data based on the regression coefficients, while Hypotheses 3 and 4 were not supported. As shown in Table IV, Hypothesis 1, which proposed a significant negative relationship between anxiety and employee engagement was supported ($\beta = -0.374$, $p < 0.05$). Hypothesis 2, which postulated a significant negative relationship between depression and employee engagement was also supported ($\beta = -0.490$, $p < 0.05$) in this study. However, the moderating role of job demand on the anxiety-employee engagement relationship (Hypothesis 3: $\beta = 0.101$, $p= 0.117$, *ns*) and the depression- employee engagement relationship (Hypothesis 4: $\beta = - 0.010$, $p= 0.881$, *ns*) were not supported by the data. The moderation slopes associated with Hypotheses 3 and 4 are also illustrated in Figure II.

Discussion

The overriding goals of this study were to examine the relationships between anxiety, depression, and employee engagement, while assessing the moderating effect of job demand on these relationships. This study, therefore, examined the relationship between key mental health dimensions, employee engagement, and job demand. The research results and the contributions of the study are discussed below.

Firstly, this study suggests that employees who are faced with anxiety are less likely to be engaged in their work. This reinforces the assertions by Green and Medlin (2010) and Nugraha and Wardhani (2022) that high levels of anxiety directly and negatively impact employee engagement. High levels of anxiety can influence thinking, leading to distractions that makes it difficult to self-regulate one's work behaviour, thereby negatively impacting their engagement (Khan 2021). More recently, Khan (2021) suggested that extreme anxiety results in heightened emotions of fear, which leads to distractions, and reduced dedication/engagement on the job.

Secondly, this study also supports the idea that higher levels of employee depression are associated with lower levels of engagement, in line with existing research (Ahola and Hakanen 2007). Employees who are depressed tend to develop negative perceptions of their work and well-being (Lau 2020). Lau (2020) also concluded that the negative perceptions are a direct result of depressed moods,

an inability to enjoy and experience interests, and pessimistic reflections, which negatively impact employee engagement. Employees with depression also retain, assess, or remember information about the job in a distraught manner, which results in low work engagement (Lau 2020).

Finally, and perhaps most importantly, this study suggests that job demand did not significantly affect anxiety- employee engagement or depression- employee engagement relationships. Indeed, research suggests that high job demand can deepen the negative effects of anxiety and depression on employee engagement (Bakker and Costa 2014; Day, Crown and Ivany 2017; Muhamad *et al.* 2020; Bakker and Demerouti 2008; Purnami and Handoyo 2018). However, in this study, high job demand and its associated stress does not affect the negative relationships between anxiety, depression and employee engagement. One may suggest that high levels of anxiety and high levels of depression deplete the personal resources of employees to such an extent that its relationship to work engagement may not be affected in a significant manner by job demand (Chen and Fellenz 2020). In addition, those who lack personal resources are more vulnerable to resource loss, which also fosters increased future loss (Hobfoll 2001). While previous research has shown that job conditions may shape work engagement, less research have explored the conditions under which personal resources can shape engagement beyond job demand. The findings of this study suggests that anxiety and depression deplete personal resources which shape engagement, regardless of job demand. Consequently, job demand becomes irrelevant in shaping the relationships between anxiety, depression and work engagement.

Furthermore, the non-significant effect of job demand may have occurred due to job resources acting as a buffer between mental health dimensions, job demand and engagement (Rai 2018). For instance, when personal resources are already depleted due to anxiety and depression, job resources may become much more relevant and powerful in shaping employee engagement, independent of job demand. Job resources are not only crucial for dealing with job demands but they are also important in its own right. Upadyaya, Vartiainen and Salmela-Aro (2016) suggest that a lack of job resources may even shape poor work engagement and strengthen the effect of increased anxiety and depressive symptoms (Hakanen and Schaufeli 2012), beyond job demand, thereby also offering opportunities for future research.

Theoretical Implications

From a theoretical perspective, while some studies have explored the relationships between employee mental health and engagement, this study further validates such

existing research. Validation is important to provide consistent support to strengthen literature on employee anxiety, depression, and engagement.

Second, this study extends employee engagement research by using alternative perspectives on the conservation of resources theory to understand the negative relationships between anxiety, depression, and employee engagement. This alternative theoretical lens is not widely used in engagement research.

Finally, this study explored the less researched role of job demand in affecting the relationships between key mental health dimensions and employee engagement. Research on the role of job demand in shaping mental health- employee engagement relationships have been sparse. Consequently, this study extends research in this direction by noting that factors independent of job demand may have more significant impacts on employee mental health and their work engagement.

Practical Implications

Practically, this study provides empirical evidence to show that anxiety and depression can each have significant negative effects on employee engagement within the oil and gas services sector of Trinidad, Guyana, and Suriname. This context is under-researched within the existing literature. Managers in this sector are tasked with generating high performance results within the competitive markets of the oil and gas industry (Deery and Jago 2015). The findings of this study can empirically be used to promote management decisions aimed at encouraging and improving employee mental health to increase engagement levels in the workplace. Therefore, focus should be placed on creating an environment that supports employee mental health and wellness. Certainly, providing supportive mental health policies and programs is one of the most frequent indicators of organisational support for employees (Singh and Ramdeo 2021). As a result, managers must promote the use of such services and embody positive behaviours, encouraging employees to prioritise well-being (Singh and Ramdeo 2021).

While managers cannot provide treatment themselves, the research on workplace accommodations for employees with anxiety and depression may be of use to employers. Regular meetings with supervisors and quieter workspaces were shown to be the most important factors for employee engagement (Wang *et al.* 2011). Such accommodations are simple to adopt and often do not incur any direct expenditures for organisations (Wang *et al.* 2011). Further, managers can build employee support by focusing on functional leadership styles.

Finally, leadership approaches should also focus on evaluating the role of job demand and job resources and managing that process to maximise employee mental health and engagement. Further, an evaluation of the personal resources of employees that they bring to the work domain should also be conducted to manage anxiety and depression, while building work engagement.

Limitations and Future Research

Although this study makes several contributions, it is not without its limitations. First, this study uses a cross-sectional research design, and therefore only provides a snapshot of the research variables and associated relationships at one point in time. It is recommended that cross-lagged panel designs or longitudinal designs be used in the future to address the issue of common method variance, while assessing some degree of causality between the research variables. Second, the study sample focused only on employees within the oil and gas services sector across three countries within the West Indies. While this sample may be representative of employees within the energy industry, the generalisability of the research results may be somewhat limited in other sectors. Hence, future researchers can explore the research model beyond the energy sector to enhance the generalisability of the findings. Third, this study only explored the influence of two mental health dimensions on employee engagement. Other studies can explore the role of other mental health dimensions, beyond anxiety and depression. Fourth, anxiety and depression have been construed theoretically as outcomes within previous research, and not predictors of engagement as shown in this study. However, these variables can even change in their relationship with job demands as these variables have been shown/theorised to be outcomes of job demand stressors in past research. Consequently, the findings of this study in relation to anxiety, depression, engagement and job demands must be evaluated, while recognising such potential limitations. Finally, this study examined the moderating effect of job demand but failed to potentially assess the role of job resources in shaping relationships associated with employee engagement. This limitation provides the opportunity for future research which can dissect and evaluate the differential effects of job resources versus job demand. Evaluating the additional role of job resources can also provide alternative perspectives on the study relationships.

Conclusion

This study adds to the existing body of engagement research by exploring the relationship between key dimensions of mental health, namely anxiety and depression, and employee engagement. The findings suggest that employees who experience high levels of anxiety and depression are more likely to be less engaged

in their work. The study also adds to the dearth of research on the role of moderators, such as job demand, in shaping the relationship between mental health and employee engagement. Although job demand did not significantly influence the anxiety-engagement and depression-engagement relationships as hypothesised this study indicates the need to recognise the role of personal resources and job resources to fully understand its role in employee mental health and engagement. In these ways, this study advances research and practice in an emerging area of interest.

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devastated-workers-mental-wellbeing-which-types-of-jobs-are-most-affected-and-what-can-employers-do.

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FIGURES

Figure I: Research Model

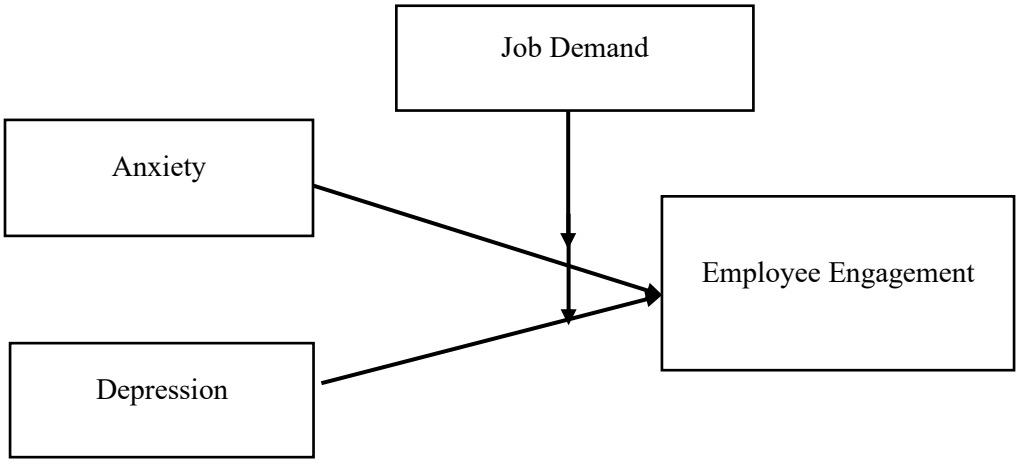
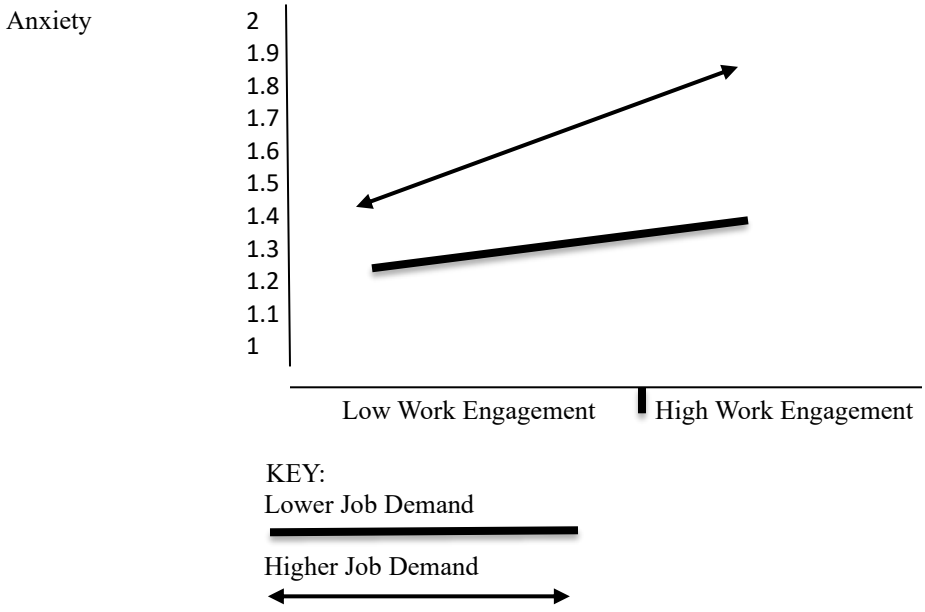
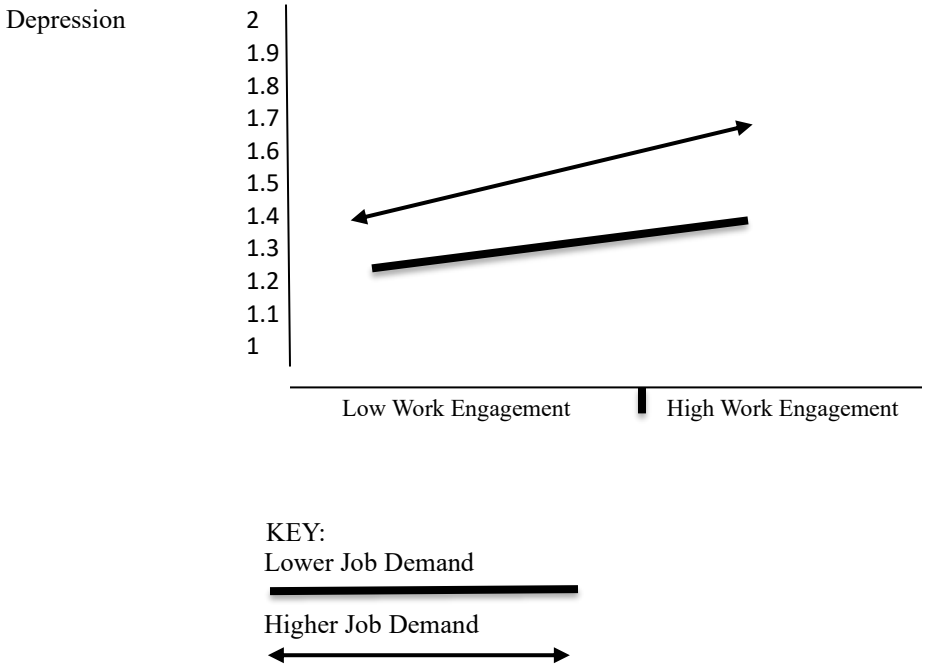


Figure II: Moderation Slopes

A. Moderation Slope for Hypothesis 3



B. Moderation Slope for Hypothesis 4



TABLES

Table I: Measurement Model Results

Model	**Satorra-Bentler x^2**	**CFI**	**RMSEA**	**SRMR**
4-factor (anxiety, depression, employee engagement, job demand)	(913)= 1,252	0.97	0.067	0.071
3-factor	(1003)= 1,671	0.86	0.090	0.080
2-factor	(1221)= 1,955	0.79	0.098	0.091
1-factor (single factor omnibus model)	(1361)= 2,234	0.62	0.131	0.133

KEY:

X^2- Chi-square
CFI- Comparative Fit Index
RMSEA- Root Mean Squared Error of Approximation
SRMR- Standardised Root Mean Square Residual.

Acceptable Fit Standards (Carmines and McIver, 1981; Hair *et al.*, 2001):
CFI > 0.9
RMSEA < 0.09
SRMR < 0.08

Table II: Average Variance Extracted and Factor Loadings

Research Variables	Average Variance Extracted	Factor Loadings
Anxiety	71.5%	**All 7-items retained as follows:** 0.86 0.87 0.87 0.86 0.81 0.79 0.81
Depression	63.6%	**Reduced from 20-items to 13-items as follows:** 0.72 0.81 0.74 0.87 0.78 0.84 0.74 0.76 0.87 0.77 0.77
Employee Engagement	77.2%	**Reduced from 17-items to 15 items as follows:** 0.76 0.71 0.87 0.85 0.68

		0.79 0.73 0.71 0.73 0.78 0.84 0.77 0.85 0.77 0.80
Job Demand	73.0%	**Reduced from 15-items to 14 items as follows:** 0.79 0.81 0.84 0.84 0.79 0.89 0.85 0.67 0.65 0.87 0.83 0.71 0.84 0.80

Table III: Means, Standard Deviations, Reliability Coefficients and Bivariate Inter-correlations

Variable	Mean	Standard Deviation	1	2	3	4	5	6	7	8
1. Anxiety	1.1	0.8	*(0.91)*							
2. Depression	1.8	0.7	0.74*	*(0.87)*						
3. Employee Engagement	3.5	1.2	-0.37*	-0.49*	*(0.79)*					
4. Job Demand	2.4	0.6	0.39*	0.37*	-0.13*	*(0.72)*				

5. Age	37	11	0.10*ns*	0.18*	0.12 *ns*	-0.12*ns*	*(0.74)*			
6. Gender	0.77	0.9	0.24*	0.12 *ns*	0.20*	0.18*	0.11 *ns*	*(0.71)*		
7. Education	4	2	0.11*ns*	0.19*	0.19*	0.19*	0.08 *ns*	0.19*	*(0.74)*	
8. Job Tenure	4.1	1.7	0.10*ns*	0.12 *ns*	0.12 *ns*	-0.10*ns*	0.18*	0.23*	0.24*	*(0.77)*

KEY:

N= 210
Cronbach's alpha reliability coefficients in parentheses (-), shown in italics along the diagonal
*Correlation values significant at $p < 0.05$
ns Non-significant correlation values at p values > 0.05

Table IV: Research Model Results

Employee Engagement (EE)

Variables	**Model 1** **ΔRSq** **β**	**Model 2** **ΔRSq** **β**	**Model 3** **ΔRSq** **β**
Step 1: Controls	0.05**		
Age	0.11	0.11	0.11
Education	0.17**	0.17**	0.17**
Gender	0.18**	0.19**	0.18**
Job Tenure	0.13	0.12	0.12
Country	0.10	0.12	0.11
Step 2: Main Effects			
H1: Anxiety (A)		0.14** -.37**	0.12
H2: Depression (D)		0.24** - 0.49**	0.13
Step 3: Interactions			
H3: A X JD (Anxiety X Job Demand)			0.01 0.10
H4: D X JD (Depression X Job Demand)			0.002 -0.01
Total RSq.			0.41
Total F Value (9.69**)			

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Contrasts between Family and Non-Family Businesses in Barbados: Succession Planning and Performance Measures

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Abstract

This study seeks to further the development of family business theory by providing a more detailed discussion of the differences between family and non-family businesses in relation to variations in the approach to succession planning, and the contrasts in how performance is measured. Family businesses are important for economic growth in many countries, and they provide a primary source of employment (Allouche and Amann 2002). Despite this international importance, many studies indicate that several first-generation family businesses do not survive to the next (El-Chaarani 2013). Bernice and Folker (2007) contend that the growth of family businesses is less likely than non-family businesses due mainly to their management practices which tend to be less formalised. An effective approach to succession planning in family businesses increases the chance of success of a family business in both short-term and long-term. A qualitative research design was implemented, and the paper focuses on differences in how family-owned businesses and non-family businesses measure performance and whether there are any differences in the approaches to succession planning in a developing country context. The rationale for the paper is to understand the differences in planning for succession between family and non-family businesses and the role played by differences in how performance is measured.

Key Words: succession planning, performance measures, family businesses, non-family businesses

Introduction

The research seeks to address two issues, primarily the different approaches to succession planning in family-owned businesses and non-family businesses, and to address the much-debated issue of performance differences in these two types of firms, specifically how performance is measured. This paper is not about discussing whether family businesses perform better or worse than non-family businesses, but it is seeking to identify areas for improvement since family-owned

businesses are important, not only in terms of their prevalence, but they are socially important for the Caribbean. According to Lewandowska and Nowak (2012), family, both officially and unofficially, performs an important role in the business. The authors made the point that family businesses focus on maintaining long-term stability rather than focusing on short-term profitability. The future generations of the family businesses are inspired not only because of financial motivations but to maintain cultural and social traditions in the business (Lewandowska and Nowak 2012). Chua, Chrisman and Steier (2003) contend that an important issue that should be addressed to develop family firm theory is to understand the reasons behind family businesses behaving differently from non-family businesses.

The article starts with a review of literature in relation to the various aspects of family and non-family businesses. Having reviewed the literature, the research questions are outlined. Thereafter, the methodological approach is discussed. The data is analysed using elements of the Theoretical Framework. Having analysed the data, the findings are discussed. The contribution of the article is presented, after which suggestions are given for future research. The limitations and practical implications are discussed.

Definitions

Family Business

According to Anderson and Reeb (2003b), a family business is a business owned, managed and controlled by one or more of the family members who are actively involved in the operations of the business activities. It is a family business when control, management and a majority of voting rights are within the same family and family leaders define the business as a family business (Hall, Melin and Nordqvist 2011).

Non-family business comprises shareholders who are not related by blood or marriage, and which has full-time salaried non-family employees (Galambos 2010).

Succession Planning

Rothwell (2001) defines succession planning as the systematic effort by a business to make sure there is continuity of leadership in key positions. It is also a process which makes sure there is continuous efficient performance of a business by introducing a process for employees to grow and the opportunity to replace staff (Rothwell 2001). Succession planning involves not only top personnel but other elements. It can include procedures required for an effective transfer,

psychological factors, financial and legal considerations, leadership development and exit strategies (Ip and Jacobs 2006).

Performance Measures

All businesses seek to achieve profits through financial measures but with family, other factors are considered such as long-term horizon, harmonious relationships with family members, long-term supplier relationships, commitment of family members and open communication with family members, when measuring performance. The performance goals of family businesses include financial and non-financial goals.

For non-family businesses, ultimate performance measures include physical growth such as product development, market diversification and market development. These non-family businesses' financial goals include achieving a high profit, return on assets and return on equity.

Literature Review

Differences in the Succession Process

In investigating the differences in succession planning and performance measures between family and non-family businesses, it is important to understand the core variations between family and non-family businesses. It is important to understand the differences between these two entities as they prepare for succession differently. In addition, succession in family-owned businesses is not generally a frequent occurrence. However, in the non-family businesses, there is usually a higher frequency of succession. In relation to availability of successors for the business, in many instances, the potential heirs usually pursue other professional careers. In the non-family businesses, the employees are generally groomed for leadership positions because of the wider pool of potential successors, both internal and external to the business.

Cabrera-Suarez (2005) suggests that the main differences between family-owned businesses and non-family-owned businesses, as indicated in the literature, is that there is generally less formalisation of succession plans in family-owned businesses than in non-family businesses. In family-owned businesses, the selection of employees tends to be done from within the family, unlike non-family businesses who recruit employees based on their knowledge, experience and competence and are given the opportunity to rise within the organisation. There is more of an in-family development in family-owned businesses (Chrisman, Chua,

Sharma and Yoder 2009). There is also a more intimate relationship between incumbent and successor. Within family-owned businesses, there is more of a focus on tacit knowledge than there is in non-family businesses. If tacit knowledge is converted to explicit knowledge, the organisation experiences less challenges with regards to loss of knowledge when employees leave (Davenport and Prusak 1988; Baumard 1999; Lave and Wenger 1991).

Differences in Performance and Performance Measures

According to Poza and Daugherty (2013), family owners have a long-term horizon while, on the other hand, the focus of managers of non-family firms is to satisfy shareholders and pursue their own personal interests by generating revenue in the shorter-term. The differences in points of focus in the two types of firms, according to these authors, are high sales revenue and increased improvement in net profits for the non-family firms compared to family firms. The authors examined first generation publicly listed companies and stated that since market results suggest a more competitive position, the data collected would infer that family firms perform better than non-family firms. Charbel, Eli and Georges (2013), however suggest that because of the need to satisfy the deep social and emotional needs of family members, family owners and managers may not always be solely profit driven. This is also a valid point made by Charbel that most family businesses are not always profit-oriented, but they seek to satisfy emotional needs of family members. The view of family owners and managers can prove disadvantageous to shareholders as the company may be seen as a family recruitment agency. There is a disadvantage of family businesses that recruit top management from within the family, thereby reducing the cadre of top employees to family members and foregoing the opportunity of having competent and talented external candidates.

