Structural breaks, reserve currency and balance of payments constrained growth

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Structural Breaks, Reserve Currency and Balance of Payments Constrained Growth: A Test of Thirlwall's Law in the UK (1950-2017)

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Abstract

We apply Thirlwall's law (Thirlwall 1979) to estimate long run growth in the UK. In particular, we develop a new test allowing for potential structural breaks based on 2SLS to remedy potential weaknesses that existed in previous methods. Our results show the UK had different balance of payments positions in different time periods, and its growth has been constrained in the past two decades. We further elaborate on the pound's changing role as a reserve currency and how this has affected the UK's external constraint and growth.

Keywords: Thirlwall's Law, balance of payments, reserve currency, UK, growth
JEL Classification: F30, N20, O11, O16, O24.

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I Introduction

It has been four decades since Thirlwall published his seminal paper challenging the orthodox growth theory that argues for endowments and technology as the main determinants of international growth rate differences. In particular, Thirlwall (1979) departed from the neoclassical approach and developed a demand side model in which countries grow at rates that are consistent with their balance of payments equilibrium, unless they can finance their deficits continuously.

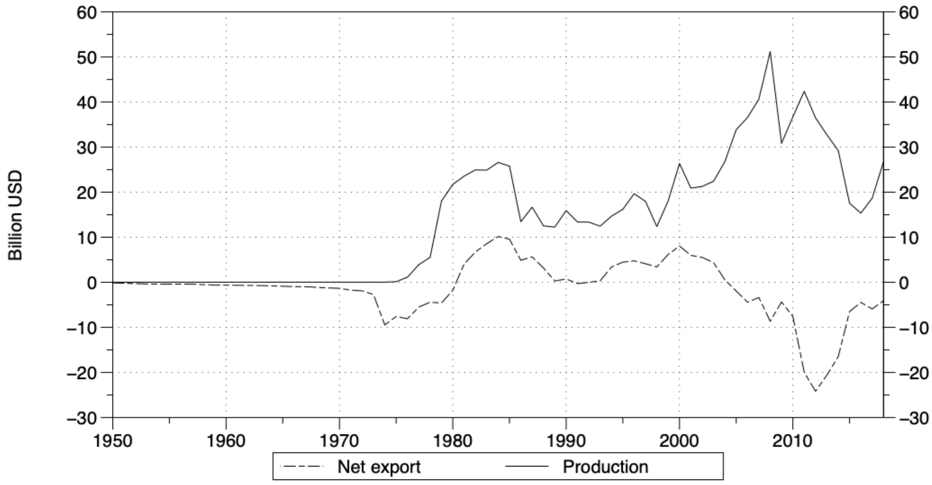
Thirlwall's law, often referred to as the dynamic Harrod trade multiplier, states that long run growth of a country can be approximated by the ratio of the growth of exports to the income elasticity of demand for imports if balance of payments equilibrium on current account is a requirement, and the real exchange rate remains constant. However, a country that continuously runs trade deficits must reverse its balance of payments in the long run. Otherwise, it would run out of foreign exchange, resulting in a financial crisis. The only way for such a country to reduce the deficits is to slow down output growth, which is the balance of payments constraint. As a result, the country would grow at a rate below the maximum growth permitted by its supply-side factors.

Most of the empirical studies following Thirlwall (1979) on different countries confirm the validity of the balance of payments constraint on economic growth. Alonso (1999) tests the Spanish case between 1960 and 1994, confirming that Spain is constrained by the balance of payments. Hussain (1999) investigates the validity of Thirlwall's law in 29 African countries and 11 East Asian Economies, and the balance of payments constrained growth model performs well. When tests for individual countries are conducted, actual growth rates of 29 countries are not statistically different from the balance of payments constrained growth rates (see Thirlwall 2011, for an extensive review of studies for individual and groups of countries).

Among all the countries tested empirically, the UK is unique regarding its balance of payments position. In almost all cases, the countries could be divided either as balance of payments constrained or not, while the UK cannot be classified as such. McCombie (1997) argues that the UK was severely balance of payments constrained only prior to 1974. Although the economic growth after 1974 was still not strong, the hypothesis that a balance of payments constraint existed is rejected, suggesting a systematic break. McCombie claimed that the high-volume production of North Sea Oil helped the UK to relieve its balance of payments constraint in the 1980s (more detail is discussed in McCombie & Thirlwall 1994, where a negative correlation between unemployment and current account balance is shown, with a break around 1974).

As seen in Figure 1, the UK became a net oil exporter after the 1980s. However, the UK became a net oil importer once more in the new millennium. Consequently, the trade balance may have deteriorated and growth be constrained again. Our objective is to test whether the UK has been constrained by its balance of payments during 1950-2017, while allowing for additional structural breaks. Furthermore, McCombie (1997) used regressions in log first differences to estimate elasticities, and this may have resulted in a loss of long-run information in the data. In this paper, we estimate the income elasticity of imports using both Johansen Cointegration and Autoregressive Distributed Lags (ARDL) approaches, which should produce more precise results. We also use a new test based on a 2SLS estimation procedure, in addition to the two standard tests suggested in the literature, to test whether the UK is constrained by its balance of payments, and to confirm the robustness of our results.

Figure 1: UK Oil Production and Net Export



Source: Authors' own calculations based on volume data from Department for Business, Energy & Industrial Strategy and price data from BP

The rest of the paper is as follows. In Section II, we discuss Thirlwall's model and some of the relevant extensions. In Section III, we go over different approaches to estimate the elasticity of demand for imports and test the constraint. In Section IV, we present our methodology followed by Section V, where we discuss the empirical results. We finalise our paper in Section VI with our concluding remarks.

II Balance of Payments Constrained Models

The pioneering work on the balance of payments constrained growth model was by Thirlwall (1979). In this section, we will discuss the original model developed by Thirlwall and some of its seminal and more recent extensions.

II.A Thirlwall's Law

The starting premise of the model is that no country can grow faster than the rate consistent with its balance of payments equilibrium on the current account, unless it can continuously finance its deficit. Since this is not sustainable, the balance of payments will need to be corrected, and as a result, economic growth will be constrained in the long run.

To model growth under the constraint, Thirlwall (1979) imposes the balance of payments equilibrium condition on the current account, incorporates export and import demand functions and solve for the growth rate consistent with long-run balance of payments equilibrium, since import growth is a function of domestic income growth.

Assuming equality of own price elasticities of demand for imports and exports to the cross-price elasticities, and constant relative prices in international trade, or constant real exchange rates, results in:

$$y_{Bt} = \frac{\epsilon z_t}{\pi} \tag{1}$$

where ϵ is the income elasticity of demand for exports, z_t is the growth of world income, π is the income elasticity of demand for imports and y_{Bt} is the domestic growth rate consistent with balance of payments equilibrium. If relative prices are indeed constant, this further reduces to a simple but a robust relationship:

$$y_{Bt} = \frac{x_t}{\pi} \tag{2}$$

Equation (2), generally referred to as Thirlwall's Law, states that the growth rate consistent with balance of payments equilibrium is equivalent to the growth rate of exports (x_t) divided by the income elasticity of imports.

Theoretically, all balance of payments constrained countries should follow Thirlwall's Law, and hence, there should be a correspondence between countries' actual growth rates and the balance of payments constrained growth rate predicted by Equation (2). Vast amount of empirical work supports this observation. However, in its original form, Thirlwall's Law only considers exports as the sole determinant of long-run economic growth, and overlooks other factors that could potentially affect a country's balance of payments position. In the next two subsections, we briefly look at some of the extensions to the model, addressing these.

II.B Capital Inflows

A major problem with the original form of the Law is that it assumes balance of payments imbalances cannot be sustained for long periods and the Law only fits countries that need to keep long run balance but also enjoy low relative real price volatility e.g., developed countries, whereas many developing countries are able to sustain large balance of payments deficits financed by large-scale capital inflows. For such developing countries, capital inflows can become the ultimate constraint on economic growth.

Thirlwall & Hussain (1982) extended the original model to include capital inflows into the balance of payments equilibrium on the current account. Imposing the previous assumptions on own price elasticities and relative real prices, the growth rate consistent with the extended balance of payments equilibrium becomes

$$y_{Bt} = \frac{\theta x_t + (1-\theta)(c_t - p_{dt})}{\pi} \tag{3}$$

where export growth in Equation (2) is replaced by the weighted average of export growth and real capital inflows growth, where $(c_t - p_{dt})$ is the growth of real capital inflows, θ and $(1-\theta)$ are the shares of exports and capital inflows in total receipts financing imports, respectively. Note that if there are no capital inflows and foreign claims for domestic assets, Equation (3) reduces to the original form of the Law. Thirlwall & Hussain (1982) show that although there are differences between the predicted growth rates based on the basic model and the extended model, the main source of the difference between actual and predicted growth rates is the export growth rate for a selection of developing countries.