One of the advantages of family businesses is their ownership structure and this type of ownership assists them in circumventing agency challenges and short-term objectives (Sarbah and Xiao 2015). The authors further contended that the managers of non-family businesses focus more on the accounting aspect and profit motive of the business (Sarbah and Xiao 2015). Family businesses performed more consistently than non-family businesses even in challenging economic periods (Economist 2015). Another benefit of family businesses is their strong internal culture; however, the culture in family businesses is unique with different family businesses using different strategies (Economist 2015). The benefits of these internal cultures of family businesses include a steady cadre of employees, stronger labour relations and security of tenure for employees which is derived from a sense of loyalty. The trust factor underpins the core existence of family businesses more than any other type of business.

Notably, Japanese family businesses tend to be less focused on profitability than non-family businesses. The concept of long-term, generational succession is firmly rooted in Japanese society (Allouche, Amann, Jaussaud and Kurashina 2008). Additionally, the Japanese family firm model is focused mainly on preserving the family inheritance and values for transition to future generations (Fama and Jensen 1983).

In summary, there are several benefits of family businesses according to the literature. Family businesses are advantageous because of their long histories and relationships that redound to the benefit of the business. They can also take advantage of their networks with other family members and relatives to enhance the performance of the business. The commitment of family members is also another benefit that has augured well for the family business. These are unique family advantages relating to the Resource Based View.

Barney (1991) argues that the Resource Based View of the firm indicates that an organisation is evaluated for the capabilities that are distinctive to it. According to Grant (1996), these capabilities, considered as organisational capabilities, can provide firms with a competitive position. Sirmon and Hitt (2003) state that family businesses have five distinctive resources that make them more beneficial than non-family businesses. They identify these resources as human capital, social capital, patient capital, survivability capital and governance structure. Human capital is the developed knowledge, capabilities and skills of a person. To a larger extent, family members are very committed to the family business and therefore tacit knowledge is evident, Social Capital is defined as relationships between organisations and among individuals (Hitt 2003), and as noted above, these would be stronger than in non-family businesses. Sirmon and Hitt (2003) suggest that these resources include borrowed labour, types of free labour, equity investments or financial loans. The authors made the point that these resources are likely to be a significant source for long-term projects which have high risks. Survivability capital is the accumulation of the idiosyncratic social, human and patient capital (long term) resources in family businesses and distinguishes family businesses from non-family businesses (Wilson, Wright and Scholes 2013). Survivability capital can be of good use in circumstances which might not have predictable outcomes. Family businesses with patient capital means that these businesses can engage in creative strategies because patient capital is typically used for longer term investments (Sirmon and Hitt 2003). Since innovations tend to be long-term projects with long-term payoffs, they benefit from these types of financial arrangements (Sirmon and Hitt 2003).

Although there are several benefits of family businesses, there are also drawbacks. The disadvantage of a family business is when disagreements occur, it can create conflict among family members, affecting the business's performance (Sirmon and Hitt 2003). According to Chua, Chrisman and Steier (2003), relationships among family members can negatively affect financial performance. The authors state that this can lead to agency costs to the family where they receive benefits from the business but at the expense of non-family shareholders. Governance issues tend to be less serious at family business because of the level of trust inherently at family firms (Sirmon and Hitt 2003). One of the liabilities of family businesses is the confusion that can happen between business goals and family goals which in some instances might impact on business performance (Alderfer 1988). Many family firms do not have succession plans, either because of a reluctance by the incumbent to step down or they believe that the family will deal with it at the time (Chua, Chrisman and Steier 2003).

The Impact of Family on Performance

In applying the Resource Based View theory, Habbershon and Williams (1999) describe the extent to which the notion of familiness can create a competitive position and improve the performance of the business. According to Habbershon, Williams and MacMillan (2003), the familiness concept states that family businesses differ from non-family businesses based on the unique resources and competencies they establish. Chrisman, Chua, Litz (2003) make the point that the extent of familiness within family businesses can contribute to the continuation of family bonds and value creation. The authors emphasise that it is trans-generational value creation that distinguishes between family and non-family businesses. Chua, Chrisman and Sharma (1999) asserted that the family business is pursuant of economic and non-economic goals to enhance the business throughout generations. Recent research has devoted much focus on non-financial goals of family businesses (Berrone, Cruz and Gomez-Mejia 2012; Chrisman and Patel 2012; Zellweger, Nason, Nordqvist and Brush 2013). Emerging research emphasises the importance of non-financial goals, namely, succession in family business (Williams 2015). This is one of the core conceptual differences between family and non-family business.

In relation to the main indicators of firm performance, the broad literature related to profitability and growth in family-owned businesses and non-family businesses are highlighted below.

Profitability

According to Anderson and Reeb (2003b), firms with founding family control are perceived as less profitable than firms with dispersed ownership. The authors note

that businesses with varied shareholders usually support their investments on the rules of the market that enhance the firms' cash flows. However, there are negative features of non-family ownership, particularly conflict, higher agency costs and a lack of trust.

Conventional Agency Theory suggests that family firms will perform better than non-family firms because the division of ownership and control enables non-family business managers to follow their own personal goals (Demsetz and Lehn 1985; Daily and Dollinger 1991; Randoy, Jenssen and Goel 2003). Davis (1983) asserts that the emotional involvement that family members have in their business positively increases business performance. However, Westhead and Cowling (1997) found that there was no disparity between the profitability results of family and non-family businesses. The authors indicate that some family businesses reported a higher return on assets than non-family firms. As noted previously, some of these conflicting results may be the result of different research approaches, different geographical settings or different definitions of family business.

Growth

Agency theorists suggest that very often growth is not the main objective of family businesses because of the overarching motivation to maintain control of the business for the family (Chrisman and Patel 2012). Daily and Dollinger (1992) state that on the other hand, in non-family businesses the focus is on growth, which enables opportunities for higher levels of compensation. Anderson and Reeb 2003b; De Angelo and De Angelo 2000; Schulze, Lubatkin and Dino 2003; Gomez-Mejia, Cruz, Berone and Castro (2011) indicated that there is an expectation of lower growth in family businesses and some of the behaviour of family businesses impact on the growth aspect negatively. The authors contend that there is managerial entrenchment in family businesses and these businesses tend to take less business risk (Anderson and Reeb 2003b; Casson 1999; Graves and Thomas 2004). However, there are contrary research findings suggesting that there were no differences between the growth of family and non-family businesses (Teal, Upton and Seaman 2003; Daily and Dollinger 1991). This may be because the research is done in different geographic locations and different methodologies were used in the research.

Based on the themes arising from the above literature review, and the theoretical framework on the succession process, a series of research objectives and questions were developed.

Research Objectives, Questions and Methodology

The overall research objective and research questions for this manuscript are as follows:

Objective 1: To investigate the differences in succession planning and performance measures between family and non-family businesses in Barbados?

RQ 1 (a) What are the differences in succession planning between family and non-family businesses in Barbados?

RQ 1 (b) What are the differences in performance measures between family and non-family businesses in Barbados?

This article adopted a qualitative approach which used a cross-sectional method that would lead to an appreciation of the succession planning process and performance differences between family and non-family businesses in Barbados. The qualitative paradigm of research generally uses methods that are interactive (Creswell 2003). The theoretical framework is designed from existing theories in the literature and the manuscript applied the theories of the Learning Organisation, Human Capital and Family Capital, under an overarching perspective informed from the Resource Based View.

Businesses of interest were chosen from the Barbados Industrial Development Corporation (BIDC) database. The Barbados Industrial Development Corporation is a statutory corporation that has a mandate to act as a catalyst for the establishment of businesses in Barbados and for stimulating exports from Barbados. The organisation also provides technical support and other forms of support in a variety of areas. The sample was selected from this organisation because it maintains a record of the manufacturing businesses in Barbados. Manufacturing businesses were chosen for this sample as there are several manufacturing businesses that are family-owned and non-family owned.

With respect to the profile of the manufacturing sector in Barbados, Lashley and Moore (2016) estimate that there were 1,053 manufacturing enterprises in the country (11% of all businesses). Industry (manufacturing, mining and quarrying and construction), of which manufacturing comprises 65% of enterprises, was estimated to contribute to 21% of employment, 24% to value added in the economy, and comprised 68% of total exports. While manufacturing is not the most significant sector of the Barbadian economy, it does make a substantial contribution to the economy.

The selected sample is used to investigate any major differences in performance measures, whether family businesses have a longer-term orientation than non-family businesses and reveal any differences in their succession processes. Purposive sampling is chosen as it relates to a valuable kind of sampling for special situations. There were 27 businesses chosen from the BIDC database – 13 family businesses and 14 non-family businesses. The category of businesses is manufacturing. The majority of the businesses had been in existence for between 10 years and 55 years. There were 10 small businesses, 8 medium sized businesses and 9 large scale businesses. Fourteen of the businesses were family businesses and 13 were non-family businesses. Face-to-face interviews were chosen as they have the highest response rates, and 27 owner managers of family and non-family businesses were interviewed. The face-to-face interviews and surrounding protocols were designed to encourage a thoughtful discussion from family and non-family business owners about their experiences and perceptions of succession and performance. The questions posed during the interview arose from a review of the literature. For this study, the open-ended questions were specific enough to garner a response, yet broad enough to allow for an individual's interpretation of the topic.

An inductive approach to data analysis is used to identify themes that were observed from the data itself. This strategy incorporated all content within the topic areas that is provided by participants. According to Roulston (2010), thematic analysis provided guidance for treatment of the data. This type of analysis involves three iterative and overlapping steps; first coding data to establish theoretical categories, next, sorting the data into like groups or clusters and finally reorganising the data into themes through a series of iterations (Roulston 2010).

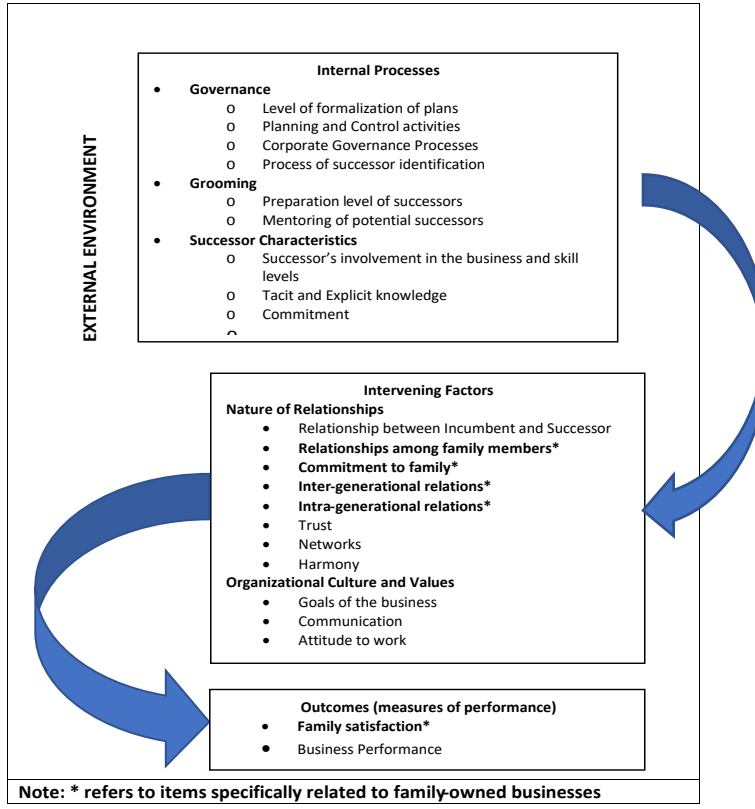
These interviews were conducted with the owner-manager of each business, and, in some cases, the interviews were conducted with either the General Manager or the Accountant in the non-family business. The ages of the interviewees ranged from 40–75 years. The instrument used consisted of 46 open and closed ended questions with the first 5 questions obtaining demographic information about the business. These demographic questions included the number of employees in the business, their opinion of the definition of a family business and the form of the business. The second section of the interview schedule comprised questions for non-family businesses, the third section comprised questions for family businesses only, the fourth section consisted of general questions for both family and non-family businesses and the fifth section of the interview schedule consisted of questions for both family and non-family businesses with regards to financial information. The interviews lasted about 45–60 minutes and the notes from the interviews were written, while the respondent is speaking. The responses from

each question were coded, and themes were developed out of the codes. The interviewer can make important observations apart from the questions asked in the interview (Babbie 1986).

Framework for the Analysis

The analytical framework is derived from the literature review and forms the general approach to analyse the findings of the manuscript (see Figure 1). The focus of this manuscript is on succession planning and performance measures as well as the key internal processes and intervening factors that are relevant to these.

Figure 1: Factors Affecting the Quality of the Succession Process



The paper examines the differences in performance measures used and succession differences between family and non-family businesses. The premise for the research, drawn from the literature, is that because family businesses have different

goals, there are different types of succession. The Resource Based View addresses the unique resources within the business that allow the internal processes of succession to take place. In examining the internal processes, succession planning is thought to be more formalised in non-family businesses than it is in family businesses. This is because the organisational culture varies between both types of businesses. In addition, family businesses tend not to think about succession planning until someone is about to retire or dies, while the non-family businesses recruit competent personnel to fill positions, based on their experience and qualifications to maximise returns. In addition, the culture of the family business is one that prefers internal candidates to maintain family satisfaction.

Succession happens more frequently in non-family businesses because these businesses have a large pool of potential successors both internally and externally from which to choose. However, in family businesses, succession rarely takes place and there is not usually an agreed time as to when the event should occur.

Successor identification is usually more formalised in non-family businesses as management tends to groom employees for key management positions. Successor development is more formalised in the non-family businesses as there is generally more formalised training programmes for employees.

Generally, family-owned businesses focus on non-financial goals, as they are concerned primarily with earning a living for them and their family members. However, non-family businesses' goals are performance-related in seeking to maximise profits for their shareholders. This is the broad framework, drawn from the literature, within which the research is being conducted.

Data Analysis

The data analysis of the face-to-face interviews is based on the transcripts of the interview sessions which were recorded in writing to capture the salient points from the respondent in the interview. The data collected from the respondents were analysed using thematic analysis (Miles and Huberman 1994). Essential to the research were quotes from the respondents which were used to represent the findings of the analysis. In this section, the findings are analysed from the study, and discussed based upon the elements of the theoretical framework, with the Resource Based View being the guiding theory in the analysis.

The remainder of this manuscript takes the following structure. The data is analysed using the broad elements of the general theoretical framework, under the headings Internal Processes, and Intervening Factors. Specifically, the emerging

themes that are analysed are: The Formalisation of Succession Plans; Succession Identification; Succession Selection and Development; and Organisational Culture, Communication and Values. These issues are analysed in relation to the differences seen between family and non-family businesses, and the reasons for any differences seen, specifically the role played by family satisfaction as a business goal.

The thematic analysis is followed by a general discussion of the findings of the manuscript and its contribution to theory and practice. Suggestions for future research, limitations of the research and practical implications of the research follow.

Internal Processes

Formalisation of Plans

The objective of this section is to identify the differences in formalisation of succession plans between family and non-family businesses. According to Daily and Dollinger (1991), succession plans are more likely to be formal in non-family-owned businesses than family-owned businesses. The analysis of the interviews in Barbados suggests a similar trend. It is revealed that the majority (9 of 13) of family business owners have mental succession plans and do not perceive it as necessary to develop documented succession plans. This is perhaps one of the reasons that few family businesses survive to the second generation. A few (4) of the family business owners interviewed admitted that they had informal succession plans. Their decision to have at least an informal plan may have been precipitated by the need for survival to the next generation; however, some of the businesses indicated that there is no desire to transfer ownership to the next generation of the family. One of the owner-managers of a family business said:

> "I do not see the requirement of a succession plan. I believe when the owner has retired or died, the business should be sold."

Another owner-manager of a family-owned business declared that:

> "Succession planning is not important if the persons who own the business decide they will build value for the family before selling it."

In contrast, the findings revealed that the majority (11 of 14) of non-family businesses prepared detailed formal succession plans. One owner-manager of a non-family business who believed in the long-term survival of the business said that "succession planning is important for the continuation within the business."

Some of the non-family businesses had crafted a policy document with a formalised training document which enabled employees and management to be groomed through special training. The decision for the non-family businesses to plan for succession is underpinned by the importance of planning for the future leadership pool within the organisation. One owner-manager of a non-family business stated:

> "A written succession plan is designed, taken to a legal person and adjustments are made to the plan."

This finding is consistent with the literature as stated by Venter (2003). Some of the non-family businesses' succession plans document the various management positions. The findings revealed that the majority of the succession initiatives were very detailed at the managerial level, and they identified the gaps, developmental opportunities and number of years it will take to fill a position. This level of detail is not observed in the family businesses.

The analysis also revealed that the majority of the non-family businesses explicitly selected the successor to lead their businesses in future years. It is evident from the findings that these businesses see the importance of succession planning and the necessity of ensuring a smooth transition of leadership. In the majority of the non-family businesses that had prepared a well-planned succession initiative, they had chosen successors at the executive level. There were some non-family businesses that had documented the name of the person who would succeed the incumbent, although they did not have a formal succession plan.

One of the non-family business owners stated:

> "We see succession planning as a priority in the business if it is to be successful."

This suggests that strategic planning occurred in these businesses. While the majority of non-family businesses seemed to have been better prepared for succession through formal planning, family businesses seemed to be more ad hoc and prepared for succession informally or not at all. One of the owner-managers of a family-owned business said:

> "Why should we have to consider succession planning when we can just sell the business."

Some family businesses did not see the need to discuss succession, and only a few of the family businesses indicated that they have successors who are being trained and groomed to take over the business. One owner-manager stated that "I know my daughter will take over and therefore there is no problem", indicating that there is no need for a formal succession plan. However, in a few of the family businesses interviewed, some of the family members were not cognisant of the transition plans because they were not documented.

Although succession planning is necessary to ensure validity and continuity of the business, only a few of the family businesses planned properly for succession, as seen in previous research by Royer, Simons, Boyd and Rafferty (2008) and Venter (2003).

The majority of the owner-managers of the family businesses and the non-family businesses suggested that it is critical that the business survives the current management team. They indicated that there is need for the training of persons to succeed in that role. As the owner-manager of a family business suggested:

> "Continuity should occur as there needs to be persons trained for the job. Therefore, one person leaving should not close the company. The persons should have experience in all areas if they are to run the entire operation."

Based on the findings, in relation to the research on size of the business and the formalisation of plans, the larger businesses tend to have more formal regulations and policies in place than smaller firms. The smaller businesses tend to be more ad hoc and non-formalised with their systems and procedures.

Sonfield and Lussier (2005) observe that as family firms age and grow, they progress from more informal styles of management to more professional management styles. However, it is important to note, as described earlier, that family firms may be less focused on growth than non-family firms, and therefore smaller. Therefore, the finding for Barbados that family firms are more ad hoc in their planning could also be a size issue rather than solely a family issue.

Successor Identification/Selection

The difference between family and non-family businesses relative to successor identification is that the family-owned businesses do not generally identify successors early so that they can be groomed appropriately. In contrast, the non-family businesses choose their successors well in advance and groom them to take over the business. This is evident as the owners of family-owned businesses tend to focus on their immediate subsistence rather than long-term. The family business owners view long-term as being in existence for several years and making

substantial returns for owners and shareholders. The non-family businesses value succession planning as part of their strategic thinking.

The objective of this section is to contrast how successors are identified in these two types of businesses. The results of the analysis here support the literature (Kuratko and Hodgetts 2004), that the process of successor identification tends to be slow in family-owned businesses. This is due to the type of organisational culture in family businesses, where their focus is not on succession until there is a death. In contrast, Cater and Justis (2009) highlight that in the majority of non-family businesses, the evidence indicated that the owners identify the successors and groom them from very early in their careers. It is evident from the data, that non-family businesses see the value of succession planning, as well as a well-planned succession which should provide the best opportunity in identifying capable successors.

In the majority of non-family businesses that have prepared well-developed succession plans, they have chosen successors at the executive level rather than at the operational level. However, in the absence of a formal succession plan, successors are still identified; one of the non-family business owners said that:

> "Although we did not have a formal written plan, we had documented the name of the person who would succeed the current manager and groom them properly."

Some businesses do not directly identify a successor but provide opportunities for a new leader to emerge. One owner-manager of a non-family business stated:

> "There are two persons who are presently in leadership positions, but I am still open to broadening that to have a balanced portfolio in marketing, finance, administration and corporate governance. I would prefer to have a team of four persons who are shareholders and leaders within the business and from that group a leader can be selected, so that ultimately, we can better serve customers and have a much more satisfied staff."

Most of the non-family businesses choose their successors to lead their businesses. These businesses see the importance of planning for succession, as a well-considered and planned succession should maximise the chances of finding competent successors. It should ensure a smooth transition of leadership.

The data suggests that the successors are identified in non-family businesses, but in family-owned businesses, there is no clear identification of the successors and

only a minority (4) of family businesses identified successors. Based on the data, in many of the family-owned businesses, the owners of the businesses assume that one of their children or any other member of the family business will take over the business when the incumbent demits office. Therefore, as with succession planning, the process of successor identification is more ad hoc than in non-family businesses.

Successor Development

The objective of this sub-section is to contrast family and non-family businesses with respect to successor development. In terms of successor development, the difference between family-owned businesses and non-family businesses is that the family-owned businesses do not generally focus on a specific criteria of leadership training of family members, whereas the non-family businesses organise training for employees so that they will be equipped with the necessary skills-set and abilities. This is evident in the findings as the non-family businesses engage in training and development programmes, while the non-family-owned businesses encourage their family members through experience on the job.

According to Van de Merwe (2009), successor development is a critical factor in the succession process. De Massis, Chua and Chrisman (2008) also stated that failure to develop successors appropriately, may result in a lack of succession. The results of the research in Barbados suggest that some level of successor development is seen in family-owned businesses, but more in terms of on-the-job experience rather than formal training.

In many of the family-owned businesses interviewed, they have not crafted plans to train or groom any of the employees or family members to transition the business into the future generation. Some of the owners believed that because their children had formative education, there is no need for further training. They believed that the business could grow based on existing knowledge.

However, the majority of the non-family businesses trained and groomed their supervisory team for management of the business.

The manager of one of the first-generation family businesses interviewed stated:

> "We don't have any plans to train or groom any of our employees or family members to transition the business into the future generations."

This is an interesting theme arising from the findings, that some of these founders seem to be suffering from "founders' disease" where they do not want to face the issue of relinquishing control.

There seems to be a stark contrast between family and non-family businesses, because as the data suggests, the majority of the family-owned businesses tend not to focus on the training or development aspect of the members of the business. However, the non-family business owners focus on the training element of the employees in their business, so that there is always an employee groomed for leadership.

Intervening Factors

The following analysis of intervening factors considers some of the issues that may be causing the differences seen in succession planning between family and non-family businesses.