Based on Equation (3), McCombie (1993) divides countries into two groups: those that are balance of payments constrained and those that are constrained by other factors i.e., either resource constrained, or policy constrained. In this framework, if autonomous economic growth happens in balance of payments constrained countries, it results in current account deficits, pushing them back to the balance of payments constrained growth rate. A similar effect is not observed for the other group of countries i.e., it's impossible for every country to be constrained by its balance of payments.

II.C Recent extensions

Inclusion of capital inflows to the basic model by Thirlwall & Hussain (1982) was a major breakthrough concerning the applicability of the model. Nevertheless, the extended model puts no limit to how much countries can externally finance their ever-growing current account deficits. This issue was first addressed by McCombie & Thirlwall (1997) and later generalised for the case of constant terms of trade by Moreno-Brid (1998) where the balance of payments constrained growth rate consistent with a fixed deficit to GDP ratio is computed as

$$y_{Bt} = \frac{\theta x_t}{\pi - (1-\theta)} \tag{4}$$

where θ is the export import ratio at nominal prices. Note that Equation (4) reduces to the original form of the Law if the current account deficit is zero. In a more recent extension, Moreno-Brid (2003) introduces foreign debt repayments into the model and argues for the important role played by the interest payments on debt. Assuming constant terms of trade, the balance of payments constrained growth rate consistent with a fixed deficit to GDP ratio with foreign debt repayments is given by

$$y_{Bt} = \frac{\theta x_t - \theta_i i}{\pi - (1-\theta-\theta_i)} \tag{5}$$

where θ_i is the share of debt repayments in the total receipts and i is the rate of growth of debt repayments, and the negative sign implies the country is a net debtor. Once again, if there are neither foreign claim for domestic assets nor foreign debt to repay, Equation (5) reduces to the original Thirlwall's Law. It should be noted that export growth remains as the primary source of growth even in the presence of large capital inflows, and when these create interest bearing repayments (Thirlwall 2011).

Sector dynamics have also been introduced to the model. Araujo & Lima (2007) derived a multisectoral version of Thirlwall's law, where the balance of payments constrained growth rate is equivalent to the weighted average of sectoral export growth rates with different income elasticities. The implication is a country can grow faster by changing the structure of its exports, from those with a higher income elasticity of demand for imports to those with higher income elasticities of demand for exports, even when the elasticities remain constant. The extension not only improves the model's accuracy, but also allows the identification of key growth-promoting sectors for the economy.

III Testing for the Constraint

In order to determine whether a country is balance of payments constrained, the income elasticity of imports is estimated first, which is then used in computing the growth rate consistent with balance of payments equilibrium. If this constrained growth rate, y_B, is not statistically different from the actual growth rate y, then it can be argued that the country is balance of payments constrained.

III.A Estimating Elasticities

Early studies testing for the constraint, estimated the elasticities using OLS. Yet, those estimates could be substantially biased due to non-stationary time series data, resulting in spurious regressions. Although Bairam (1993) shows that the income elasticity of exports estimated in levels is not significantly different from that estimated in first differences, and Leon-Ledesma (1999) argues that the variables for Spain during 1965-1993 are stationary, the possibility of spurious regression should still be avoided. In order to preserve the long-run information contained in data, unit root tests and cointegration methods, rather than taking log first differences, are widely used in empirical studies. Johansen cointegration (Johansen 1988) and Autoregressive Distributive Lags (ARDL) (Pesaran et al. 2001) are among the most common methods employed.

Johansen Cointegration

Recent studies testing for Thirlwall's Law, or its extensions, mainly apply Johansen cointegration method. For the Spanish case between 1960 and 1994, Alonso (1999) applies Johansen cointegration method to estimate the elasticities and verifies the existence of a long-run relationship between the actual growth rate and the constrained growth rate. Similarly, Moreno-Brid (2003) applies Johansen cointegration for the case of Mexico, and confirms the existence of a balance of payments constraint between 1967 and 1999.