The Nature of Relationships: Relationships, Trust and Commitment

Due to some family business owners' desire to retain control, it appears that some of the owners "held onto the reins" of the business, and the children were not able to develop their leadership or decision-making skills. In addition to this lack of successor development, there were several other issues, namely that the incumbent lacked confidence in their children's ability to continue the business, as well as believing the children were not committed to the business. These occurrences have contributed to a lack of formal succession planning and hence a lack of successor development.

The issue of lack of commitment and lack of trust arose on several occasions. In many situations the founder had preferred the older sibling to take over the business because of their responsible nature and experience, but in some cases the older sibling was not interested. While some of the younger siblings were interested, the owners did not trust that they would continue with the business in the long-term. It appears that incumbents not trusting their children's ability to manage the business is encouraging incumbents to either not plan for succession or decide the business will not continue because they do not have a suitable successor. Therefore, while formal plans are important, strong relationships, trust and commitment can compensate.

In relation to non-family businesses, the absence of these family relationships and the presence of principal-agent issues is compensated for through preparation of formal succession plans and formal training programmes.

Organisational Culture and Values: Goals of the Business and Attitude to Work

Based on the findings, the effect of goals of the business and attitude to work influence succession planning, successor identification and successor development in several ways.

In some family-owned businesses, the goal of the business is finite, where there is no intention to continue after the founder. Therefore, there is no requirement to plan for succession or identify and develop successors. For some family-owned businesses, the perception of a poor attitude to work amongst potential successors led to lack of planning as no suitable successor existed within the family. For some family businesses, their goal is meeting family needs (incomes for family members, meeting school expenses) and therefore formal planning for succession is not viewed as a priority. This contrasts with non-family businesses whose goal is profit-maximisation.

In one of the family-owned businesses, the owner-manager said:

> "As long as I can make enough money to send to school my children, I am comfortable."

Another family business owner said:

> "The business exists to pay our salaries, expenses and to send to school our children."

In one of the non-family businesses, the owner said:

> "The business is here to make as much profit as we possibly can and to remain competitive."

For some family businesses, where there was a desire to transfer to the next generation, successors were identified and developed. Succession still occurred without formal planning because of strong relationships, trust and commitment as highlighted in the previous subsection.

Networks

The findings revealed similarities between family-owned and non-family businesses. The majority of family-owned and non-family businesses capitalised on networking with other owners who also managed family-owned businesses. This networking happened at cocktail parties, while playing golf or over the board room table. The owners and managers found this as beneficial to their business as

it allowed them to share best practices and to benchmark some of the procedures in business.

Discussion/Interpretation of Findings

In the following subsection, the findings are discussed with reference to the general theoretical framework and the research questions developed for the manuscript.

It is apparent from the findings that one of the reasons for a lack of formal succession planning in family-owned businesses, albeit from a minority of businesses, is that the goal of the business is not longevity, but finite, where the business will cease when the incumbent leaves. Another reason is a lack of inculcation of a work ethic and strong values in the business, which has implications for the trust the incumbent has in the potential successor. Hence, there is the consideration of planning for succession. This is an observation by family members, that when they observed their children in the business that some of them refused to take initiative.

Some of the interviewees also thought that the next generation had a different lifestyle than the business owner. Many of them did not share the same drive and commitment that their parents had when building the business. Despite children having a good education, they did not share the same passion as the founder. Some interviewees indicated that some of the young family members think that their place in the company is guaranteed because they are part of the family.

In addressing RQ 1 (a) (What are the differences in succession planning between family-owned and non-family businesses?), the data collected revealed that the majority of the family businesses have mental succession plans because they do not think it is important to discuss the future of the business as it reminds them of their mortality. In contrast, in non-family businesses, employees are groomed for management positions, and they receive training to experience a smooth transition to management. The process of successor identification is slow in family businesses as suggested by the data. The majority of the family business owners tend not to think about retirement nor relinquishing control of the business. Therefore, the research fits with the theory that the majority of family businesses do not explicitly consider succession planning.

In addressing RQ 1 (b), (What are the differences in performance measures between family and non-family businesses in Barbados?), the findings reveal that the major concern of non-family businesses is profit maximisation. The majority of the respondents of the non-family businesses stated that they use financial

measures such as return on equity, return on assets and profitability because they have several constituents to satisfy, including shareholders and social stakeholders. The non-family business owners hold the view that once their business is realising substantial returns on profit, the continuity of the business would be highly possible. Family businesses generally measure success of their enterprises by qualitative measures, namely meeting family goals, family satisfaction and immediate family needs. The idea of the family business owners is that once their family can survive, it would be adequate to sustain the family business.

Based on the findings of the research for this paper, there seems to be a paradox, where the research indicates that family-owned businesses have a more long-term perspective and use different performance measures to non-family businesses. However, family-owned businesses have been found to address succession planning in a more ad hoc or less formalised manner. It begs the question that if the businesses are more long-term in their approach to business, why are their plans not as formalised? The focus of family businesses tends to be more on commitment to the business, networks, alliances and family bonding.

Contribution of Paper

The paper has contributed to the body of academic literature by examining the differences in succession processes and performance measures between family-owned businesses and non-family-owned businesses in Barbados. While there has been research done in Barbados and the Caribbean on family businesses, the focus has been on the success and failure of businesses in Barbados. However, this research seeks to add to the academic body of knowledge by examining the differences in succession and performance measures used between family-owned businesses and non-family businesses in Barbados. The thesis also adds to the body of academic knowledge by investigating the factors influencing the quality of the succession process. The thesis also differentiates between internal process factors and intervening factors that affect the quality of the succession process. This thesis draws on a number of theories to support the focus of this research. Although theories such as Stewardship theory and Agency theory are used in relation to family business research, this thesis also draws on the Resource Based View as the overarching theory to research family-owned businesses and non-family businesses. In addition to the Resource Based View, the thesis borrows from the Social Capital theory of which Family Capital theory is a subset, to investigate the reasons for any differences that might exist between family-owned and non-family businesses.

Limitations of the Research and Future Research Directors

The non-availability of financial data constrained the extent of financial analysis to substantiate the findings. The study would have been subject to social desirability bias and therefore the administration of questionnaires might have reduced bias. The study addresses Barbadian businesses but a comparative study with another Caribbean island would be interesting. A study of black family and non-family businesses might yield interesting results.

Conclusion

In summarising the findings, in response to RQ 1 (a) What are the differences in succession planning between family and non-family businesses, non-family businesses have formal plans to a larger extent than family-owned businesses. The family-owned businesses have informal plans, and they believe that this is adequate. The non-family businesses tend to plan as they deem it as important for the continuation of their business. In relation to RQ 1 (b) What are the differences in performance measures between family-owned businesses and non-family businesses, is that the family-owned businesses do not use a quantitative measure as their prime measure of performance. Their performance is measured based on the ability to satisfy their family requirements as well and satisfying the family's immediate needs. However, non-family businesses measure their performance using quantitative measures and their focus is on continuity and profit maximisation.

These results suggest that there is some link between the level of succession planning and the performance measures used by the business. Because family satisfaction is a goal of the family business, there may be a reluctance to plan because there is a desire to maintain the status quo.

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An Empirical Investigation of the Impact of a Star Player on Team Performance: Brian Lara on the West Indies Test Cricket Team 1990-2006

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The performance of the West Indies test cricket team began declining in the mid-1990s after dominance (1976–1995). The decline took place simultaneously with the emergence of Brian Lara, one of the greatest players in West Indies' history and world cricket. Despite Lara's tremendous performances, the team fell behind arch-rivals Australia, India, England and South Africa. Using Generalised Additive Models (GAMs), this study investigates the presence of non-linear relationships between elements of Lara's batting and game outcomes with consideration for contextual conditions such as whether the team bats first. At a game level, Lara's presence is not significant. However, significant nonlinear interactions are identified at an innings level with varying effects depending on whether the team bats or bowls first. A critical finding is that for most of the interval, increases in Lara's strike rate had a crowding out effect on the rest of the team's runs in a given inning, eventually becoming positive at extremely high strike rates. These findings indicate some mismatch in Lara's offensive skillset and the needs of the rest of the team and underscore the importance of strategic utilisation of star players such as Brian Lara to optimise team performance and outcomes.

Key Words: Brian Lara, West Indies, Cricket, Dutch Disease, Booming Tradeable Sector

Introduction

Cricket West Indies (CWI) (formerly the West Indies Cricket Board) became a member of the international governing board for cricket, the International Cricket Council (then the Imperial Cricket Council), in 1926. The West Indies played its first test match against England in 1928. Their performance remained inconsistent until the 1960s (Cricket West Indies 2023). After losing the series against Australia 5-1 in 1975/76, the fortunes of the West Indies changed, and barring one controversial series lost to New Zealand in 1980, the West Indies was dominant from 1976 to 1995 when they lost the Sir Frank Worrell Trophy to Australia in the Caribbean. During the period of dominance, the West Indies was recognised as

unofficial world test champions (Cricket West Indies 2023). The team set a world record of 11 consecutive Test victories, including 27 tests without defeat (Cricket West Indies 2023). The results fluctuated from the mid-1990s, forewarning the team's downward spiral from the 2000s.[1]

The start of the decline of the West Indies coincided with the development of the phenomenal career of Brian Lara, arguably one of the game's all-time greatest players, who debuted for the West Indies in 1990. Lara is the only cricketer to score a century, double century, triple century, quadruple, and quintuple century across international and first-class test matches (ESPN Cricinfo 2023c). He set two world records for the highest test score, 375 runs and highest first-class score, 501 runs not out within two months in 1994, highlighting his batting prowess that remained consistent throughout his career.[2]

Lara's talents propelled him to the helm of the West Indies team as captain in 1997. However, this period featured unflattering results over three stints as captain until 2006 (International Cricket Council 2023). This incongruity between Lara's individual brilliance and team performance was captured most succinctly in the West Indies tour of Sri Lanka in 2001.

Despite Lara scoring the highest runs output (688) ever recorded and the largest proportion (53.83 per cent) of team runs by a single player in a single match, the West Indies lost 3-0, highlighting, the mixed relationship between his batting output and the team winning (Fernando 2023).

Prompted by such results throughout his career, this paper aims to investigate if Brian Lara performance had a negative impact on West Indies cricket through the crowding out of the rest of the team within the theoretical frame of the Dutch Disease.

This paper uses Generalised Additive Models (GAMs) to explore the non-linear relationships between Lara's strike rate, his share of balls faced, and various game outcomes, including match results and team runs scored. By modeling these interactions, particularly in the context of whether Lara's team bats first or bowls first, we aim to uncover how and when Lara's contributions are most effective.

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[1] The West Indies team is currently ranked 8th out of the ten test-playing nations, additionally, the team only won 32 out of 102 test series played over the period 2000-2023 (International Cricket Council 2023).

[2] None more evident than his magnificent 401 not out to reclaim his international test batting world record six months after losing it to Matthew Hayden of Australia on the same ground as his previous record ten years earlier.

The analysis indicates that while Lara's performance is certainly relevant to game outcomes and the performance of the surrounding team, that impact is not straightforward. For instance, increasing concentration of 'batting space' in terms of Lara's share of balls faced varies depending on whether or not the team bats first. There is generally a positive effect on game outcomes of increasing Lara-concentration of batting space when the West Indies bats first, however, bowling first positive the effect of increasing Lara-concentration diminishes then reverses at higher levels of concentration. The performance of the rest of the team in terms of run scoring output on an inning level is sensitive to Lara's strike rate. For much of the domain of Lara's strike rate, increase in strike rate have a crowding out effect on the rest of the teams run scoring output, however, at higher levels of strike rate in excess of 60 this effect reverses.

Formally, this paper can be considered as an extension of the literature on peer effects in a reciprocally interdependent context. As defined by Thompson (1967), organisations where the output of one member becomes the input of another member towards the production of some goal can be defined as reciprocally interdependent. While there has been significant literature on the effects of peers in individual sport (Yamane and Hayashi 2015; Emerson and Hill 2018) and team contexts (Molodchik, Paklina and Parshakov 2021) most of the literature has focused on the peer impact on individual performance. Previous ones have investigated productivity spillovers of individual performance in a sport context via within-game impacts (Arcidiacono, Kinsler and Price 2017) and star player impacts on rest of team performance proxied by absence (Wegelin, Orlowski and Dietl 2022). There is a dearth of research on the within game effects of over-reliance of a star player on game outcomes and potential crowding out effects in a sports context due to stylistic rather than psychological effects. Within this framework we suggest that the potential crowding out effects of a star player can be understood through the lens of the international trade theory of the Dutch Disease.

Theoretical Background

The Dutch disease theory connects a commodity boom to premature deindustrialisation through the appreciation of the real effective exchange rate (Custa, Devarajanb and Mandon 2022). Premature deindustrialisation refers to the erosion of non-booming tradable sector output and employment at a much lower level of total output and non-booming tradeable sector productivity (Rodrik 2015).[3]

[3] An economy experiencing an export boom is typically divided into three sectors the booming and lagging export sectors and the non-tradeable sectors usually retail, construction, and service industries which deal with supplies to the local market (Ebrahimzadeh 2017).

The mechanisms through which a resource boom triggers premature deindustrialisation are the resource and spending effects (Wenner, Bollers and Hosein 2018). Due to the relatively higher marginal product of labor in the booming tradeable sector, labor is attracted from the non-booming tradeable and non-tradeable sectors resulting in an asymmetric redistribution of output and inputs such that production and labor are increasingly concentrated in the booming tradeable sector (Kojo 2015).[4] This phenomenon is referred to as the resource effect.

The increase in real income generated by the export windfall increases the domestic demand for non-booming tradables and non-tradables, triggering an increase in spending and ultimately leading to domestic inflation which furthers asymmetric sectoral output (Kojo 2015). Crucially, since the ability to match demands cannot be expanded rapidly, the relative price of non-tradables increases to reduce excess demand creating a real appreciation of the domestic currency in turn eroding external competitiveness and hence reducing sectoral output over time (Kojo 2015).[5] This is the spending effect.

It is important to note that despite the abundance of evidence in support of the negative effects of a resource boom through Dutch disease mechanisms, it has been found that commodity price booms can positively impact growth in the short-term (Collier and Goderis 2009; Brahmbhatt, Canuto and Vostroknutova 2010).[6] Indeed, the Dutch Disease is a phenomenon that predicts the asymmetric decline of sectoral productivity alongside the secular decline of total output following a resource boom in the absence of interventions. Short-term improvements in absolute output do not prevent this.

Contemporary empirical sports theory has established that a team consists of individual players who operate as a group and can be conceived as a technical unit, that produces output using some set of inputs with the principal aim to outscore their opponents (Araújo and Davids 2016). In the context of cricket, the team

[4] As the value of exports in the booming tradeable sector is greater than that of the non-booming tradeable sector, there is an appreciation of the overall value of the export profile and hence an appreciation of the real effective exchange rate. This reduces the external competitiveness of the non-booming tradeable sector hence leading to a reduction of sectoral output. This is the second mechanism within the resource effect.

[5] As non-booming prices are exogenous and do not increase even if demand is higher, any excess demand for non-booming tradables is compensated by increased imports, while non-tradables excess demand is partially met by increased supply (Kojo 2015).

[6] Some researchers (Bjornland and Thorsrud 2016) argue that conventional studies of Dutch disease did not consider productivity spillovers between the booming resource sector and other non-resource sectors, utilising a simple theory model to accommodate productivity spillovers they discovered that the booming resource sector has positive effects on non-resource sectors.

(economy) is the amalgamation of 11 input units (players) combining in a function (batting, bowling, and fielding) for a given production run (game) to produce an output of a given quality (game results).

There exists an opportunity in cricket to extract significant insights on the actions and strategies of individuals and teams along with the decision-making process that would be beneficial to sport economics and can enhance models of economic behavior, inform policy and contribute to the development of more effective strategies (Gregory-Smith, Paton and Sacheti 2019). Cricket has intrigued economist due to its longevity, various formats, technological innovations, availability of individual and team performance data, decisions are discrete in nature, and exogenous factors that influence the outcome of the game, additionally, in the longest version the production space of a test cricket game is constrained by the number of days[7] (Jewell, Reade and Singleton 2020).

Further, due to batting occurring in tandems, the occupation of the crease by one pair of batsmen necessarily reduces the potential time of occupation and in turn run-scoring opportunity for other batsmen. It is natural then to decompose the team output into the summation of the contributions of players (Duch, Waitzman and Amaral 2010). Moreover, the team result is combined such that the increase in production from one player necessarily incurs a reduction of potential productive space available to other players. Dom Sibley's 120 runs in more than nine hours at the crease in July 2020 test series against the West Indies, was recorded as the slowest century by an England cricketer in 20 years, however, it propelled the team's score above 400 to claim victory (Wallace 2020). Nevertheless, players like Sibley have divided public opinion, even suffering under the hands of their own team, he was infamously asked to standdown for the big hitters to provide scoring in the same series, whereas Geoffrey Boycott was purposely run out by his teammates, and Nick Compton was dropped for being dull (Wallace 2020). Additionally, teams may resort to strategic tactics such as rotating the strike to bowl to the lesser batsmen who have a higher degree of getting out, however, during the 3rd Test in Bridgetown between West Indies and Australia, Lara batted for six hours, scored 153 not out, while facing 256 balls, with mainly tailender to chase 308 for victory, the support batsmen role was simply to allow Lara to face the majority of balls. Accordingly, cricket team output can be nested within

[7] In test cricket the number of potential overs is unlimited. Games are instead scheduled to last up to 5 days in contemporary practice. Some historical matches were played with unlimited time and overs constraints and were coined "timeless matches." Due to the constraint on days, there is a fuzzy boundary on the maximum number of overs available to a team. Since this fuzzy boundary exists the occupation of bowling overs by one player necessarily means a reduction in potential bowling overs by another though the observed relationship is not a readily specified function.

conventional economic modelling as a production frontier (Hoon Lee 2012) with the contributing players representing the sectors of the macroeconomy. In the context of our investigation, the West Indies cricket team (economy) is bisected into Lara and the rest of the team.

Within this framework, it is reasonable to infer that an increase in the productive output of a single sector may lead to deleterious results in terms of total team output due to the crowding out of contributions of other members of the team. This may occur in the absence of managerial (government) intervention (Lechner and Gudmundsson 2012) as overs faced (productive space) is allocated towards the star player (Booming sector). As this pattern is engrained within the team, the development of other players is chronically reduced (Lechner and Gudmundsson 2012) leading to limits on team performance which may be retained beyond an individual production run, i.e., secular stagnation.

Further, the reliance on a single booming sector, in a similar way to the Dutch disease, may lead to a perverse restructuring of the economy wherein the productivity of other sectors is chronically hampered due to effects on competitiveness which asymmetrically impact the non-booming sector. In the context of cricket, this may occur if the most individually effective style of the most productive player (booming sector) does not align with the style that is most productive for the rest of the team (non-booming sector). Assume that this style is one of extremely high run-scoring pace. High run scoring pace proxies for the asymmetric productivities of booming and non-booming sectors within Dutch Diseased economies, which manifests in differences in prices. As non-star players attempt to emulate or adjust to the stylistic trappings of the star player this may lead to an unsustainable rise in pace. In turn, there is potentially a decline in the rest of the team's run-scoring, as they are unable to effectively score runs while maintaining the pace set.[8] Much like an economy experiencing Dutch Disease the team performance overheats rising in pace while becoming less competitive.

Further, it should be noted that the manifestation of Dutch disease effects in the presence of a star player with an idiosyncratic style is not inevitable. Much like a government, the role of captains and management would be to control the star resource, potentially restraining run-scoring output in favor of a more sustainable pace of play to best optimise team performance over the long term.

Empirical Applicability to Cricket

Throughout his 130-test match cricket career, Brian Charles Lara amassed the most runs (11,912), recorded the greatest number of centuries (34), and attained second-

[8] Researchers note that players ought to align with the team style or else increase the chances of team success (Gyarmati, Kwak and Rodriguez 2014).

place ranking for the number of half-centuries (48) tallied by a West Indian cricketer.[9] Lara achieved these feats through a dynamic style maintaining a rapid strike rate of 60.48 and a batting average of 53.17, which is the highest of any West Indian cricketer with 20 test or more since Lara made his debut. Due to this combination of prolific scoring output and pace, it is natural to apply a Dutch Disease framework where Lara's batting output represents the booming tradeable sector, his strike rate proxies for the relatively higher marginal product of labor, and the rest of the team represents the other sectors of the economy.

Despite the boom in runs from Lara, the West Indies team won 32 matches throughout his test career, a win percentage of only 24.62%, versus 62 (47.69%) matches lost, and 36 (27.69%) matches drawn. Although Lara scored approximately 70% of his runs in the first innings the team's success rate was dismal when he made over fifty runs (in the first innings) with the team losing a whopping 42.86% (24).[10] This phenomenon may have manifested, where Lara's brilliance did not align with an overall improvement in winning (increase in total output), due to crowding out of the other players on the team, in a similar way to how the booming tradeable sector detracts output and employment from other sectors. Excess reliance on Lara's run production versus the collective output of the West Indies team to win, much like the concentration of factor inputs and production within the booming tradeable sector which erodes the endogenous dynamic potential of other sectors predicted by the Dutch Disease hypothesis.[11]

As Lara's second-highest 1st innings (65 runs) and highest[12] 2nd innings (42 runs) run output led to West Indies winning, a case may be made that increasing the teams' productivity without maximising Lara's run output can translate to more wins. Furthermore, it begs for the inherited knowledge obtained by Lara to be disseminated amongst the team to further develop their technical ability to positively impact their performances. This functions similarly to the potential for technical and technological spillovers from high-productivity booming sectors observed by Bjornland and Thorsrud (2016). Crucially, much as the Dutch Disease

[9] All game statistics are sourced from Cricinfo.

[10] Interestingly, when analysing Lara's run production output an average of 65 runs in the 1st Innings and 42 in the 2nd Innings led to wins, 52 in the 1st and 32 in the 2nd accounted for losses, and 83 runs in the 1st Innings and 41 in the 2nd led to draws. The data suggests that even during his peak production output, the West Indies team still struggled to win matches, however, his performance may have decreased the number of games lost via matches drawn.

[11] When combined, the runs scored by the four players who played significant matches with Lara showed contrasting results as they could not combine to surpass his overall run production even though they played significantly more matches than him.

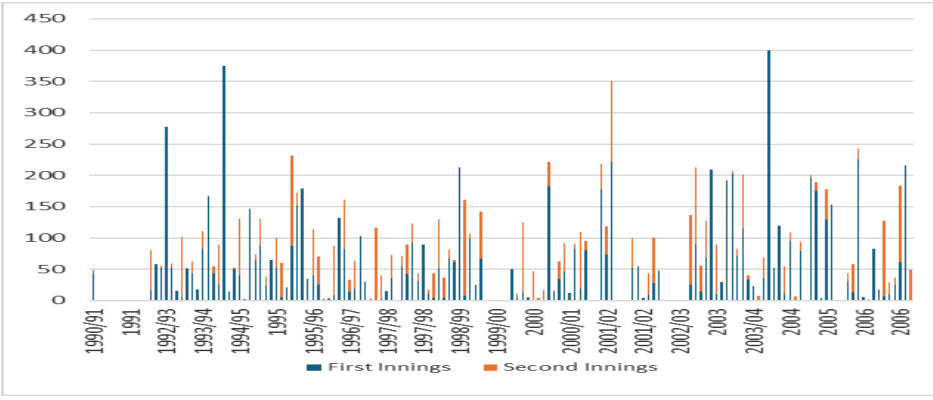
[12] Lara's second highest 2nd innings run output is 41 runs, 1 run less that his highest and led to West Indies drawing matches.

effect is stymied by the sustainable management of the booming sector resource to maximise total output over a long to infinite time horizon through reducing asymmetric growth, Lara's great batting capacity should have been managed[13] to reduce potential crowding out effects on his teammates so that team (economy) performance in the long term may be maximised even if there would be an immediate to short-term reduction in team success (output).

A Descriptive Assessment of Brian Lara's Contribution to Test Cricket

Brian Lara played in 130 test matches and scored 11,912 total runs at an average of 53.17 over his career with the West Indies. Reflecting his skill in rapid scoring buildups 69.2% of Lara's career scoring output 69.21% of Lara's total runs were scored in first batting innings representing a difference of 4,556 runs difference between first and second innings.

Figure 1: Brian Lara Test Scores



Source: Compiled from ESPN Cricinfo 2023c. www.espncricinfo.com

However, it should be noted that Lara's scoring distribution and first inning outburst did not align with optimal team outcomes. In games where Lara scored 50 or more runs in the 1st Innings, the team's win percentage was a paltry 30.36% (17), drawing 26.78% (15), and losing a staggering 42.86% (24). A similar

[13] Note that the manifestation of the Dutch Disease is fundamentally predicated on the fiscal mismanagement of the booming sector resource (Wenner, Bollers and Hosein 2018; Sala-I-Martin and Subramanian 2008). In the context of cricket, captains, and coaches function as the government. It is noteworthy therefore that Lara represented both the booming sector and government (captain) for a sizeable duration of his career which may have stymied the institutional development necessary for the effective utilisation of the booming resource.

relationship is apparent in those games where Lara scored over 100 runs in the 1st Innings16. Lara's run distribution and its relationship with team success is of interest as it may indicate a detrimental stylistic flaw, the unsustainability of his pace.

Odds ratios are calculated by considering each reference category against the cumulative compliment results i.e., win is compared to not win – the composite of loss and draw. The Cochrane Armitage trend test (Cochran 1995; Armitage 1955; Tang *et al.* 2006) evaluates whether the treatment has a significant linear association with proportions of categories over an ordinal response. Considering a period of 5 years before and after Lara's career the individual odds ratio on win (0.539) and loss (2.429) are significant indicating that there is a significant difference in winning rates during Lara's career compared to the period outside of it despite no clear difference in drawing rates.

Table 1: Lara Win Shares

Lara Career Win Shares				
	Won	Loss	Draw	Total
Lara Career	32	62	35	129
5 yrs Before and After	33	24	30	87
Total	65	86	65	216
Odd Ratios	0.539831	2.429104	0.707447	
Upper Bound OR	0.973112	4.353203	1.274038	
Lower Bound OR	0.29947	1.35545	0.392831	
Cochran-Armitage test	Z stat	1.428	p-value	0.15

Source: Own calculation using data from ESPN Cricinfo 2023c. www.espncricinfo.com

Table 2: Lara Career Games Played

Lara Played				
	Won	Loss	Draw	Total
Games Lara Missed	10	9	9	28
Lara played	22	53	26	101
Total Games Lara Played	32	62	35	129
Odd Ratios	1.994949	0.428997	1.366397	
Upper Bound OR	4.936292	1.03847	3.394401	
Lower Bound OR	0.806237	0.177221	0.550035	
Cochran Armitage trend test	Z stat	-0.489	p - val	0.62

Source: Own calculation using data from ESPN Cricinfo 2023c. www.espncricinfo.com

Examining the most extensive margin there is no clear significance of whether or not Lara played in determining game outcomes. The individual odds ratio insignificance is mirrored by the insignificant Cochrane Armitage result statistic.

Table 3: Scoring Threshold Output Contingency Tables

Scoring threshold output contingency tables				
Lara First innings above and under 50				
	Won	Loss	Draw	Total
First Inns over 50	17	24	15	56
First Inns under 50	15	38	20	73
Total	32	62	35	129
Odd Ratios	1.68547	0.690789	0.969512	
Upper Bound OR	3.767064	1.392044	2.12305	
Lower Bound OR	0.754118	0.342798	0.442738	
Cochran-Armitage test	Z stat	-0.81	p-value	0.415
Lara First Innings above and under 100				
	Won	Loss	Draw	Total
First Inns over 100	7	8	9	24
First Inns under 100	25	54	26	105
Total	32	62	35	129
Odd Ratios	1.317647	0.472222	1.823077	
Upper Bound OR	3.539579	1.198052	4.656449	
Lower Bound OR	0.490509	0.18613	0.713765	
Cochran-Armitage test	Z stat	0.57	p-value	0.57
Lara Second Innings above and under 50				
	Won	Loss	Draw	Total
Second Inns over 50	6	12	6	24
Second Inns under 50	26	50	29	105
Total	32	62	35	129
Odd Ratios	1.012821	1.1	0.873563	
Upper Bound OR	2.822064	2.670885	2.418173	
Lower Bound OR	0.363495	0.453033	0.315574	
Cochran-Armitage test	Z stat	-0.18	p-value	0.86

Source: Own calculation using data from ESPN Cricinfo 2023c. www.espncricinfo.com

Reflecting the insignificance of game whether or not Lara played, scoring thresholds in either innings have no significant results evaluated either in terms of individual odds ratios or overall linear association. This suggests that if Lara's scoring output produces any meaningful impact on result either the relationship cannot be captured by a linear association or there is insufficient granularity considering averages across all opponents.

Performance against Elite Opposition

Further scrutiny of the data indicated that Lara played most of his test matches against the top three cricket nations internationally with (78) 60% of the games shared between Australia (31), England (30), and India (17). Lara was on the losing end 36 times (46.15%) against the top three even though 6,839 (57.41%) runs were scored off the top three versus the other six teams he played against.[14] Despite this consistency in scoring, however, Lara's results did not align with team success.

Table 4: Lara Career Versus Opposition

	Span	Mat	Inns	Runs	HS	Avg	SR	Win	Loss	Draw
Australia	1992-2005	31	58	2856	277	51	61.09	8	19	3
Bangladesh	2004-2004	2	2	173	120	86.5	77.57	1	0	1
England	1994-2004	30	51	2983	400*	62.14	64.21	9	14	3
India	1994-2006	17	29	1002	120	34.55	52.73	4	3	10
New Zealand	1995-2006	11	17	704	147	41.41	61.11	2	5	4
Pakistan	1990-2006	12	22	1173	216	53.31	67.76	3	6	3
South Africa	1992-2005	18	35	1715	202	49	53.71	3	12	4
Sri Lanka	1993-2003	8	14	1125	221	86.53	56.99	2	3	3
Zimbabwe	2003-2003	2	4	222	191	55.5	85.38	1	0	1

Source: Compiled from ESPN Cricinfo 2023c. www.espncricinfo.com

Impact on Peers

A review of ten players with a minimum of 45 test matches and who played during Brian Lara's test career revealed four players whose entire test career was within Lara's tallied only 11,079 runs with an average of 33.7 in 216 test matches over 375 innings. Furthermore, only one player was able to score more than 3,000 test runs while the highest career average was 41.2 and the lowest 28.3. Remarkably, even when combined these four players did not surpass Brian Lara's overall run tally of 11,912 despite having played 86 more matches and batted in 145 more innings.

To assess differences in performance of Lara's peers in the period overlapping Lara's career vs otherwise we perform a t-test on the mean of runs, strike rates and

[14] The closeness between Lara's run share attributable to games against the top teams and the percentage of games played indicates the consistency of Lara's scoring output as it suggests a near uniform distribution for run scoring.

balls faced. To establish temporal independence acf plotting was performed for each series up to 12 lags. There were no consistent lag patterns indicating an absence of autocorrelation. T-testing was performed using the Welch's t-test (Welch 1947) as it is robust to different variances between groups and uneven sample sizes (Derrick, Toher and White 2016).

Table 5: Lara Impact on Peers

Hooper				
	Lower bound	Upper bound	Lara-period mean	Non-Lara-period mean
Runs	11.0085	45.47484	62.575	34.33333
Strike Rate	6.958061	67.491939	121.225	84
Balls Faced	2.791456	19.876627	49.56737	38.23333
Chanderpaul				
	Lower bound	Upper bound	Lara-period mean	Non-Lara-period mean
Runs	-32.313228	1.517099	67.36	82.75806
Strike Rate	-4.498157	5.256144	42.0498	41.67081
Balls Faced	-68.832066	2.124969	156.34	189.6935
Gayle				
	Lower bound	Upper bound	Lara-period mean	Non-Lara-period mean
Runs	-37.41778	14.98521	66.54688	77.76316
Strike Rate	-25.66601	-3.28154	55.11359	69.58737
Balls Faced	-35.10022	46.03937	119.3906	113.9211
Sarwan				
	Lower bound	Upper bound	Lara-period mean	Non-Lara-period mean
Runs	-52.63544	26.55852	65.66154	78.7
Strike Rate	-19.289412	-1.896973	41.52831	52.1215
Balls Faced	-73.49558	69.88789	146.4462	148.25

Source: Own calculation using data from ESPN Cricinfo 2023a and 2023b. www.espncricinfo.com

There is not a consistent impact on peer performance within the Lara sample period compared to the non-Lara period across all players surveyed. Interestingly, Hooper was the only player who scored significantly more runs in the Lara period. Hooper was considered a preeminently talented batsman who underperformed consistently over his career. Perhaps in the period overlapping with Lara the reduction of attention allowed Hooper to shine, increasing scoring output and strike rate while increasing offensive load, in turns of balls faced.

Contrastingly, Chanderpaul who is commonly considered a complementary pairing scored significantly fewer runs while facing fewer balls without any significant strike rate difference. This may be indicative of some level of adaptiveness in Chanderpaul's game where he was able to take on a lower offensive load, in turn scoring output, without any significant change to the efficiency of play. Sarwan's

descriptive statistics directly oppose Chanderpaul's as there was a significant reduction in pace of play alongside no significant change of offensive load or output. This may be a direct influence from playing alongside Lara. Sarwan himself has stressed the role of Lara in encouraging a direct offensive style of play which he would increasingly grow into (Sharma 2016). The lower scoring rates of Chris Gayle in the Lara-period may be due to the influence of increasing participation in One Day International (ODI) play in recent years which encourages faster pace of play.

Performance as Captain

Twelve players captained West Indies in 20 or more test. The data revealed Brian Lara recorded the fifth-most victories (10), fourth-most draws (11), and lost the most matches (26) while playing the third-highest matches (47). This culminates in the third lowest win percentage (21.27%), and the second highest loss percentage (55.31%), despite recording the second most runs (4,685) and batting average (57.83) as captain.

Though Brian Lara's batting results were impressive his approach never translated into a high win percentage. Furthermore, four players with forty-five or more test matches played during or outside Lara's career had better averages playing without Lara, while another four scored less than 3,000 career runs. This suggests that either the team surrounding Lara was below average or they stagnated during his career as a player and captain.

Table 6: Contingency Table Lara Captained

Contingency table Lara Captained				
	Won	Loss	Draw	Total
Lara captain	10	26	11	47
Not captain	22	36	24	82
Total Games Lara Played	32	62	35	129
Odd Ratios	1.994949	0.428997	1.366397	
Upper Bound OR	4.936292	1.03847	3.394401	
Lower Bound OR	0.806237	0.177221	0.550035	
Cochran-Armitage test	Z stat	-0.02	p-value	0.9811

Source: Own calculation using data from ESPN Cricinfo 2023c. www. espncricinfo.com

In terms of odds ratio and linear association testing there is no clear difference in game outcomes comparing the Lara captaincy period to the non-captaincy period.

This indicates that Lara, while not clearly a negative as a captain, was not meaningful in influencing outcomes. To assess potential differences in Lara's captaincy period compared to other West Indies captains we perform a Kruskal-Wallis (1952) rank sum test. The Kruskal-Wallis test is an extension of the Wilcoxon signed rank test to more than two independent samples. In this way it is a non-parametric alternative to an ANOVA applicable to ordinal data and robust to non-normality (Ramchandran and Tsokos 2015). The Kruskal-Wallis' test had a chi-squared as 18.755 with 11 degrees of freedom with a resulting p-value of 0.06563. This provides some moderate indication that a captaincy period significantly differs from others. Pairwise testing was performed using the Dunn's test (Dunn 1964) as it is considered a suitable nonparametric test across multiple comparisons (Dinno 2015). The sole significant result across the Dunn testing robust to Bonferroni (1936) and Holm's (1979) correction criteria is the difference between Walsh and Lara. Across the sample this indicates that Lara's captaincy was not particularly meaningful on results.

Table 7: West Indies Captain's Record

Names	Mat	Won	Lost	Draw	Win/loss ratio	% of matches won	% of matches lost	result %
CH Lloyd	74	36	12	26	3.0	48.6	16.2	75.0
IVA Richards	50	27	8	15	3.4	54.0	16.0	77.1
BC Lara	47	10	26	11	0.4	21.3	55.3	27.8
GS Sobers	39	9	10	20	0.9	23.1	25.6	47.4
JO Holder	37	11	21	5	0.5	29.7	56.8	34.4
DJG Sammy	30	8	12	10	0.7	26.7	40.0	40.0
KC Brathwaite	26	7	14	5	0.5	26.9	53.8	33.3
RB Richardson	24	11	6	7	1.8	45.8	25.0	64.7
JDC Goddard	22	8	7	7	1.1	36.4	31.8	53.3
CA Walsh	22	6	7	9	0.9	27.3	31.8	46.2
CL Hooper	22	4	11	7	0.4	18.2	50.0	26.7
CH Gayle	20	3	9	8	0.3	15.0	45.0	25.0

Source: Compiled from ESPN Cricinfo 2023a. www.espncricinfo.com

Model Methodology

While cricket outcome would intuitively be understood as an ordinal response (loss, win, draw) (Allsopp 2005), explicit ordinal logistic modeling assumes the proportional odds assumption and linearity of the covariates. As there is the expectation of nonlinearity in the relationship between a star player's performance and team outcomes it is inappropriate to fit a logistic model. Rather, we employ a generalised additive model (GAM) with logit link function using the mgcv package in R. To increase flexibility in allowing the impact of covariates to vary across category boundaries while balancing the complexity of interpretation, separate models are specified with response 'loss', 'not loss' and 'win', 'not win' (Bender and Grouven 1998).

Preliminary analysis is performed on game level data for the subset of test cricket games for which Lara played for the West Indies (n=129), then refined to consider differences in innings level effects. One may consider specifying a dummy variable for whether Lara played a given game or not in the course of his career to establish an extensive margin. However, given the expected nonlinearity in Lara's individual effect on outcomes such a dummy variable is unlikely to be meaningful.

The GAM can be considered as a generalisation of the generalised linear model (GLM,) relaxing the assumption of linearity in covariates. So that rather than the response being modeled as a linear combination of the predictor variables (GLM) the response is considered as a linear combination of some potentially nonlinear function of the predictors (Jones and Wrigley 1995). In this way linearity in the parameters is maintained while the relationship between covariate and response can be captured by a univariate smooth function.

General form of a GAM: $g(\mu_i) = X_i^*\theta + f_1(x_{1i}) + f_2(x_{2i}) + \cdots$
Where $\mu_i \equiv E(Y_i)$ *and* $Y_i \sim$ *some exponential family distribution.*
Y_i *is a response variable.*
X_i^* *is a row of the model matrix with strictly parametric components,*
θ *is the corresponding parameter vector*
f_j *are smooth functions of the covariates*

Accordingly, there is a corresponding equivalence of the GAM to the logit model. Namely, the GAM is specified as an additive model in the binomial family with a logit link function.

Logistic Functional Form: $P_i = \frac{e^{\beta_0+\beta_1 X_{1i}+\beta_2 X_{2i}}}{1+e^{\beta_0+\beta_1 X_{1i}+\beta_2 X_{2i}}}$

GAM equivalent: $P_i = \frac{e^{\beta_0 + f_1(X_{1i}) + f_2(X2i)}}{1 + e^{\beta_0 + f_1(X_{1i}) + f_2(X2i)}}$

GAM logit $(P_i) = ln\frac{P_i}{1-P_i} = \beta_0 + f_1(X_{1i}) + f_2(X_{2i})$

Rather than manually selecting the number and location of knots arbitrarily we can determine the appropriate regression spline model by specifying a penalty term to the least square fitting process. This term is the integrated square of the second derivative, hence penalising the complexity (wiggliness) of the model (Wood 2017).

$$\|y - X\beta\|^2 + \lambda \int_0^1 [f''(x)]^2 dx$$

The trade-off between model fit and smoothness is controlled by the smoothing parameter λ.
In familiar matrix algebra representation this is

$$\int_0^1 [f''(x)]^2 dx = \beta^T S \beta$$
$$\|y - X\beta\|^2 + \lambda \beta^T S \beta$$
$$\beta = (X^T X + \lambda S)^{-1} X^T y$$

Smoothing parameter selection is performed using the restricted maximum likelihood (REML) selection criteria as it performs better in terms of mean-squared error than generalised cross-validation (GVC) or Akaike information criterion (AIC) in most cases (Wood 2017). All models are tested with the 'select=TRUE' restriction. This introduces penalties for the null spaces of all smooths in proposed models, enhancing the parsimony of the model as variables which are not significant in contributing to the model can be reduced to zero (Wood 2017). Bayesian confidence intervals are used to capture the effects of smoothed components (Marra and Wood 2012).

To capture possible crowding out effects by Lara we use his percentage share of balls faced by the team. Lara's share of team runs may be an alternative measure of offensive domination of the productive space; however, it is highly correlated with balls faced. The rest of the teams' strike rate, runs and balls faced on the level of games and individual batting innings were considered as controls for offensive team performance controls. Bowling performance was proxied using bowling runs per over (RPO) and overs bowled at the innings level.

To capture heterogeneity in response across opponents an opponent factor variable was considered as a fixed effect. Home vs away differences were captured as a fixed effect via a dummy variable with 1 if the venue is a grounds in the West Indies. Individual venue fixed effects were omitted due to high multicollinearity with the opponent variable. A dummy variable capturing whether the West Indies bat or bowled first was considered. The lead value before the last West Indies batting inning was considered as chase or lead may influence the stylistic approach of the team.

An initial model is formed with only the Lara share of balls faced variable, then controls are added in a stepwise manner. Models are then compared based on AIC to select a candidate model then diagnostic testing is performed. In addition to modelling game outcomes, rest of teams' (ROT) runs in the first and second inning were modelled using a GAM approach. In log form ROT runs in each inning were normally distributed accordingly a Gaussian family was specified. We seek to investigate whether Lara's pace of play proxied by strike rate creates negative effects on the rest of the teams runs.

Results

Game Outcome Modelling

Considered on a game level the Lara coefficient is consistently insignificant regardless of considered controls and interactions. The Bat variable was found to be significant at the 1% level in all models in which it is considered indicating that bowling first increased loss outcomes. This was reflected in game-level win models where bowling first decreased the probability of winning. All other controls were insignificant at the 5% level regardless of model specification.

When considered on the innings level the Lara variable is insignificant when considered in isolation. However, the smoothed interaction between the Lara variable and the Bat factor is consistently significant across considered models, indicating that the effect of Lara's share of balls faced in a respective inning on game outcome varies non-linearly depending on whether or not the team bats first. These findings are consistent across loss and win models. Moreover, the optimal model according to the AIC criteria uses the same set of control variables for win and loss models.

The selected model based on AIC is specified as:

$$ln\frac{P_i}{1-P_i} = \beta_0 + s(Lara.first.bat * Bat) + s(Lara.last.bat * Bat) + s(ROT\ runs) + s(First.bowl.RPO * Bat) + s(Last.bowl.RPO * Bat) + Opponent + Bat + Home$$

Plots of significant coefficient variable results are shown for the loss model only as win model plots are merely the inverse of the presented loss model plots. The penalty criterium reduces the model contribution of ROT run and first inning bowling RPO interactions with the batting variable to 0. The model deviance explained is 40% with an adjusted R-squared of 0.362. Hence, the overall explanatory power is adequate.

We observe that when the team bats first an increase in Lara's share of balls faced linearly reduces loss probability. When the team bats first there may be a stylistic slant towards aggressively acquiring a lead. Accordingly, a greater concentration of batting possessions (balls faced) in the most productive attacking player effectively improves winning chances given the context.

When the team bowls first this interaction becomes nonlinear. At low levels increasing concentration of balls faced by Lara decreases probability of losing, eventually turning towards increasing the chance of losing. If a more defensive style matches well with batting second, then increasing concentration of balls towards Lara who tends to be a more aggressive scoring player creates a mismatch which may reduce probability of positive outcomes. Interestingly, Lara's 2nd batting inning share linearly increases chances of loses when batting first. To some extent this may be reflective of individual tiredness where Lara is unable to return the scoring output necessary to justify higher levels of concentration.