Several studies also incorporate the short-run dynamic adjustment mechanism in the analysis. Fugarolas Álvarez-Ude & Matesanz Gómez (2008) test the balance of payments constraint in Argentina for the period 1968-2003 with Johansen cointegration and ECM. They estimate an extremely high income elasticity of imports π, ranging from 3.545 to 4.812 across the period. Although the authors don't test whether y_B and y are statistically different, the estimated balance of payments constrained growth rate is close to the actual growth rate. Britto & McCombie (2009) apply the same method to test the validity of Thirlwall's Law in Brazil for the period 1951-2006. The authors refuted the original form of Thirlwall's Law, but accepted the extended specification suggested by Moreno-Brid (2003). In a later paper on Brazil, Alencar & Strachman (2014) applied Johansen cointegration method and VECM, and argue for the existence of structural breaks, which was not considered by the previous study.

Autoregressive Distributed Lags (ARDL)

In addition to the Johansen cointegration, the ARDL approach has also been used in this context. Hussain (1999) applied ARDL to estimate the long-run income elasticity of imports when testing the extended Thirlwall's Law accounting for capital inflows. Hussain argues that 29 African countries and 12 selected East Asian economies are balance of payments constrained. Considering the problem of small sample size, Jeon (2009) uses the ARDL-UECM method to test whether a balance of payments constraint existed in China from 1979 to 2002. The paper estimates y_B close to the actual growth rate. Lastly, Felipe et al. (2010) use ARDL to test the extension of Thirlwall's Law accounting for capital inflows and overseas labour remittances for Pakistan and decomposed the balance of payments constrained growth rate into different components: export growth, terms of trade changes, real effective exchange rate changes, capital inflows, and remittances.

III.B Hypothesis testing

Rank correlation

The original test employed by Thirlwall (1979) was the Spearman rank correlation. He confirmed a statistically significant correlation between the actual growth rates and the growth rate predicted from his model. He calculated coefficients of 0.764 in one sample of 18 developed countries, and 0.891 in another sample of 12 developed countries. Although the results verified the assumption of unchanged relative prices in international trade, and that countries' growth rates are constrained by their balance of payments, rank correlation is not a parametric test, and as criticised by McGregor & Swales (1985), a high correlation was not sufficient to claim a one-to-one effect of y_B on y. Succeeding literature developed three main parametric tests to achieve conclusive results.

Regression analysis

Hypothesis testing based on regression analysis was first proposed and used by McGregor & Swales (1985) and was based on the following regressions.

$$\log y = c_0 + c_1 \log x + c_2 \log \pi \tag{6}$$

$$y = c_3 + c_4 y_B \tag{7}$$

where Equation (6) is directly derived from Equation (2), Thirlwall's Law. McGregor and Swales test whether the intercept terms are zero and the slope coefficients are not significantly different than unity. However, when testing with the data provided by Thirlwall (1979), neither equation was supported and refuted Thirlwall's Law based on this parametric test.

Yet McCombie (1989) argued the results from McGregor and Swales are driven mainly by the outliers (i.e. Japan) that ran huge surpluses during the investigated time period. Furthermore, according to McCombie (1993), not all countries are balance of payments constrained simultaneously, and the sample requires a full set of countries such that the deficits cancel out the surpluses. Therefore, caution must be exercised when testing on cross-sectional data.

In addition, Equation (7) should not produce correct estimates for c_0 and c_1 since y_B itself is an estimator, which leads to error-in-variable bias. Instead, it is better to compare the estimated π with the value of the computed π that would make $y = y_B$. If there is no statistically significant difference, then y_B will be a good predictor of y. This test was first performed by McCombie (1989) at the individual country level, and the results confirm the validity of Thirlwall's Law.

Cointegration

The final test, suggested first by Alonso (1999), uses Johansen Cointegration to evaluate the long-run relationship between y_B and y. A study by Britto & McCombie (2009) confirms the existence of cointegration between the balance of payments constrained growth rate and the actual growth rate for Brazil over the preiod. They use a Likelihood Ratio (LR) test based on the cointegration equation and the result does not reject the null hypothesis, confirming that Brazil was balance of payments constrained.

IV Methodology

The primary objective of the current paper is to investigate the changes in the UK's balance of payments constraint position over the period 1950-2017. The UK is often seen as balance of payments constrained in the postwar period. On the other hand, McCombie (1997) argues that the UK should be described as policy-constrained subsequent to the collapse of the Bretton Woods System in 1971, and confirms this with a structural break around 1973/74. Yet, the UK may again have been constrained by its balance of payments considering the period 2000-2017.

IV.A Model

The first step is to test whether the variables are stationary, and an ADF/DF test will be used. Since macro variables are commonly integrated of order one i.e., I(1), we expect that variables in levels are not stationary while their first differences are.