Figure 2: Impact of Lara 1st inning share of balls faced when West Indies bats first

p-value = 0.001

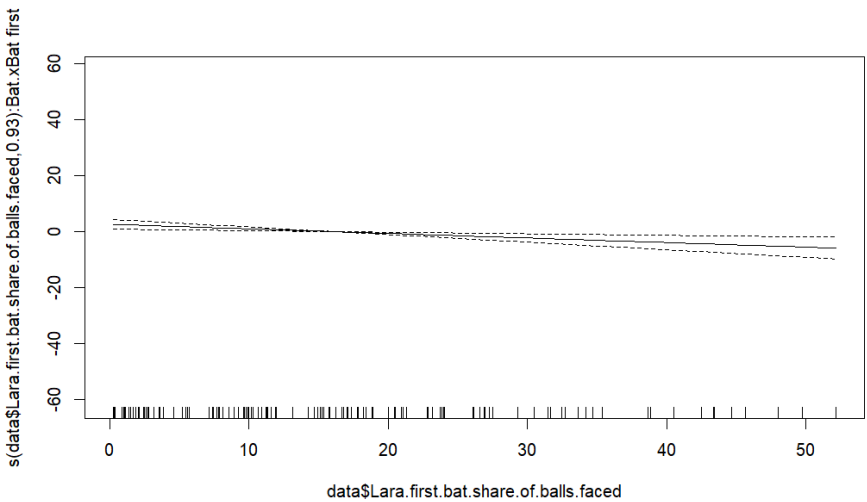


Figure 3: Impact of Lara 1st inning share of balls faced when West Indies bowls first

p-value = 0.022

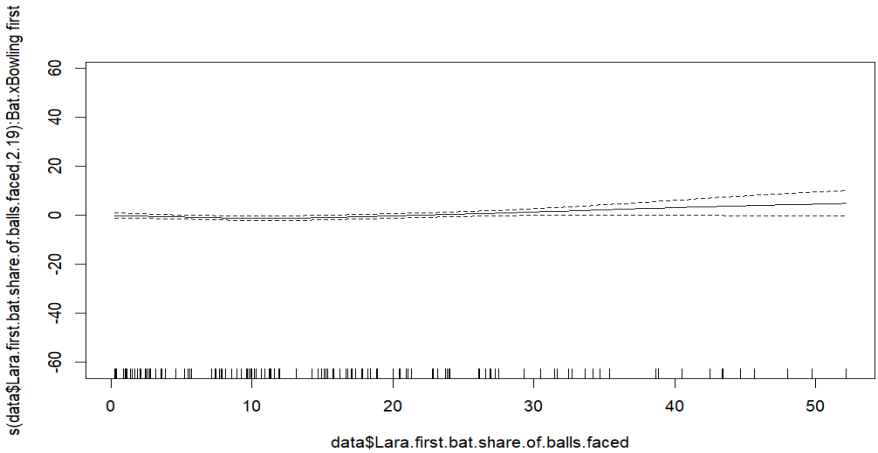
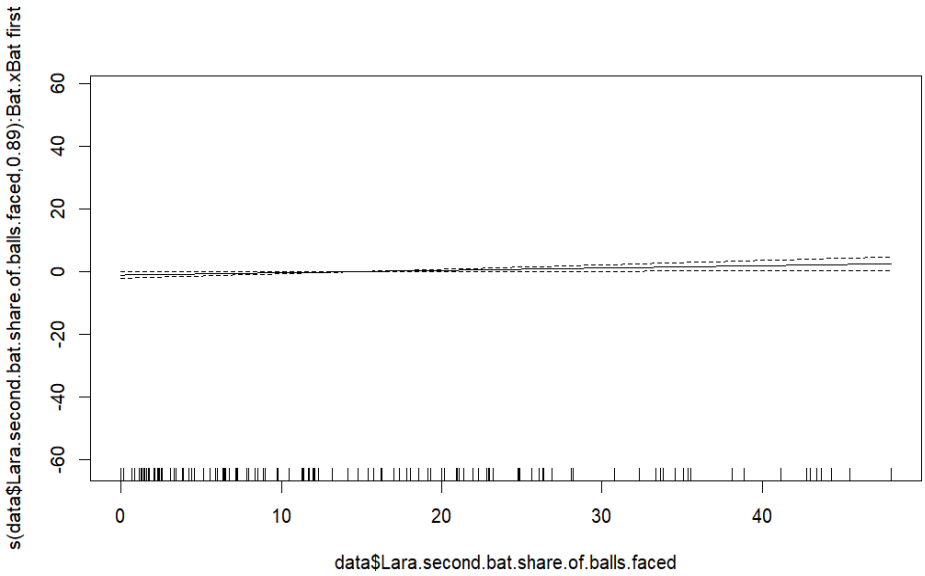


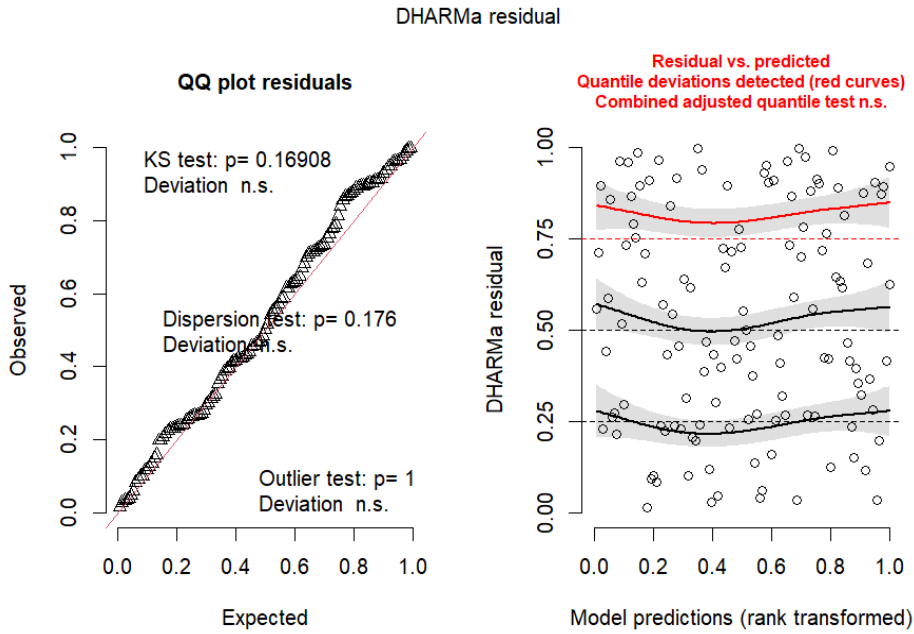
Figure 4: Impact of Lara 2nd inning share of balls faced when West Indies bats first

p-value = 0.014



While the quantile deviations plot identifies some possibility of minor under dispersion, testing of simulated residuals vs the fitted values through the Dharma package indicates that we cannot reject the null of normality and appropriate residual randomness (in terms of heteroscedasticity) at the 10% significance level.

Figure 5: GAM Logistic Model Residual Diagnostics



ROT Runs Modelling

The selected model for the ROT first innings runs was specified as:

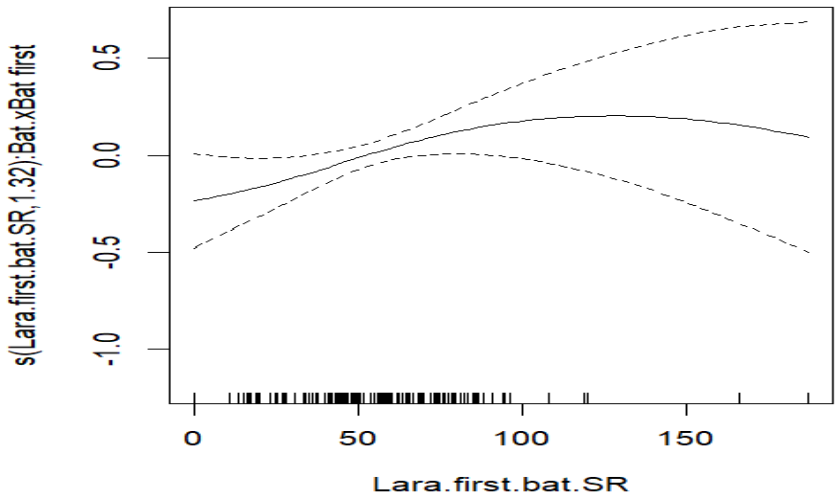
$$\log(ROT.1st.innings.runs) = s(Lara.first.bat.SR, by = Bat) + s(Lara.first.share.of.balls.faced) + Opponent + Bat$$

Residual diagnostic results reveal no issues of heteroskedasticity, non-normality or inappropriate dispersion patterns. Adjusted R-squared value was 0.171. Lara first batting inning strike rate when the team bats first was found to be significant and nonlinear. At lower levels of strike rate there is a negative impact on the rest of the team's first innings runs scored, becoming less negative as the strike rate increases nonlinearly, eventually becoming positive at extremely high strike rate levels above 70. So that when controlling for the offensive 'space' available to the rest of the team an increase in Lara's pace of play causes a decrease in the runs of the rest of the team for most of the interval indicating crowding out effects within the first

innings. Potentially this may occur as the team attempts to play at a comparable pace to Lara in attempting to set a strong first inning target ultimately resulting in lower run values due to the skill limitations of the players.

Figure 6: Impact of Lara first batting inning strike rate on ROT first batting inning runs when West Indies bats first

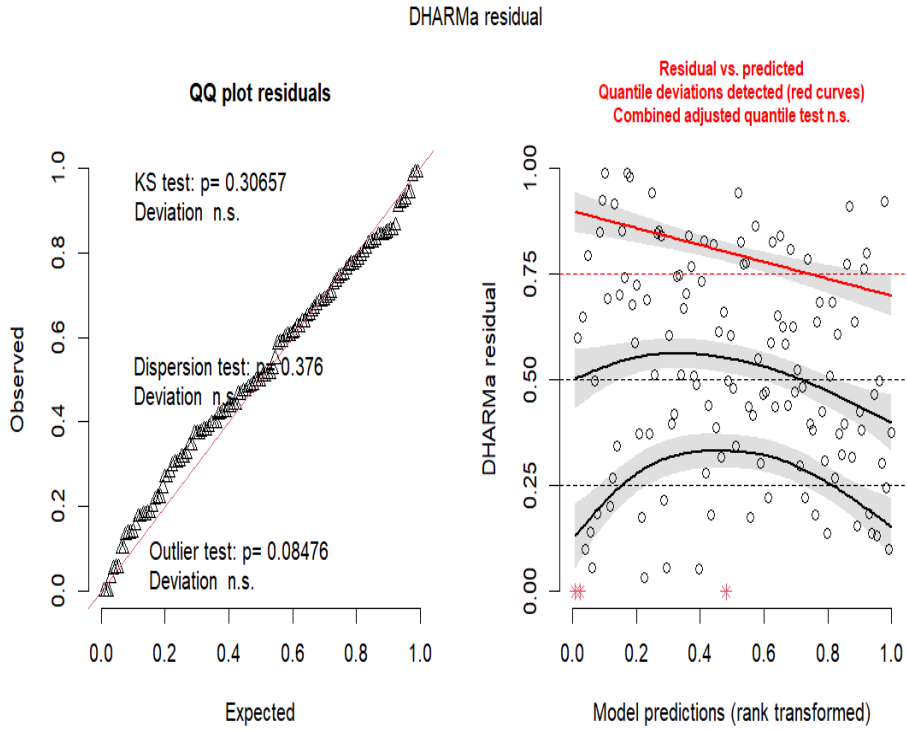
p= 0.02



In modeling ROT last batting inning runs model selection on the basis of AIC proved to be inappropriate due to the failure of stability diagnostics. Accordingly, an economically significant model was specified and investigated.

$$\log(ROT.last.bat.runs) = s(Lara.last.bat.SR, by = Bat) + s(Lara.first.bat.runs, by = Bat) + s(Pre.last.bat.lead.value) + Opponent + Bat$$

Figure 7: ROT First Batting Inning Runs Model Diagnostic



Residual plots indicate potential distortion of confidence intervals by the presence of outliers. Formal diagnostics of dispersion and quantile deviation fail to reject the nulls of appropriate fit and dispersion at the 5% level. Interpretation of effect plots must be cautiously applied however, identified deviations are largely minor suggesting appropriateness of the model.

The penalisation criteria reduce the effect of Lara's first batting innings strike rate to 0, however, last batting innings strike rates are significant and nonlinear, in both bat first and bowl first cases.

Figure 8: Impact of Lara last batting inning strike rate on ROT last batting inning runs when West Indies bats first

P=0.02

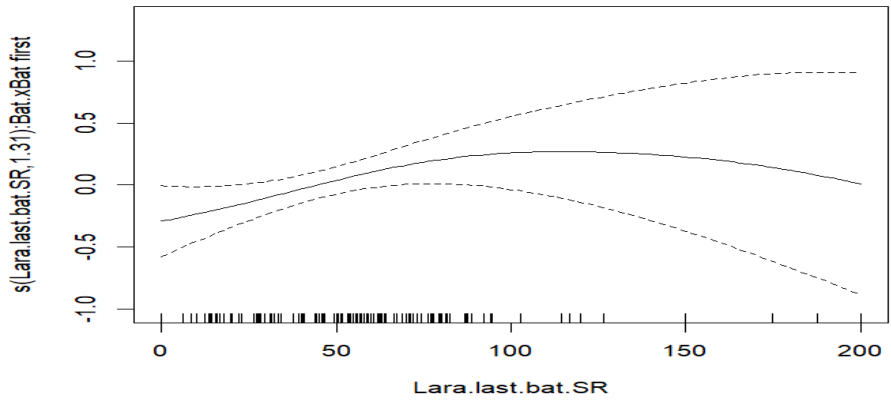
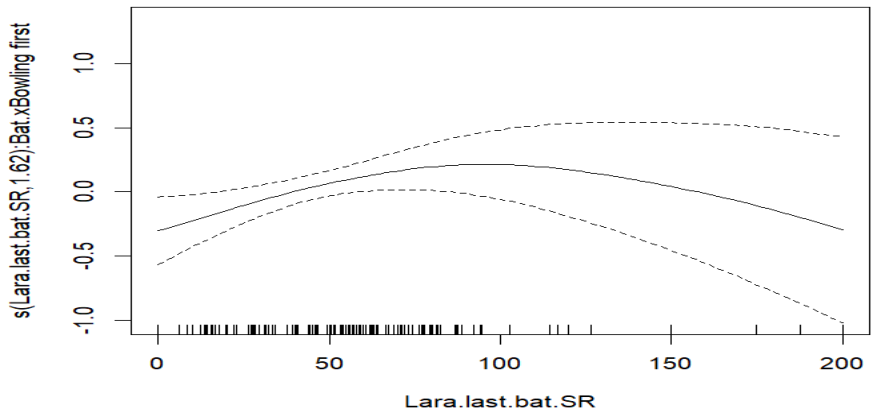


Figure 9: Impact of Lara last batting inning strike rate on ROT last batting inning runs when West Indies bowls first

P=0.02



In both bat and bowl first scenarios, increases in Lara's last bat strike rate produce negative effects on the ROT runs scored for low and moderate strike rate values. This effect becomes less negative as the strike rate rises, eventually becoming positive at extremely high strike rates approaching 100.

Conclusion

This study investigates the impact of Brian Lara's batting performance on the performance of the West Indies team in terms of match outcomes and the scoring output of the rest of the team. Generalised additive models are specified to account for non-linear interactions. It was found that Lara's influence on game outcomes requires nuance and varies according to the match context. At a game level, Lara's performance is consistently insignificant in influencing match outcomes. The sole consistently significant determinant of match outcomes at the game level of aggregation is whether the team bat or bowled first. At the innings level however, concentration of offensive space in Lara produces a varied impact depending on whether the team bats first.

When the team bats first, increasing Lara's share of balls faced reduces probability of losing. This suggests that concentrating 'batting space' in the hands of the most offensively talented batsman when attempted to set a batting lead produces positive effects on game outcomes. However, when bowling first, wherein practice suggests a more moderate or defensive orientated batting style, concentration of balls faced by Lara produces a nonlinear effect. At lower levels of concentration, increasing Lara's share of balls faced reduces probability of loses but eventually, this effect reverses.

Considered on an innings level Lara's strike rate, particularly in last batting innings, produces significant linear effects on the rest of teams run scoring output. At lower strike rates, increasing Lara's strike rate has a crowding-out effect on the rest of the team's performance. It is only at extremely high strike rates, in excess of 60, that increases in Lara's strike rate positively impacts the rest of the team's runs.

In culmination these findings suggest that management of Lara's batting output both in terms of pace and relative load was critical to maximising the team's success. Additionally, there is evidence of an inappropriate pairing of Lara's offensive skillset with the rest of the team. While eventually, increases in strike rate eventually convert to rising ROT runs, the interval over which the effect is negative suggests that the utilisation of Lara to rapidly score runs was to some extent inappropriate. Given Lara's skillset, greater flexibility in team strategic response in the context of bowling vs batting first was necessary to convert his prolific talent to positive outcomes.

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The Spatial Characteristics of Real Estate Prices in Barbados

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Abstract

Barbados, and most of the post-colonial islands of the Eastern Caribbean, have experienced a long-term shortfall in access to affordable housing. This study examines the extent to which spatial factors affected house price transactions in Barbados and derives house price sub-indices related to tourism-focused versus residential property trends. Using a mixed model approach, the paper finds strong evidence of significant spatial effects, with locations in Barbados' tourism/coastal belt positively associated with higher property transaction prices and higher average prices per unit of area. More rural areas, as well as the urban parish of St. Michael, experienced lower unit average transaction prices. However, given that housing prices for both coastal and non-coastal locations escalated at a much faster rate than average income growth, the forgoing suggests that the Barbados government may need to continue to intervene in the housing market to support access to affordable housing in Barbados.

Key Words: real estate market, spatial effects, mixed model, market segmentation, tourism

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Introduction

Barbados is ranked 60 out of 193 countries in the United Nations Development Program 2023/2024 Human Development Report (UNDP 2024) and is considered to have a very high level of human development despite its small size. Despite this ranking, low-income households in Barbados experience a number of barriers in their quest for housing: high land and construction costs, an imbalance between demand and supply for affordable housing, affordability constraints, limited access to finance, insecurity of tenure, and poor housing conditions in tenantries, particularly in urban/St. Michael areas. McHardy and Donovan (2016) noted that demand for low-density, single-family housing outside the urban corridor along the coast – where over 60 per cent of the population lived – has pushed up the price of land and housing throughout the country, making it difficult for low- and moderate-income households to purchase land. The rising cost of affordable housing has seen the emergence of illegal settlements, with the 2022 Barbados Social and Economic Report (BSER (2022) noting that provision had been made for the relocation of occupants from unsafe and illegal settlements at Rock Hall, St. Philip, to 92 alternative lots in the same or surrounding parishes.

Furthermore, in a study conducted by the Inter-American Development Bank (IADB), Fryer *et al.* (2017) comparing four Caribbean countries, characterised Barbados as the country with the smallest size but highest land costs. The authors detailed that local demand for affordable housing has resulted in the Government of Barbados intervening in the market through the expansion of state-built homes. The escalating cost of local housing has been noted by Belgrave, Grosvenor and Lowe (2016), who compared the real price indices of land, housing, and wages and found that the prices of houses outpaced average wages, as well as the general price levels. Based on the data used in that study and, comparing the nominal house price index changes using the United States (US) Federal Reserve's International House Price Database found in Mack and Martínez-García (2011), Barbados' nominal growth rate in house prices (295 per cent) exceeded the US (120 per cent), Canada (240 per cent), and the United Kingdom (221 per cent), between 1998 and 2019. The escalating local housing cost issue was also highlighted by Browne, Clarke and Moore (2008), who reported that an October 2007 Caribbean Development Research Services poll identified rising land and house prices as the most important constituency issue. The problem in Barbados, at least from the social side, appears to be a mismatch between the demand for affordable housing and its supply, despite a boom in residential construction from around 2006. These conditions, and the dominance of tourism in the economy, suggest the possible existence of at least two housing market segments in Barbados, namely a non-resident-focused real estate market and a domestic residential real estate market.

In the paper entitled "A Framework for Constructing a Housing Price Index," Belgrave, Grosvenor and Lowe (2016) developed a real estate price index for Barbados and concluded that whereas retail prices rose by 100 per cent between 1995 and 2016, land prices rose by 350 per cent and housing prices rose by over 500 per cent. The above study was part of an effort to create an indicator that could be used to assess the adequacy of financial institutions' valuation of real estate collateral. Indeed, real estate price indices are frequently used as an important indicator of the overall health of an economy and should be continuously monitored by financial regulators. Fenwick (2013) added that on the regulation front, real estate prices are key factors in financial stability, with real estate prices having financial as well as general economic effects via the wealth effect on households.

While the studies by Belgrave, Grosvenor and Lowe (2016) did not consider spatial effects, an earlier study by Browne, Clarke and Moore (2008) addressed the impact of location, with the use of parish dummies being used as location proxies and the number of bedrooms and size of house were used as indicators of the characteristics of the individual property. Unfortunately, the period covered was short (May 2007 to April 2008) and property prices were based on listings, rather than transacted prices as a result of data availability. Transactions are superior in the sense that an economic exchange actually takes place to generate the price, while listings only indicate the seller's desired price. The current study also considers spatial considerations and evaluates the impact of these spatial differences.

The remainder of the paper is structured as follows: Section 2 examines the literature review related to spatial effects on real estate prices; Section 3 analyses the segmentation of tourism and non-tourism (housing) real estate properties in Barbados; Section 4 looks at the model-based estimate of the effects of location using a hierarchical/mixed model; and Section 5 concludes the findings of the paper and gives recommendations for future consideration.

Literature Review

A substantial body of literature suggests that the housing market is heterogenous with demand for the housing stock being centred around consumers' preferences, which leads to location being a significant characteristic Galster (1996). Galster (1996) opined that consumers' view such as social status, the availability of public goods and access to private goods and jobs, influence the pricing of houses and creates inelastic demand as a result of the expense of changing occupancy. Supply was determined to be inelastic as the existing housing stock, and new construction respond only after significant lags. Similarly, it has been argued by Watkins (2001) and Galster (1996), that the housing market is a set of interrelated submarkets

whereby excess demand for particular types of housing and close substitutes push prices upwards, while excess supply reduces the submarkets prices.

Consequently, the importance of the housing submarkets has been explored by various authors. Many authors have used Bourassa *et al's* (1999) definition of the housing submarket as a "set of dwellings that are reasonably close substitutes of one another, yet relatively poor substitutes for dwelling in another submarket" (161) with substitution related to price, structural and locational features of the property and neighbourhood quality. Goodman and Thibodeau (1998) defined housing submarkets by structural type such as property age, neighbourhood characteristics, for example, public education or household income, and race. Spatial factors were also highlighted in the works of Ball and Kirwan (1977) who identified the submarket as the instance when there is a restriction on the freedom of buyers and sellers to enter the market in certain geographical areas, with one major restriction being the ability of potential homeowners to obtain mortgages for such areas. The likes of Can (1998) supported the definition by Ball and Kirwan (1977) but explored variation in housing prices caused by spatial variations in the physical characteristics of housing stock inclusive of type, style, quality, and structural characteristics. This author questioned whether the observed transaction prices were significantly different from the expected market prices, once structural and physical characteristics are accounted for.

Many techniques have been employed by authors to identify submarkets. Hwang and Thill (2009) utilised the statistical method of the fuzzy clustering, a form of k-means clustering, with physical, locational and resident specific attributes from the US census, to identify housing submarkets. To account for the spatial dependence, a principal component analysis (PCA) and cluster analysis was used to outline housing submarkets by Wu and Sharma (2012). Moreover, Keskin and Watkins (2017) opined that, submarkets in the housing sector should be determined by either statistical analysis of empirical evidence or in a less data-intensive approach, the use of market experts such as real estate agents or valuers should be used. The latter method, commonly known as "a priori knowledge," was utilised by Leishman *et al.* (2013), and compared the traditional hedonic OLS (Ordinary Least Squares) model with a distance variable for Western Australia. The results showed that the hedonic model with the real estate agents' familiarity with the submarkets outperformed the traditional model.