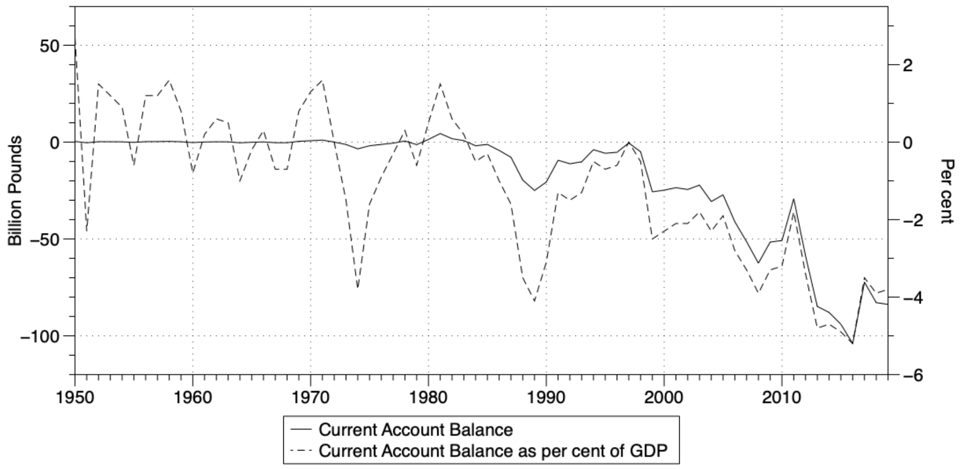
We will then estimate the income elasticity of imports, π_B, using the following equation

$$m_t = \alpha + \Psi tot_t + \pi y_t \tag{8}$$

$$tot_t = p_{ft} + e_t - p_{dt}$$

where lower-cases are logarithm forms, and imports m_t depend on country's income y_t and its terms of trade tot_t (which is a function of relative prices corrected by the exchange rate). Following the existing literature, we assume identical own price elasticity of imports to its cross price elasticity. We will use Johansen Cointegration to estimate the income elasticities in the long-run framework since all variables in Equation (8) are expected to be I(1). We will then employ ARDL model to check for the robustness of the results.

Figure 2: Current Account Balance of UK as a Percent of GDP



Source: Office of National Statistics

As shown in Figure 2, the current account balance of the UK has plummeted to historically low levels from 1999 onwards, and the ratio of the current account balance to GDP hit its historically lowest value in 2016. Thus, it's reasonable to assume that a structural break might have occurred into the new millennium. Another structural break might have happened during the financial crisis of 2007/2008, and both potential breaks will be tested. As suggested by McCombie (1997), a break happens in 1973/1974 during the oil crisis, and a dummy variable and an interaction term are added in the cointegration equation for this. Finally, *tot* is found insignificant in the regression, a situation also observed in the literature. Therefore, *tot* is removed from the model. The final Johansen Cointegration vector becomes

$$\begin{bmatrix} m_t \\ y_t \\ d_{74} \\ d_{pb} \\ d_{74} \cdot y_t \\ d_{pb} \cdot y_t \end{bmatrix}$$

where d_{74} and d_{pb} are the dummy variables for the 1973/1974 break and the potential breaks in 2000 and 2008. $d_{74} = 1$ for $t \geq 1974$ and $= 0$ elsewhere. $d_{pb} = 1$ for $t \geq 2000$ or $t \geq 2008$ and $= 0$ elsewhere.

The number of lags in cointegration is set equal to the number of lags in the corresponding VAR model minus one, while the number of lags in the VAR model is selected based on the Schwarz Criterion (SC). According to Equation (8), the intercept should be included in the cointegration equation, but the trend should not be included. As long as the null hypothesis that *no integration equation exists* is rejected, we can argue the existence of cointegration.

As for the ARDL model, since all variables are I(1), the dependent variable should be in first differences. ARDL(1,0) is specified based on the SC, and we will estimate the following model

$$\Delta m_t = \alpha_0 + \alpha_1 \Delta m_{t-1} + \alpha_2 \Delta y_t + \delta_1 m_{t-1} + \delta_2 y_{t-1} + \delta_3 d_{74} + \delta_4 d_{pb} + \delta_5 d_{74} \cdot y_t + \delta_6 d_{pb} \cdot y_t \quad (9)$$

where Δm_t is the first difference of series m_t and Δy_t is the first difference of series y_t.