In terms of house prices, Fik, Ling and Mulligan (2003) estimated three models to explain house price variation. In an effort to model the explanation without prior knowledge of the submarkets, the authors applied the absolute location coordinates {x,y}in an interactive variables approach based on the assumption that the

inclusion of the coordinates should have a significant impact on a model's ability to determine house price variation. The results determined that the interactive models performed better than the 'aspatial' and discrete-spatial model, while the models that only incorporates {x,y} coordinates perform well. Hence, the use of cartesian {x,y} coordinates in an interactive model is a quicker and less expensive way to explain house price variation. Moreover, as house prices are recorded by time and location, ignoring the spatial independence and heterogenous temporal effects of the observations, results in serious specification problems and will bias estimates. Houses are typically embedded within neighbourhoods, which are, in term, embedded within higher level structures – parishes etc. Dai, Felsenstein and Grinberger (2023) exploited the multilevel nature of the data in measuring the visibility value of coasts and natural open areas using a spatial panel model with multilevel random effects. Like Dai, Felsenstein and Grinberger (2023), the current study also adds to the literature by using a multilevel model, with a particular focus on coastal versus non-coastal areas.

This paper seeks to add to the existing literature regarding the determinants of house prices using spatial considerations in the specific case of a small microstate. Larger countries allow internal migration for citizens to seek lower cost housing. However, these opportunities are likely to be more limited in smaller states. How these submarkets behave is thus of interest to all citizens. Given limited research on the topic throughout the Caribbean, this paper is pioneering for the region on the topic and provides a guide for other Caribbean countries regarding tourism's spillovers on local residential housing prices. Moreover, this current effort examines the issue using actual transaction data rather than listed prices. Listed and the actual transaction price can differ, ultimately rendering analyses based on listed prices potentially misleading. It utilises location characteristics based on the parish but also attempts to use the more granular location information embedded in the area grid of the Barbados Land Tax Department. Location characteristics are important as there is usually a spatial demarcation between the areas purchased by residents and non-residents.

Data[2] and Methodology

Data was obtained from the Barbados Revenue Authority which contained the registered sale prices of land and houses in the real estate market. The data was observed over the period 1996 to 2020 and included information on the transaction date, the date the property was conveyed, the date of transaction filed at the Land Registry, the size and existing use of the property, the location, the map reference, the nature of the structure and the transaction price. Based on boxplots of the data, transactions which were less than $1000 in value were excluded, as were those

[2] All monetary data used in this study refers to Barbadian currency.

above $1 million, as these were deemed as outliers, in the sense of outside the interquartile range of the data. In addition, only residential transactions for which there was a structure were included. This narrowed the data set to 10,469 transactions covering the period 1996 to 2020.

Due to the lack of key quality attributes in the data set, the median sale price was utilised to develop the real estate price index, given that this measure produces a simple but robust measure of the average prices faced by consumers.

Harrison and Jönsson (2015) identified high-end tourism as the focus of tourism marketing in Barbados. In addition to travel, high-income visitors also tend to invest in Barbados' real estate catered towards tourism, also known as the foreign luxury market. The investment has the potential to spill-over in the residential real estate market used by residents. Recognising the spatial nature of real estate market in Barbados, Kaidou, Moore and Charles-Soverall (2014) developed a price index for villas and cottages using state-space modelling. That paper recommended an index for luxury properties with a local real estate price index to identify any spillovers from luxury properties prices. Over the years, the coasts of Barbados have attracted housing catered towards the tourism sector, thus shifting the local residents away from the two identified coasts. Hence, the types of real estate markets were classified as tourism and non-tourism through location features using the map reference data received.

Using Google Maps, we confirmed that the majority of tourism-focused establishments were concentrated along the coast. Furthermore, the majority of tourism-focused real estate was located on the west coast and the south coast of the island, with the city of Bridgetown separating the two. For the west coast, the starting point was Port St. Charles to Mighty Grynner Highway and the south coast were identified between Needham's Point also known as Hilton Barbados Resort to the Grantley Adams International Airport. This was further confirmed using the information from a major Caribbean realtor - Terra Caribbean, the Red Book Barbados (2020), which identified the two coasts as luxury locations which typically carry a higher sales price than other locations on island.

A disadvantage of the methodology used to identify real estate related to tourism was that Google's search engine was unable to identify residential luxury houses, such as second houses. These luxury properties can potentially be rented by tourists, but since the location was unidentifiable, it is assumed that these types of properties were situated on the coasts of the island following the pattern of all other identifiable tourism-related properties.

Figure 1: Map of Barbados showing Tourism-Related Real Estate

Figure A: Apartments

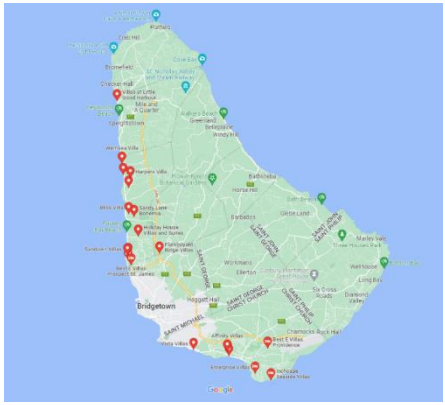


Figure B: Condominiums

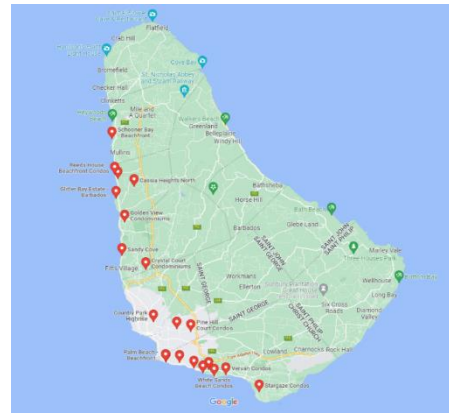


Figure C: Vacation Rentals

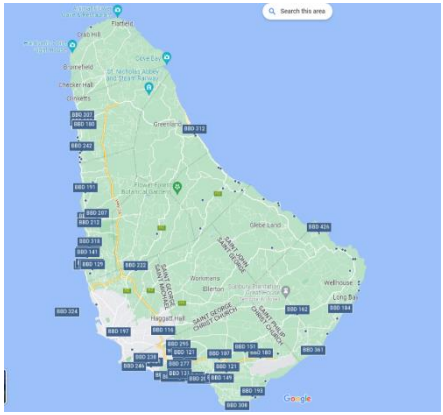
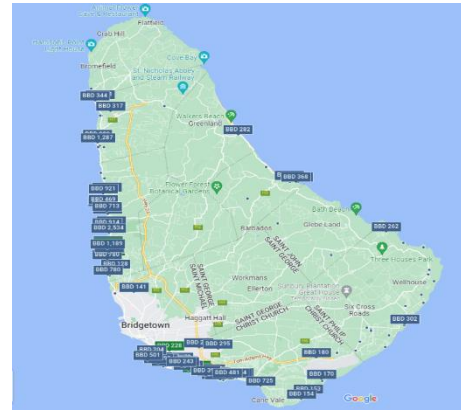


Figure D: Hotels Properties

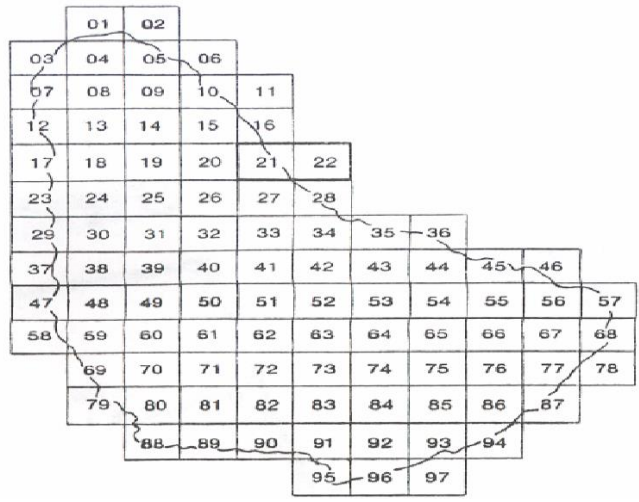


Source: Google Maps (6th July, 2023)

To gain a better insight of location factors beyond administrative parish boundaries, the Barbados Land Tax map reference was utilised (Figure 2). Barbados Land Tax and Valuation Department references each land plot through CAD maps which are subdivided into grids, enclosures, and plots and a land tax number denotes these elements. An example of this reference found in Charlemagne, Mahon and Marshall (2006), is illustrated in the Figure 2. Land tax

number 20:11:01: 001 for example, indicates that the plot 001 is found in CAD map 20, Grid 11, and enclosure number 01.

Figure 2: CAD Map of Barbados



Source: Charlemagne, Mahon and Marshall (2006)

The dataset was further broken down by property types by the use of price indices. An index of all buildings on the coast was plotted accompanied with a coastal tourism-based real estate price index, to determine the extent of tourism-based real estate on the coast compared to non-tourism-based real estate. For clarity, all real estate transactions that take place on the coasts of the island and are captured in the *full coastal index*. On the other hand, coastal real estate transactions on the west and south coast of the island only, compose the *partial coastal index*. The indices were created to determine which index would better identify tourism accommodation across the island of Barbados. Furthermore, to determine whether there is market segmentation in Barbados, a (locally-focused) residential price index was created to analyse how real estate in the residential property market was performing, compared to the tourism property market. This residential price index would exclude any grid which touched the coast in Figure 2. A second dataset utilised was the subsection of the 2016 Barbados Survey of Living Conditions found in Beurermann and Ramiro (2018) pertaining to housing quality. In this effort, a survey of 2416 households over 276 enumeration districts was carried out with specific areas of interest to this study being captured include questions

relating to the condition of the house's foundation, outer walls, number of bedrooms, bathroom facilities and ease of access to water. Potter (1986) reports that in 1980 only 58.9 per cent of homes had piped water directly into the dwelling with most depending on water piped into the yard or public standpipe. In addition, 52.2 per cent depended on pit latrines with the norm being wooden cottages set on loose rock foundations. Potter (1986) noted the presence of 320 identified tenantries with 203 plantation-owned and 117 non-plantation tenantries. Two legislative developments modified arrangement that had been in place for around 150 years with plantation tenantries being compelled in law to sell at $1 per square metre, while urban tenantries would have to negotiate a market price.

Based on the BSLC, a quality score for each respondent's housing unit was derived where the score is based on a weighted average of five factors: the condition of housing unit's foundation (35 per cent), the nature of toilet facilities (35 per cent), the number of bedrooms (10 per cent), the ease of access to water (10 per cent) and the nature of the outer walls of the housing unit (10 per cent).

$$Quality_i = 0.358 * Foundation_i + 0.35 * Toilet_i + 0.1 * Outer\ Wall_i + 0.1 * Ease\ of\ Water\ Access_i + 0.1 * No.\ of\ Bedrooms_i$$

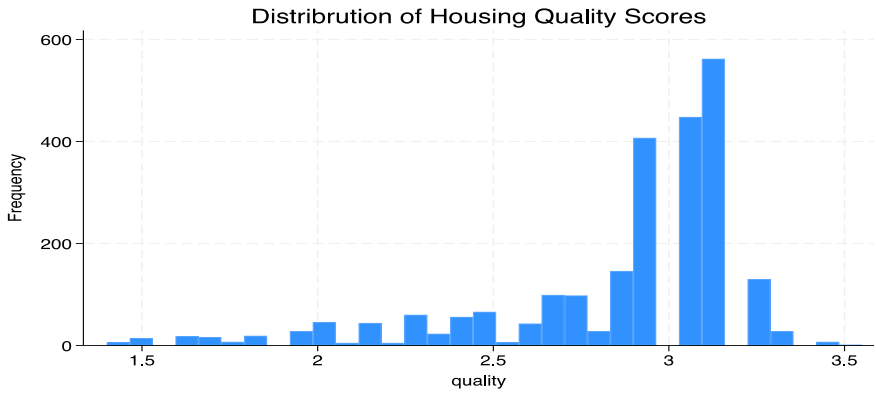
Table 1: Summary Indicators of Housing Quality in BSLC 2016

Stats	Walls	Foundation	Toilet	Water	Bedrooms
N	2416	2416	2416	2416	2416
Min	1	1	1	1	0
Max	8	3	6	5	8

Source: Beurermann and Ramiro (2018)

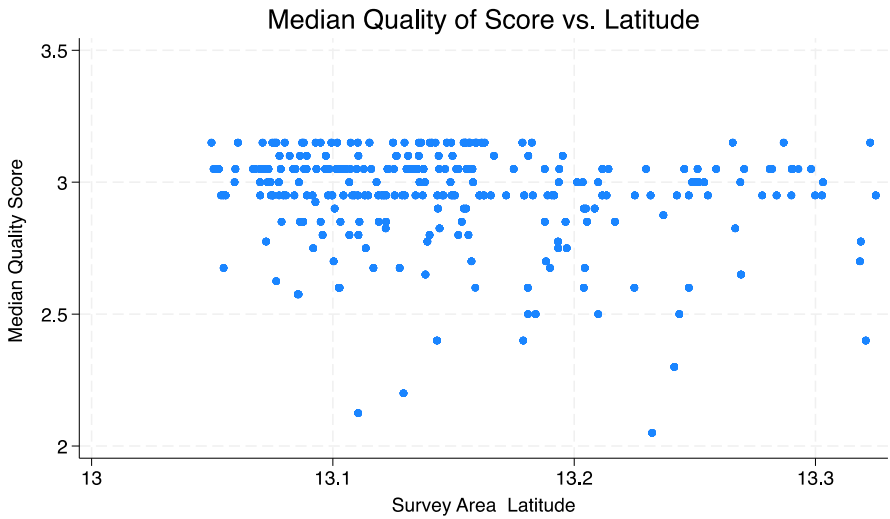
By weighting the respective housing characteristics and constructing a housing quality score for each household in the BSLC, a mean area score by each enumeration area was derived. A mean score was calculated for each enumeration area using coordinates of the centroids of each enumeration area which allowed the linking of characteristics of the BSLC data to the coordinates of the original Land Tax data set. The above represents a proxy for area quality (Level 2) that is fed into the multilevel regression model as an alternative to the parish indicator variable.

Figure 3: Histogram of Housing Quality



Source: Author's calculations based on data from Beurermann and Ramiro (2018).

Figure 4:

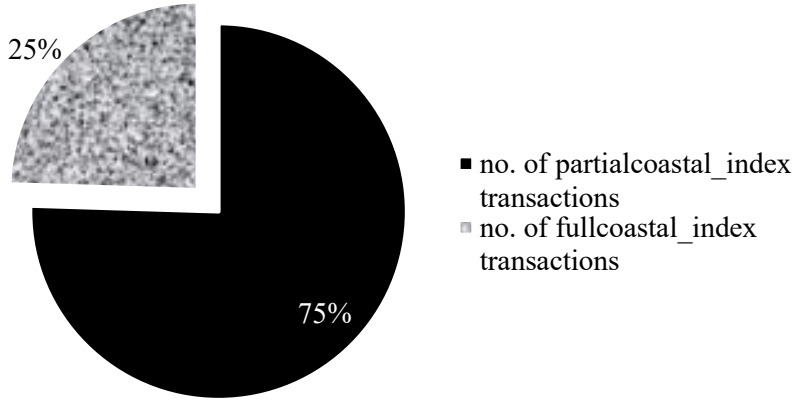


Source: Author's calculations based on data from Beurermann and Ramiro (2018).

Figure 5 displays the share of tourism related properties on the selected coastal areas to total coastal properties in Barbados, based on transactions over the period of 1996 to 2019. Noticeably, tourism-based coastal transactions, known as *partial coastal index* accounted for more than 75 per cent of all coastal transactions, full

coastal index, thus cementing the notion that the western and southern coastlines of Barbados is catered heavily towards the tourism economy. The remaining 25 per cent of coastal transactions not identified as tourism-related transactions are related to properties situated outside of the west and south coast of the island.

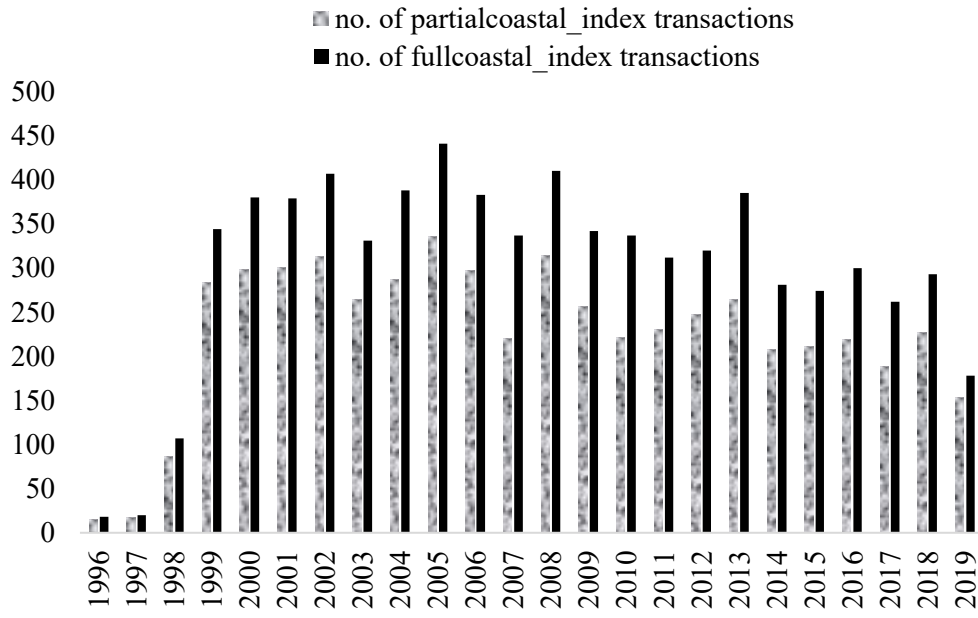
Figure 5: Share of Coastal Real Estate based on Transactions (1996 – 2019)



Source: Author's calculation from Barbados Revenue Authority data

Figure 6 gives a broader inspection of the coastal transaction grouped by years. The *partial coastal index* transactions represented all tourism identified transactions captured by the Barbados Revenue Authority on the west and south coast, while the *full coastal index* contains transactions made on the full coast of Barbados in the dataset. Over the period, *full coastal* property transactions and *partial coastal* property transactions averaged 301 and 227 annually, respectively. It can be seen in 1999, *full coastal* grew significantly, driven mainly by *partial coastal* purchases. This phenomenon continued throughout the years, however, since 2014, *full coastal* property transactions have been below average. In 2019, there was a substantial decline in both *full coastal* property transactions, and *partial coastal* property transactions. Additionally, the gap between number of transactions for tourism-based properties and all coastal properties shrunk in the latter years.

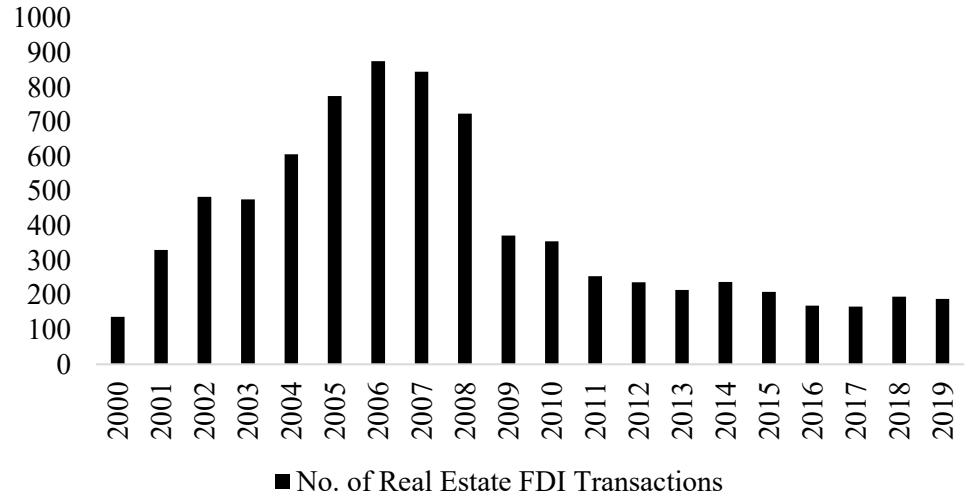
Figure 6: Number of Transactions for Coastal Buildings (1996- 2019



Source: Author's calculation from Barbados Revenue Authority data

Data on annual foreign direct investment related to real estate purchases in Barbados was collected containing the date of transfer, purpose of investment, the size of investment dominated in foreign currency, the local amount of the size of investment, the applicant's name and the country of origin. This was used to gauge the amount of real estate transactions related to foreign direct investment into Barbados. The data showed a significant growth in transactions from 2000 to 2006, but real estate transactions fell the year after. In year 2009, a sharp decline in the value transactions occurred as foreign investors reduced their real estate purchases. Between 2011 and 2019, transactions averaged 208. Prior to 2011, average transactions totalled 543. These changes reflected a shift in the general sentiment of external investors for Barbados' property market.

Figure 7: No. of Real Estate Foreign Direct Investment Transactions



Source: Central Bank of Barbados (2020)

Analysis

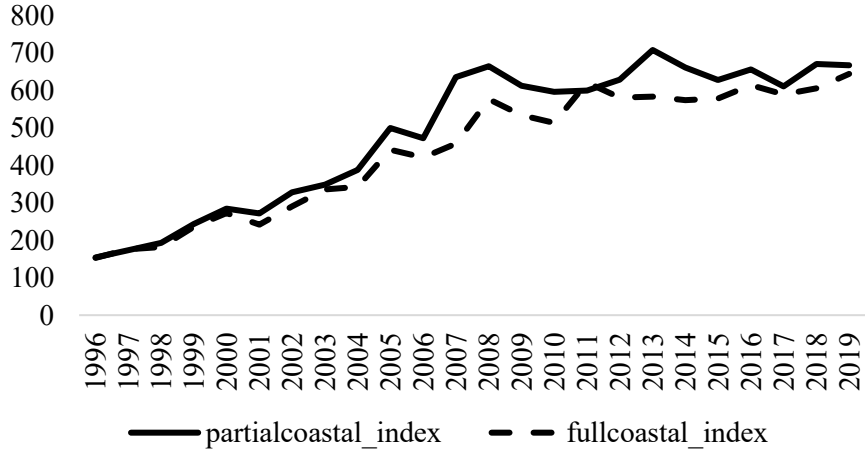
A median real estate price index for tourism-based properties was constructed, where *partial coastal index* represented properties on the west and south coasts only (grids 3 to grid 97 of Figure 2) while the *full coastal index* were all coastal properties (all grids which touched the sea). Figure 7 indicates that price of real estate on the west and south coast outpaced real estate on the full coastline on island. During the period of 1996 to 1999, the *partial coastal index* grew by 16.7 per cent on average while *full coastal index* grew by 16.0 per cent on average. Thus, both price indices were growing in line with each other with price per square metre being under $250.

The median real estate prices continued to move in the same direction between the period of 2000 to 2011, however with a widening gap with regards to pricing. As at 2000, the difference between the two were $11 per square metre, with the *partial coastal index* exceeding the *full coastal index*. By 2002, real estate on the west and south coasts reached $327 per square metre compared to $290 per square metre for properties on the full coastline. The *partial coastal index* grew by 11.6 per cent between 2003 and 2005, while the *full coastal index* grew by 15.4 per cent. In 2007, the *partial coastal index* grew exponentially indicating a significant price increase on the west and south coast of Barbados. Price per square metre moved from $471.7 to $634.7 in 2007. This could be related to significant transactions during the period of 2006 to 2007 in real estate inflows for the purchases of

properties such as condos and developments. During the same period, the *full coastal index's* price per square metre stood at $456. This indicates activity on the west and south coast was inflating the price index of all coastal properties.

After a peak price per square metre of $663 in 2008, the *partial coastal index* buildings contracted during 2009 to 2011. This coincided with a drastic decrease in the purchases of real estate during the same period. The Global Financial Crisis of 2008 may be a factor as to why real estate purchases and the partial coastal index fell. Massa (2012) indicated the crisis impacted the foreign direct investment of Latin America and the Caribbean which fell by 50 per cent in 2009. In 2013, recovery for both indices were shown with the *partial coastal* index reaching its highest price of $707 per square metre while *full coastal index* stood at $582 per square metre. Since 2014, the price index stabilised and averaged $648 per square metre compared to full coastal index at $600 per square foot. Therefore, the *partial coastal index* is the best variable for assessing tourism-focused housing in Barbados, as the coastal real estate price is being heavily influenced by tourism-based properties on the west and south coast. One inference reached is that the coastal areas of Barbados outside of the west and south coast are not currently as desirable for tourism activities.

Figure 8: Tourism Based Real Estate on the Selected Coast vs All Coastal Real Estate



Sources: Barbados Revenue Authority and Author's Calculations

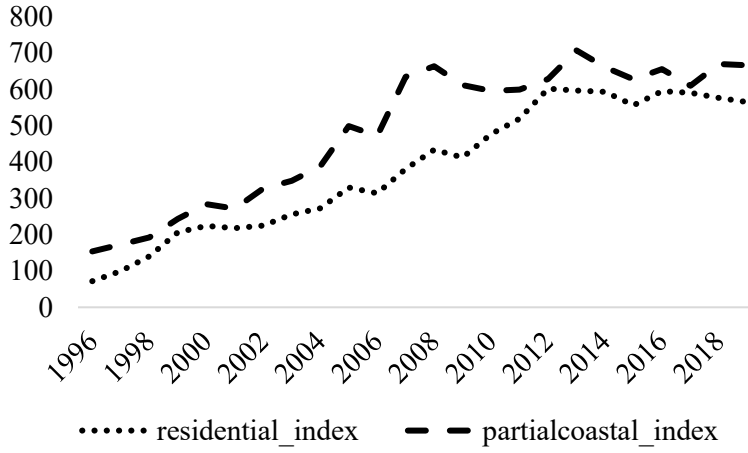
Next the *partial coastal index* is compared to the *residential index* (i.e. non-coastal areas or the inland areas of Barbados). The results suggest that there are at least two housing markets in Barbados - the residential housing market and the tourism

housing market. The indices moved in tandem, suggesting little relief for residents in the event of property booms. However, it is quite noticeably, but yet not surprising, that the *partial coastal index* is greater than the *residential index*. The difference in price widened since 2002, where the partial coastal index had a $100 per square metre uptick over the residential index, as the latter reached $225 per square metre. The increasing disparity in prices continued to occur over the years until 2007, where the difference stood at over $200 per square meter.

Surprisingly, after 2008 when the tourism housing price index slumped, the residential housing price index continued to increase rapidly averaging 39.5 per cent between 2009 and 2012, indicating that the locally focused real estate market less affected by the Global Financial Crisis, at least initially. A possible reason for this could be investors in the local real estate were less affected by global market conditions than international investors. In 2012, the *residential index* stood at $601 per square metre compared to $628 per square metre in the *partial coast* index.

After the surge in the residential housing price index, the difference in the markets decreased. The residential index shown signs of a stabilisation around $581 per square metre as the partial index stabilised around $648.

Figure 9: Residential Real Estate Price Index and Tourism Real Estate Price Index



Sources: Barbados Revenue Authority and Author's Calculations

Formal test of the difference in means between price indices confirmed the hypothesis of housing market segmentation in Barbados.

Table 2: Two Sample T-test of Difference in Means with Equal Variances

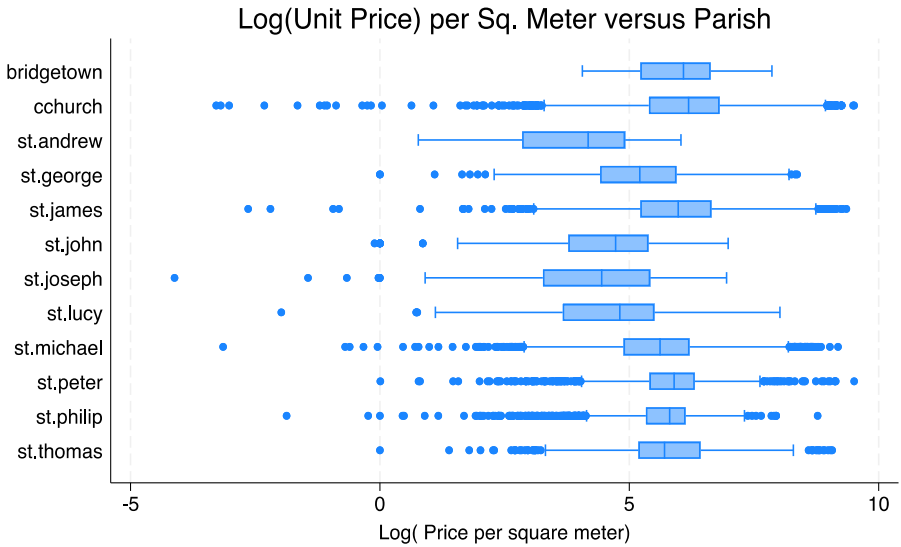
Group	Obs	Mean	Std. err.	Std. dev.	[95 per cent conf. interval]	
residential_index	**6,518**	**477.61**	**10.10**	**815.44**	**457.81**	**497.41**
partialcoastal_index	**3,945**	**849.12**	**23.63**	**1484.45**	**802.78**	**895.46**
combined	**10,463**	**617.69**	**11.05**	**1130.20**	**596.02**	**639.35**
diff		**-371.51**	**22.51**		**-415.63**	**-327.39**

diff = mean(residential_index) – mean(partialcoastal_index)
t = **-16.5054**
H0 : diff = 0 Degrees of freedom = **10461**

Ha: diff < 0 Pr(T < t) = **0.0000**
Ha: diff != 0 Pr(|T| > |t|) = **0.0000**
Ha: diff > 0 Pr(T > t) = **1.0000**

Rational for Mixed Model Approach

Figure 10: Box Plot Log (Price) vs Parish



The box plot of the natural log of the unit price by parish provides an indication of the relative importance of the variation between and within the groups. The

differences in the median line by parish (represented by the central line in each box) are suggestive of between variance of the group while the width of the box in each parish gives an indication of the within variance in parishes.

For cross-sectional data, the most common violation of assumption 3 is that errors are clustered. The assumption of conditionally uncorrelated observation under ordinary least squares (OLS) regression, dictate no role for heterogeneity, aside from the error term (ε_i) which is a noise term assumed to be uncorrelated with the regressors. With correlation between errors and regressors, OLS is no longer the minimum variance estimator, and alternative estimators may be more efficient.

To investigate this issue, a linear mixed model was utilised which contains both fixed and random effects. These models are generalisations of the standard linear regression but allow for the inclusion of random deviations other than those associated with the error term.

For the individual *i* in cluster *g,* the conditional mean of y_{gi} is to be specified to be $x'_{gi}ß$ where the regressors x_{gi} includes an intercept. Hence, I utilise the two-level version of the mixed linear-random intercept model where the two levels are the individual transaction and the identified cluster. The observed value of Y_{gi} equals the conditional mean plus the error term $z'_{gi}\, u_g + \varepsilon_{gi}$

1. $Y_{gi} = X'_{gi}\, ß + Z'_{gi}\, u_g + \varepsilon_{gi}$ where $u_g \sim N(0, \sum_u)$ and $\varepsilon_{gi} \sim N(0, var(\varepsilon))$.

The variances and covariances in the variance-covariance matrix ($\sum_u$) are random effects parameters and in the case of the simple model used, represent random intercept terms.

The data was estimated in natural logarithms of the unit price per square metre (*lprice*) and area in square metres (*larea*) as an aid to controlling price heterogeneity. In all cases (*lprice*) represented the dependent variable in the model. Since the price and area data are in logarithms, the coefficient on these regressions would indicate the per cent change in area on price. Two indicator variables were utilised to address clustering: one identifies 11 geographic parishes and the capital Bridgetown (*parish*); the other – *grid_ref2* – represents the 97 grids from the CAD map (Figure 2). In the simple mixed effects model, slopes are assumed constant with each groping variable (level 1) generating a shift the intercept relative to the overall intercept. For two other location indicators, partial_coastal represented coastal property transactions in grids 3 to grid 97 on the west and south side of the island, while *all_coastal* identified properties purchased within any grid along the entirety of Barbados' coast. Note that for the grid_ref2 variable no transactions in grid 97 survived filtering.

Table 3: Summary Statistics of Data Used in the Regression Models

Stats	*lprice*	*larea*	*year*	*grid_ref2*
Mean	**5.66**	**6.47**	**-**	**-**
SD	**1.30**	**1.06**	**-**	**-**
Min	**-4.12**	**2.62**	**1990**	**1**
Max	**9.51**	**14.57**	**2020**	**96**
N	**10,496**	**10,496**	**-**	**-**

Econometric Results

Elements of the best practices of multilevel modelling recommended by Aguinis, Gottfredson and Culpepper (2013) were adopted to address spatial heterogeneity in unit prices at the individual and grid/area levels. First, a null model was estimated to determine whether there is price clustering across the levels specified – grid location or parish. The null model is a multilevel model with no predictors as indicated by Jones and Bullen (1993).

The intraclass correlation coefficient (ICC) was then calculated which quantified the proportion of total variation in individual housing transactions accounted for by grid/parish differences. The intraclass correlation represented the ratio of the variance between groups divided by the total variation (the sum of the variance within groups and the variance between groups). The ICC can range from 0 to 1. When the ICC is zero, the means between groups are essentially identical and all variation is due to variation within groups (no clustering). When the ICC is 1, there is no variance within a group and all variation is due to differences in means between groups. This is suggestive of no clustering. Values above 0.05 are taken as indicative of clustering, suggesting a non-trivial degree of observational nonindependence that, if found, render traditional regression approaches inappropriate.[3]

[3] When the ICC is greater

Appendix Tables 1 and 2 provide summaries of all econometric results. All estimation was done in STATA 18 using the default maximum likelihood estimator in the "mixed" command.

In Models 1A and 2A (Appendix Tables 1 and 2), the mixed effects regression is first run with only the response variable - *lprice* - on two of the location indicator variables (*parish* in 1A) and the *grid_ref2* (2A). The purpose is to establish the potential clustering in the absence of explanatory variables, and hence provide a rationale for the use of mixed-level models.

In both cases the variance of the random intercepts suggests substantial variation which are all significantly different from zero as the confidence intervals do not include zero. The likelihood ratio test and p-values – provided in Table 4 – test the null hypothesis of a single level model H0: var_cons = 0 against a multilevel model. The p-values in each case are 0.0000, indicating that the multilevel model provides a significantly better fit to the data than the single-level model without random effects. In each case the ICC, the ratio of the variance of the level 2 grouping variable to the total variance of the level 1 and level 2 variables, confirmed the suspicion of the clustering of the data. The ICC estimates of 0.258 and 0.332 (Table 4) are well above conventional thresholds of 0.05 and provide strong evidence of clustering with the dataset both using level of the parish indicator and grid reference variable. In Model 2A this suggests that approximately 33 per cent from the grand mean of log of unit price was attributable to between grid differences and 67 per cent to within group variances. Despite the underspecified nature of models 1A and 2A, the information criteria ratios both suggest that the model fit is better using the grid reference variable as compared to the parish indicator variable.

Table 4: Intraclass Correlation for Models 1A and 2A

Geographic Indicator	ICC	Standard Error	[95 per cent conf. interval]	
parish	0.258	0.081	0.132	0.443
LR Test (p-value)	1011.84(0.0000)			
grid_ref2	0.332	0.038	0.262	0.411
LR Test (p-value)	1612.77(0.0000)			

For all regression models in Appendix Tables 1 and 2, the likelihood ratio test comparing the mixed model with one-level ordinary linear regression is highly significant, supporting our assumption the clustered nature between the errors and cluster indicator for the regressor.

The fixed portion of the Equation 1: $Y_{gi} = X'_{gi}$ ß utilises one overall regression line as a population average conditional on the various explanatory variables: log(area), year dummies, parish dummies. The random effect u_g serves to shift the regression line up or down according to the cluster identity variable (parish1 or grid_ref2). The variance of the level 2 errors is recorded in Appendix tables 1 and 2 (*var (_cons)*). The row labelled var(e) displays the estimated variance of the overall error term.

Models 1B and 2B add *larea* as a level 1explanatory variable for the *lprice*. In both models larea was highly significant and negative suggesting that a 1 per cent increase in the plot size results in a 0.47 or 0.49 per cent fall in the price per square metre in 1B and 2B respectively. This is likely reflective of the fact that property developers have been transitioning large tracts of formerly lower value agricultural lands into smaller middle or high-end developments. As noted in Jedlic (2009), for the private sector to be able to turn a profit a fairly large plot of land is a fundamental requirement due to economies of scale, with the private sector normally identifying the appropriate rural site and applying to the Chief Town Planner for a change in land use. The grand mean of the intercepts is 8.5 in the case of model 1B and 8.4 in 2B, both of which are highly significant. A likelihood ratio test of the mixed effects versus standard linear model supports the utilisation of the mixed model in both 1B and 2B. The ICC falls to 0.19 in the case of the parish indicator variable (1A) and 0.28 in the grid reference variable equation (model 2B) suggesting significant clustering even conditioning for the presence of the log(area) variable. The Akaike (AIC) and Bayesian information criteria (BIC) all suggest improved fit relative to models 1A and 2A, respectively. Similarly, the likelihood ratio test indicated that Model 2B success nests in Model 2A with a corresponding result for models 1B and 1A. In both cases therefore, the richer specifications are superior in terms of model fit.

In model 1C, a *partial_coastal* indicator is added as a level 2 fixed effect explanatory variable to the regression. Year dummy variables are also included as potential explanatory variables for *lprice* in this equation. Results are consistent with prior equations. However, the tourism coast indicator variable is positive and significantly mediates the negative coefficient of the area variable. Year indicator variables are generally not significant except for two points (1992 and 1994). Despite the addition of these variables, the ICC continues to suggest the clustered

nature of the data. The AIC and BIC are all lower than prior models again supporting the use of the richer model relative to more parsimonious predecessors.

In the final variant of 1D, the cluster variable in the mixed model is represented by *grid_ref2* rather than the *parish*. At the same time, 1D drops the year indicators of 1C replacing them with fixed effects parish indicator variable (*parish*). While there are small changes in the values of coefficient estimates compared to 1C the parish indicator variables suggest transaction occurring that the rural parishes of St. John, St. Joseph and St. Andrew result in a statistically significant fall in the transacted price. Location in the parish of St. Michael also appears to have a statistically negative impact on transacted prices. Despite these results this model does not fit the data as well as the 1C according to both information criteria used.

In Appendix Table 2, all models are estimated with *grid_ref2* used as the cluster indicator. The key benefit of using this, is that the 97 grids allow for greater heterogeneity compared to the 12 parish-based variables. The drawback is that each small grid has less transactions than the geographically larger parish indicators.

Across all four of the variations of the model in Appendix Table 2 (2B to 2E), a 1 per cent increase in the variable is associated with a at least a 0.4 of a percentage point decline in price.

In 2C, the *partial_coastal* indicator mediates the negative impact of area on price while year indicators are only significant in the 1992 and 1994. Another level 2 variable used is the *mean quality of houses* of the grid, a composite indicator of average house quality developed from the 2016 BSLC and outlined in Data and Methodology section of this study. This variable however is insignificant in 2C, possibly reflecting the relative uniform distribution of the grid quality across various latitudes as shown in Figure 4. The likelihood ratio test also suggest that this model can successfully nest preceding models 2B and 2A, but the Akaike information criterion (AIC) and Bayesian information criterion (BIC) suggest model 2C is inferior to model 2B.

In model 2D the *full_coastal* indicator - encompassing the entire coast of the island - replaced the more geographically limited *partial_coastal* indicator of 2C. This indicator was not statistically significant at conventional levels, however. At the same time the *mean quality of the grid* indicator segment remained insignificant. Model 2D was also less successful (larger AIC and BIC) than 2C with both of the information criteria suggesting that 2C was more successful in fitting the data.

Finally, in 2E the potential interaction between property area and the tourism coast indicator was explored via an interaction term (*partial_coastal##larea*). In addition, both the *mean quality of the grid* and *all coastal* indicators are dropped from regression given their relative lack of success. The *partial_coastal* variable remains statistically significant but only at the 10 per cent level. This interaction term - *partial_coastal##larea* - was significant at the 5 per cent level of significance, with the marginal effect on *lprice* now be conditional of whether the property purchased is in the tourism coastal belt (-0.41) or not (-0.46). The marginal effect *larea* on the transaction price a coastal property was 0.399 + 0.047*(larea). In the absence the coastal property the marginal impact remains negative (-0.457). The *year* indicators in 2E are compared to 2C and 2D in size and significance with conventional levels of significance only being seen in the 1990s. Model 2E contains the lowest values of Akaike and Bayesian indicators of all the models considered previously suggesting its superior fit relative to prior models. The intraclass correlation also remains relatively high at 0.255, supporting our usage of the mixed effects model.

Conclusion

A central finding of Belgrave, Grosvenor and Lowe (2016) was that the conditions in the Barbadian housing market had resulted in increasingly unaffordable conditions for the median worker in Barbados from 1995 to 2014. During that period, the median housing transaction price rose 500 per cent, land prices climbed 350 per cent, while the wages index trailed with an 89 per cent increase. This study further extends this insight by asking whether spatial considerations modified this conclusion. That is, 1) could statistical methods be used to divide the market into distinct submarkets focused on residents and non-residents? and 2), would price differences in these potential submarkets have addressed the issue of escalating prices and access to housing by residents? The key conclusions are twofold: there is robust statistical evidence of spatial differences with distinct delineations between tourism-focused coastal properties and non-coastal areas, but, despite these spatial differences, common trends in prices would have still resulted in an affordability issue for residents. Given Barbados' rank as one of the world's smaller nations, the extent of the mediation from location factors was limited. In fact, non-tourism residential areas mirrored the price patterns of coastal areas, although at a lower level (Figure 10).

As anticipated, the properties in the tourism market were priced above the residential market. However, the markets have moved in tandem with each other, except for 2008 to 2013, when the Global Financial Crisis impacted the tourism market. Owners of real estate on the island's west and south coast were able to

transact at higher per unit prices than properties outside the tourism coastal belt. In contrast, vendors of properties within more rural parishes, and St. Michael, were penalised by transacting in these locations. The old adage of 'location, location, location' makes a significant difference in the real estate market.

The existence of spatial differences provided no effective relief for Barbadian policymakers in terms of the issue of housing affordability, especially for low-income segments of the population. This consideration is likely also to be true for other small island states, since their small sizes implies limits on the divergence between local and foreign-focused housing submarkets. While housing transactions taking place in the more rural parishes of St. John, St. Joseph, and St. Andrew and urban St. Michael faced a significant locational penalty, the general escalation in prices over the years (outlined in Figure 9 earlier) means that they are still generally higher than low- and moderate-income households can afford.

Since spatial considerations will not address the issue of Barbados' housing affordability crisis, the dilemma faced by policymakers becomes the degree and type of government intervention. The success of these interventions is particularly important given the emergence of vacation rental platforms such as Airbnb. These have shifted interest from the provision of long-term residential housing services towards short-term rental housing by both domestic and international investors. This change has led to significant policy responses in several countries such as Portugal (Rua and Demony 2023). More broadly, countries have restricted or taxed participants on these platforms in an attempt to address domestic concerns about housing affordability. The global housing affordability crisis is not unique to island territories but tends to be most acutely expressed in these regions due to limited land availability. Despite various residential developments, housing initiatives and incentives, Hawaii, the US state with an economic profile nearest that of Barbados, due to the dominance of tourism, has - when standardised by population - a per capita rate of homelessness equivalent to that of the highest state, New York (Davis, Jeffrey-Wilensky and Haines (2025). To cite Das (2018), "If global capital and demand can vigorously alter the tourism industry in small island developing states (SIDS), then it is essential to acknowledge that the attendant disruption of customary property regimes and weak land markets can cause significant accumulation through dispossession, and drive deeper the wedge of inequity in access to land and shelter" (93).

Locally, despite the levelling-off of house prices from around 2012, factors such as the tension between housing as a social good and an investment product appear likely to continue to drive the housing affordability crisis. At the same time, most government-funded or supported housing schemes have fallen short either in scope or execution, with studies noting the complex set of trade-offs in ensuring economic growth by promoting housing activity, while balancing access to

housing for less affluent members of society. In Barbados' case, an inability to successfully expand exports outside tourism and a few niche products, constrain policymakers to consider chronic trade shortfalls in addition to social concerns about affordability, when evaluating foreign investment in housing.

An improved dataset containing a greater degree of housing quality characteristics would allow researchers a better understanding of the impact of quality characteristics on housing prices. Limitations on the quality indicators are the key constraint of the current analysis as in most of housing literature, it is quality factors such as the number of bedrooms and bathrooms, air conditioning, or garage spaces, that are found to affect prices. These variables were unavailable for this study.

Despite the above limitation, the segmentation and analysis of housing submarkets can aid financial regulators in monitoring potential exposure concentrations by financial institutions, as well as housing agencies in evaluating local access and affordability of housing services. This become especially pertinent considering that future coastal land losses associated with climate change are likely to arise within the same coastal corridor that remains crucial to Barbados' economic survival.

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Appendix Table 1:

	1A	1B	1C	1D
Log (Area)		-0.491***	-0.442***	-0.474 ***
		(0.011)	(0.010)	(0.011)
Tourism Coast Indicator			0.311 ***	0.469 ***
			(0.257)	(0.145)
Parish				
cchurch				0.059
				(0.285)
st. andrew				-0.747 **
				(0.365)
st. george				0.138
				(0.304)
st. james				0.093
				(0.284)
st. john				-0.642 ***
				(0.317)
st. joseph				-1.073 ***
				(0.332)
st. lucy				-0.482 *
				(0.330)
st. michael				-0.360**
				(0.275)
st. peter				0.284
				(0.303)
st. philip				-0.244
				(0.298)
st. thomas				0.262
				(0.290)
year				
1991			-0.642	
			(0.756)	
1992			-1.501 **	
			(0.685)	
1993			-0.770	
			(0.697)	
1994			-1.341 *	
			(0.696)	
1995			-0.624	
			(0.704)	
1996			-0.974	
			(0.644)	
1997			-0.405	
			(0.640)	
1998			-0.487	
			(0.624)	
1999			-0.117	
			(0.619)	

2000			-0.030 (0.619)	
2001			0.002 (0.619)	
2002			-0.005 (0.124)	
2003			0.619 (0.167)	
2004			0.267 (0.619)	
2005			0.431 (0.619)	
2006			0.339 (0.619)	
2007			0.582 (0.632)	
2008			0.647 (0.619)	
2009			0.521 (0.661)	
2010			0.689 (0.619)	
2011			0.709 (0.619)	
2012			0.771 (0.612)	
2013			0.881 (0.619)	
2014			0.874 (0.621)	
2015			0.747 (0.630)	
2016			0.211 (1.232)	
2020			-0.109 (1.233)	
Intercept	5.230*** (0.213)	8.501 *** (0.176)	7.712 *** (0.640)	8.506 *** (0.298)
var (_cons)	0.533 (0.225)	0.301 (0.127)	0.272 (0.115)	0.243 (0.058)
var (e)	1.530 (0.021)	1.272 (0.018)	1.137 (0.016)	1.172 (0.016)
Number of observations	10495	10495	10495	10495
AIC	34308.95	32369.09	31250.38	31714.60
BIC	34330.72	32398.12	31482.66	31830.74
ICC	0.258	0.191	0.193	0.172

*** p<0.01, ** p<0.05, *p<0.1

Appendix Table 2:

	2A	2B	2C	2D	2E
Log (Area)		-0.478 ***	-0.436 ***	-0.436***	-0.457 ***
		(0.011)	(0.011)	(0.010)	(0.014)
Tourism Coast Indicator			0.725***		0.399 *
			(0.167)		(0.215)
Mean Quality of Grid Segment			-0.342	-0.373	
			(0.370)	(0.421)	
All Coast Indicator				0.242	
				(0.154)	
Tourism Coast Indicator # Log(Area)					0.047**
					(0.020)
year					
1991			-0.636	-0.631	-0.658
			(0.741)	(0.775)	(0.775)
1992			-1.568 **	-1.567 **	-1.611 **
			(0.672)	(0.672)	(0.703)
1993			-0.937	-0.932	-0.991
			(0.683)	(0.683)	(0.714)
1994			-1.410 **	-1.404 **	-1.432 **
			(0.683)	(0.683)	(0.714)
1995			-0.852	-0.852	-0.878
			(0.690)	(0.690)	(0.721)
1996			-1.069 *	-1.069 *	-1.106 **
			(0.632)	(0.633)	(0.659)
1997			-0.520	-0.517	-0.558
			(0.629)	(0.628)	(0.657)
1998			-0.621	-0.619	-0.657
			(0.613)	(0.609)	(0.641)
1999			-0.240	-0.237	-0.280
			(0.608)	(0.609)	(0.636)
2000			-0.116	-0.114	-0.155
			(0.608)	(0.608)	(0.636)
2001			-0.123	-0.120	-0.162
			(0.608)	(0.609)	(0.636)
2002			-0.011	-0.011	-0.027
			(0.608)	(0.609)	(0.636)
2003			0.074	0.076	0.035
			(0.608)	(0.608)	(0.636)
2004			0.116	0.116	0.078
			(0.608)	(0.609)	(0.636)
2005			0.336	0.337	0.297
			(0.608)	(0.608)	(0.636)
2006			0.280	0.281	0.241
			(0.608)	(0.636)	(0.636)
2007			0.543	0.543	0.505
			(0.609)	(0.609)	(0.637)

2008			0.581	0.545	0.505
			(0.608)	(0.609)	(0.636)
2009			0.565	0.582	0.543
			(0.608)	(0.609)	(0.636)
2010			0.555	0.565	0.534
			(0.608)	(0.609)	(0.636)
2011			0.603	0.603	0.560
			(0.608)	(0.609)	(0.636)
2012			0.670	0.601	0.631
			(0.609)	(0.609)	(0.636)
2013			0.785	0.786	0.746
			(0.608)	(0.609)	(0.636)
2014			0.723	0.723	0.680
			(0.610)	(0.610)	(0.638)
2015			0.676	0.677	0.637
			(0.617)	(0.617)	(0.645)
2016			-0.001	-0.002	-0.030
			(1.200)	(1.198)	(1.253)
2020			-0.258	-0.259	-0.302
			(1.200)	(1.199)	(1.253)
Intercept	5.179***	8.430***	8.691***	8.807***	7.913 ***
	(0.915)	(0.115)	(1.202)	(1.315)	(0.621)
var (_cons)	0.702	0.458	0.366	0.441	0.365
	(0.120)	(0.080)	(0.065)	(0.077)	(0.064)
var (e)	1.411	1.186	1.065	1.065	1.065
	(0.020)	(0.016)	(0.065)	(0.015)	(0.015)
Number of observations	10496	10496	10496	10496	10496
AIC	33710.90	31867.36	30788.1	30802.45	30783.68
BIC	33732.71	31896.40	31037.64	31041.99	31023.22
ICC	0.332	0.278	0.256	0.293	0.255

*** p<.01, ** p<.05, *p<.1

El impacto de los Gastos de Transporte Marítimo en la Inflación: Un Estudio de Caso de Barbados, 1990T1-2021T4[1]

Nlandu Mamingi and Moné Craigwell

La inflación es un importante barómetro del estado de salud económica de una nación. En la misma línea, conocer los determinantes de la inflación y sus repercusiones es sumamente útil para la dirección de la política económica. En este contexto, el presente artículo investiga el impacto de los gastos de transporte marítimo sobre la inflación en Barbados en el periodo comprendido entre 1990T1 y 2021T4. Para responder a la pregunta, el artículo construye un modelo con tres ecuaciones vinculadas y utiliza el modelo autorregresivo distribuido rezagado (ADR) en su forma de modelo de corrección de errores (ECM, por sus siglas en inglés) para derivar los impactos a corto y largo plazo de los gastos de transporte marítimo, así como variables de control como los precios de importación, el PIB real y la brecha de producción de Barbados. Nuestros resultados sugieren que los gastos de transporte marítimo afectan positiva y significativamente a los precios al por menor (inflación). También son importantes determinantes de la inflación en Barbados la brecha de producción del país, el PIB real, la orientación monetaria, el tipo de interés de préstamo de Barbados y los precios de importación junto con sus factores causales, como los precios al consumo de EE.UU. (inflación), los precios mundiales del combustible (inflación) y los precios mundiales de los alimentos (inflación). Además, los gastos de transporte marítimo son una variable moderadora del tipo de interés de préstamo de Barbados y del PIB real. En cuanto a las políticas que afectan a los gastos de transporte marítimo para frenar los precios o la inflación, dado que Barbados no puede influir en el precio de los gastos de transporte marítimo, conviene elaborar políticas en torno a variables cuyas interacciones con los gastos de transporte marítimo afecten a la inflación. Se recomienda una política monetaria basada en el tipo de interés de préstamo de Barbados. Por otra parte, hasta cierto punto, impulsar el PIB real puede contribuir en gran medida a frenar la inflación.

Palabras clave: Gastos de transporte marítimo, precios, inflación, modelo autorregresivo distribuido rezagado, cointegración.

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L'impact des coûts de port sur l'inflation : étude de cas de la Barbade, 1990T1-2021T4[1]

L'inflation est un baromètre important de la santé économique d'une nation. De même, connaître les déterminants de l'inflation et leurs répercussions est extrêmement utile pour la conduite de la politique économique. Dans ce contexte, le présent article examine l'impact des frais de port sur l'inflation à la Barbade entre le premier trimestre de 1990 et le quatrième trimestre de 2021. Pour répondre à cette question, l'article construit un modèle à trois équations liées et utilise le modèle autorégressif à retards échelonnés (ARDL) dans sa forme de modèle à correction d'erreurs (ECM) pour étudier les répercussions à court et à long terme des frais de port, ainsi que des variables de contrôle telles que les prix à l'importation, le PIB réel et l'écart de production de la Barbade. Nos résultats suggèrent que les frais de port globaux ont un impact positif et significatif sur les prix de détail (inflation). De plus, l'écart de production de la Barbade, le PIB réel, la politique monétaire, le taux d'intérêt des prêts à la Barbade, les prix à l'importation et leurs facteurs causaux tels que les prix à la consommation aux États-Unis (inflation), les prix mondiaux des carburants (inflation), les prix mondiaux des denrées alimentaires (inflation) sont également des déterminants importants de l'inflation à la Barbade. Les frais de port constituent également une variable modératrice du taux d'intérêt des prêts à la Barbade et du PIB réel. En ce qui concerne les politiques impliquant les frais de port pour freiner les prix ou l'inflation, la Barbade ne peut pas influencer les frais de port. Ainsi, il est judicieux d'élaborer des politiques autour de variables dont les intéractions avec les frais de port influent sur l'inflation. Il est recommandé d'analyser la politique monétaire à travers le prisme du taux d'intérêt des prêts à la Barbade. De plus, dans une certaine mesure, la stimulation du PIB réel peut contribuer significativement à freiner l'inflation.

Mots clés : Frais de port, prix, inflation, modèle autorégressif à décalage distribué, cointégration

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Una Investigación Empírica del Impacto de un Jugador Estrella en el Rendimiento del Equipo: Brian Lara en el Equipo de Críquet de las Indias Occidentales 1990-2006

Nicholas Neaves, Anand Rampersad, Isaiah McIntosh and Roger Hosein

El rendimiento del equipo de críquet de las Indias Occidentales en partidos internacionales empezó a declinar a mediados de la década de los noventa del siglo pasado, tras su dominio entre 1976 y1995. El declive se produjo simultáneamente con la aparición de Brian Lara, uno de los mejores jugadores de la historia de las Indias Occidentales y del críquet mundial. A pesar de las tremendas actuaciones de Lara, el equipo quedó por detrás de sus eternos rivales, Australia, India, Inglaterra y Sudáfrica. Mediante el uso de modelos aditivos generalizados (GAM, por sus siglas en inglés), este estudio investiga la presencia de relaciones no lineales entre los elementos del bateo de Lara y los resultados de partidos, teniendo en cuenta condiciones contextuales como si el equipo batea primero. A nivel de partido, la presencia de Lara no es significativa. Sin embargo, se identifican interacciones no lineales significativas a nivel de entradas (innings) con efectos variables dependiendo de si el equipo batea o fildea primero. Un hallazgo crítico es que, durante la mayor parte del intervalo, los aumentos en la tasa de strike de Lara tuvieron un efecto de desplazamiento sobre el resto de las carreras del equipo en una entrada determinada, llegando a ser positivos en tasas de strike extremadamente altas. Estos resultados indican un cierto desajuste entre las habilidades ofensivas de Lara y las necesidades del resto del equipo y subrayan la importancia de la utilización estratégica de jugadores estrella como Brian Lara para optimizar el rendimiento y los resultados del equipo.

Palabras clave: Brian Lara, Indias Occidentales, críquet, enfermedad holandesa, sector comercial en auge

Étude empirique de l'impact d'un joueur vedette sur la performance d'une équipe : Brian Lara dans l'équipe de test-match de cricket des Antilles de 1990 à 2006

La performance de l'équipe de cricket test des Antilles a commencé à décliner au milieu des années 1990 après une période de domination (1976-1995). Ce déclin s'est produit simultanément avec l'émergence de Brian Lara, l'un des plus grands joueurs de l'histoire des Antilles et du cricket mondial. Malgré les performances exceptionnelles de Lara, l'équipe a été dépassée par ses rivaux historiques, l'Australie, l'Inde, l'Angleterre et l'Afrique du Sud. En utilisant les modèles additifs généralisés (GAM), cette étude examine la présence de relations non linéaires entre les éléments du jeu de batteur de Lara et les résultats des matchs, en tenant compte des conditions contextuelles telles que le fait que l'équipe bat en premier. Au niveau du match, la présence de Lara n'est pas significative. Cependant, des interactions non linéaires significatives sont identifiées au niveau de l'entrée, avec des effets variables selon que l'équipe batte ou lance en premier. Une découverte importante est que, pendant la majeure partie de l'intervalle, l'augmentation du taux de frappe de Lara avait un effet de substitution sur les autres courses de l'équipe lors d'une manche donnée, devenant finalement positif à des taux de frappe extrêmement élevés. Ces résultats indiquent un certain décalage entre les compétences offensives de Lara et les besoins du reste de l'équipe, et soulignent l'importance d'une utilisation stratégique des joueurs vedettes tels que Brian Lara pour optimiser les performances de l'équipe et les résultats.

Mots clés : Brian Lara, Antilles, Cricket, Syndrome hollandais, Secteur commercial en plein essor.

Contrastes entre Empresas Familiares y no Familiares en Barbados: Planificación de la Sucesión y Medidas de Rendimiento

Natalie Phillips

Este estudio pretende avanzar en el desarrollo de la teoría de la empresa familiar proporcionando un análisis más detallado de las diferencias entre las empresas familiares y no familiares en relación con las diferencias en el planteamiento de la planificación de la sucesión, y los contrastes en la forma de medir el rendimiento. Las empresas familiares son importantes para el crecimiento económico en muchos países y constituyen una fuente primaria de empleo (Allouche y Mann 2002). A pesar de esta importancia internacional, muchos estudios indican que varias empresas familiares de primera generación no sobreviven a la siguiente (El-Chaarani 2013). Bernice y Folker (2007) sostienen que el crecimiento de las empresas familiares es menos probable que el de las empresas no familiares debido principalmente a sus prácticas de gestión, que tienden a estar menos formalizadas. Un planteamiento eficaz de la planificación de la sucesión en las empresas familiares aumenta las posibilidades de éxito de una empresa familiar tanto a corto como a largo plazo. Se aplicó un diseño de investigación cualitativo, y el artículo se centra en las diferencias en la forma en que las empresas familiares y las no familiares miden el rendimiento y si existen diferencias en los enfoques de la planificación de la sucesión en el contexto de un país en vías de desarrollo. El objetivo del artículo es comprender las diferencias en la planificación de la sucesión entre empresas familiares y no familiares y el papel que desempeñan las diferencias en la forma de medir el rendimiento.

Palabras clave: planificación de la sucesión, medidas de rendimiento, empresas familiares, empresas no familiares

Contrastes entre les entreprises familiales et non familiales à la Barbade : planification successorale et mesures de performance

Cette étude vise à approfondir le développement de la théorie de l'entreprise familiale en proposant une analyse plus détaillée des différences entre les entreprises familiales et non familiales, notamment en ce qui concerne les approches de planification t les différences dans la mesure de la performance. Les entreprises familiales jouent un rôle important dans la croissance économique de nombreux pays et constituent une source majeure d'emplois (Allouche et Mann, 2002). Malgré cette importance internationale, de nombreuses études ont indiqué que plusieurs entreprises familiales de première génération ne survivaient pas à la génération suivante (El-Chaarani 2013). Bernice et Folker (2007) ont soutenu que la croissance des entreprises familiales était moins probable que celle des entreprises non familiales, principalement en raison de leurs pratiques de gestion généralement moins formalisées. Une approche efficace de la planification successorale pour les entreprises familiales augmente les chances de réussite de l'entreprise, tant à court qu'à long terme. L'objectif de cette étude est d'examiner les différences en matière de planification successorale et d'indicateurs de performance existant entre les entreprises familiales et non familiales à la Barbade. Une recherche qualitative a été mise en œuvre et l'article se concentre sur les différences de mesure de la performance entre les entreprises familiales et non familiales, ainsi que sur les éventuelles différences d'approche de la planification successorale dans le contexte d'un pays en voie de développement. L'objectif de cet article est de comprendre les différences de planification successorale entre les entreprises familiales et non familiales, ainsi que le rôle joué par les différences de mesure de la performance.

Mots clés : planification successorale, mesures de performance, entreprises familiales, entreprises non familiales

Una Investigación sobre la Relación entre la Ansiedad y la Depresión de los Empleados como Predictores del Compromiso en el Sector del Petróleo y el Gas: El Papel Moderador de las Demandas del Trabajo'

Riann Singh and Rennitta Achan

Propósito: La salud mental de los empleados sigue siendo una prioridad internacional con importantes implicaciones para el lugar de trabajo. Este estudio investiga la relación entre dos dimensiones de la salud mental, a saber, la ansiedad y la depresión, y su relación con el compromiso de los empleados en los sectores del petróleo y el gas de Trinidad, Guyana y Surinam. También se investiga el papel moderador de las demandas del trabajo en la relación entre estas dimensiones de la salud mental y el compromiso o *employee engagement*.

Diseño/metodología/enfoque: Se recopilaron datos cuantitativos mediante una encuesta en línea de una muestra de 210 empleados de los sectores del petróleo y el gas de Trinidad, Guyana y Surinam. Se realizó un análisis de regresión jerárquica múltiple para probar las relaciones de la investigación.

Conclusiones: Los resultados apoyan las proposiciones de que la ansiedad y la depresión de los empleados repercuten negativamente en el compromiso laboral. Sin embargo, las demandas del trabajo no moderaron la relación entre ansiedad y compromiso laboral ni entre depresión y compromiso laboral.

Originalidad: Este estudio aborda claras lagunas, ya que pocas investigaciones han examinado las relaciones de la ansiedad y la depresión con el compromiso laboral, y aún menos estudios han investigado el papel moderador de las demandas del trabajo en estas relaciones. Por lo tanto, este estudio contribuye a la comprensión de las relaciones relativamente poco exploradas entre la salud mental de los empleados, el compromiso laboral y las demandas del trabajo.

Palabras clave: Salud mental de los empleados, ansiedad, depresión, compromiso, demandas del trabajo, Caribe

Étude de la relation entre l'anxiété et la dépression des employés comme facteurs prédictifs de l'engagement dans le secteur pétrolier et gazier : le rôle modérateur des exigences professionnelles

Objectif : La santé mentale des employés demeure une priorité internationale, avec des implications importantes pour le monde du travail. Cette étude examine la relation entre deux dimensions de la santé mentale, à savoir l'anxiété et la dépression, et son lien avec l'engagement des employés dans les secteurs pétrolier et gazier de Trinité-et-Tobago, de la Guyane et du Suriname. Le rôle modérateur des exigences professionnelles dans la relation entre ces dimensions de la santé mentale et l'engagement est également étudié.

Conception/méthodologie/approche : Des données quantitatives ont été collectées via une enquête en ligne auprès d'un échantillon de 210 employés des secteurs pétrolier et gazier, à Trinité-et-Tobago, en Guyane et au Suriname. Une analyse de régression hiérarchique multiple a été réalisée pour tester les liens de recherche.

Conclusions : Les résultats corroborent l'hypothèse selon laquelle l'anxiété et la dépression des employés ont un impact négatif sur l'engagement au travail. Cependant, les exigences professionnelles n'ont pas modéré la relation entre l'anxiété et l'engagement au travail, ni la dépression et l'engagement au travail.

Originalité : Cette étude comble des lacunes évidentes : peu de recherches ont examiné les liens entre l'anxiété et la dépression et l'engagement au travail, et encore moins d'études ont examiné le rôle modérateur des exigences professionnelles dans ces relations. Par conséquent, cette étude contribue à comprendre les liens relativement peu explorés entre la santé mentale des employés, l'engagement au travail et les exigences professionnelles.

Mots clés : Santé mentale des employés, anxiété, dépression, engagement, exigences professionnelles, Caraïbe

Las Características Espaciales de los Precios Inmobiliarios en Barbados

Anton Belgrave

Barbados, junto con la mayoría de las islas poscoloniales del Caribe Oriental, han experimentado un déficit a largo plazo en el acceso a una vivienda asequible. Este estudio examina en qué medida los factores espaciales afectaron a las transacciones de precios de la vivienda en Barbados y deriva subíndices relacionados con las tendencias de la propiedad centrada en el turismo frente a la residencial. Utilizando un enfoque de modelo mixto, el artículo encuentra pruebas sólidas de efectos espaciales significativos, con ubicaciones en el cinturón turístico/costero de Barbados asociadas positivamente con precios de transacción inmobiliaria más altos y precios medios más altos por unidad de superficie. Las zonas más rurales, así como la parroquia urbana de St. Michael, experimentaron precios medios unitarios de transacción más bajos. Sin embargo, dado que los precios de la vivienda aumentaron a un ritmo mucho más rápido que el crecimiento de la renta media, tanto en las localidades costeras como en las no costeras, lo anterior sugiere que podría ser necesario que el gobierno de Barbados siga interviniendo en el mercado de la vivienda para apoyar el acceso a una vivienda asequible en Barbados.

Palabras clave: mercado inmobiliario, efectos espaciales, modelo mixto, segmentación del mercado, turismo

Caractéristiques spatiales des prix de l'immobilier à la Barbade

La Barbade, et la plupart des îles postcoloniales des Caraïbes orientales, connaissent depuis longtemps un déficit d'accès aux logements abordables. Cette étude examine l'impact des facteurs spatiaux sur les transactions immobilières à la Barbade et en déduit des sous-indices liés aux tendances de l'immobilier touristique et résidentiel. À l'aide d'une approche de modèle mixte, l'étude met en évidence des effets spatiaux significatifs, la localisation dans la ceinture touristique/côtière de la Barbade étant positivement associée à des prix de transaction immobiliers plus élevés et à des prix moyens par unité de surface plus élevés. Les zones plus rurales, ainsi que la paroisse urbaine de Saint-Michel, ont enregistré des prix moyens unitaires de transaction plus faibles. Cependant, étant donné que les prix de l'immobilier, tant sur les côtes que sur les zones non côtières, ont augmenté à un rythme bien plus rapide que la croissance moyenne des revenus, ce qui précède suggère que le gouvernement barbadien pourrait devoir continuer à intervenir sur le marché du logement pour favoriser l'accès au logement abordable à la Barbade.

Mots clés : marché immobilier, effets spatiaux, modèle mixte, segmentation du marché, tourisme

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Today, the Commonwealth Caribbean presents a rich and evolving landscape of constitutional reform processes. While the current wave of constitutional reform exercises draws much inspiration from Barbados' transition to a Republic in 2021, earlier constitutional reform commissions (1970s-early 2000s) across the Caribbean offered insights into the contemporary dissatisfactions with the existing political and legal systems throughout the region. From the legacies of colonial rule, post-independence reform to contemporary efforts at decolonisation, the Commonwealth Caribbean Island nations, Belize and Guyana, are engaged in a reimagining of their constitutional arrangements to reflect their challenges and to reflect current global benchmarks and advances in constitutional designs.

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CONTENTS

Vol. 49, No. 2, December 2024

Articles