The cointegration in ARDL should be tested by computing the F statistic for joint significance of m_{t-1} and y_{t-1} (i.e. $H_0 : \delta_1 = \delta_2 = 0$), and the bound test developed by Pesaran et al. (2001) should be applied. As long as the F statistic exceeds the upper bound, we can argue that cointegration between the two variables exists. Long-run elasticities are given by the following equations.

$$\pi_{B1} = -\frac{\delta_2}{\delta_1} \quad (10)$$

$$\pi_{B2} = -\frac{\delta_2 + \delta_5}{\delta_1} \quad (11)$$

$$\pi_{B3} = -\frac{\delta_2 + \delta_6}{\delta_1} \quad (12)$$

where π_{B1}, π_{B2}, and π_{B3} are the estimated income elasticities of imports for periods 1950-1973, 1974-1999/2007, and 2000/2008-2017, respectively.

We expect both cointegration methods to produce similar results. In particular, we will use the estimated elasticities from Johansen Cointegration to calculate the balance of payments constrained growth rate and conduct the tests. The UK is a developed country, which has a relatively small net capital inflow in terms of GDP. Therefore, the original form of Thirlwall's Law should be applied to calculate y_B.

We will conduct the following types of tests based on different samples–1950-1973, 1974-1999/2007, and 2000/2008-2017–. Firstly, we will regress y on y_B using OLS. Although the estimated coefficients will not be consistent due to the error-in-variable bias, we will use these to set a benchmark. Secondly, we will regress y on y_B using Two-Stage Least Squares (2SLS), with tot, m, c, and g as instruments, where c and g are the logarithms of consumer and government expenditures in the UK, respectively, followed by the the reverse regression of y_B on y. Lastly, we will conduct a t test based on π following McCombie (1989).

IV.B Data

Annual data for the UK are used in this paper, covering the period from 1950 to 2017. All variables are adjusted into 2017 pound values by appropriate deflators. GDP (Y), imports (M), government expenditure (G), consumer expenditure (C), and terms of trade (TOT) are directly taken from the Office for National Statistics (ONS). However, real income data are not available from 1950 to 1954, and are calculated using nominal GDP and GDP deflator data extracted from *DataStream*.

V Empirical Results

The Johansen Cointegration test is based on VAR processes, and before the model is estimated, the order of integration of the variables should be determined. The number of lags that should be included for the ADF/DF test is determined by SC, and when the number of lags is 0, the ADF test becomes the DF test. As shown in Appendix A, unit root tests show that all variables in levels are nonstationary, even when intercept and trend terms are added, while their first differences are stationary with p-value lower than 1%. This confirms that all variables are indeed I(1) series, and Johansen Cointegration can be constructed.

Next, the number of lags in the VAR should be selected, and the prediction of the lag order by SC is 1. It should also be noted that the lag order prediction by Akaike information criterion (AIC), Hannan-Quinn information (HQ) criterion, and final prediction error (FPE) criterion are also 1, which confirm the robustness of our model specification. We present the lag order criteria in Appendix B. The number of lags in cointegration is the order of VAR minus 1., i.e. 0.

In order to test the exact time of potential breaks, we include 3 dummy variables and 3 interactions (i.e. d_{74}, $d_{74} \cdot y_t$, d_{00}, $d_{00} \cdot y_t$, d_{08}, and $d_{08} \cdot y_t$), and conduct a Likelihood Ratio (LR) test. The results show that the dummy variable and interaction for 1999/2000 break is significant with p-value 0.000, while those for the 2007/2008 break are not significant at all. An F test based on the ARDL model also confirms the break was at the turn of the millennium rather than during the financial crisis. We present the test results in Appendix C. Based on these, d_{pb} becomes d_{00} and the cointegration vector specified in Section IV becomes

$$\begin{bmatrix} m_t \\ y_t \\ d_{74} \\ d_{00} \\ d_{74} \cdot y_t \\ d_{00} \cdot y_t \end{bmatrix}$$

In the cointegration equation, we allow for an intercept but not trend. MacKinnon-Haug-Michelis p-value is used in the tests. We reject the null hypothesis that at most 4 cointegration equations exist at the 5 % level, and show the test result in Appendix D. Therefore, we confirm that a long-run relationship exists among all these variables. The first normalised cointegration equation is

$$\begin{array}{lllllll} m = & 1.385y & -8.281d_{74} & -4.792d_{00} & +0.631d_{74} \cdot y & +0.39d_{00} \cdot y & -7.63 \\ & (0.070) & (1.464) & (3.639) & (0.108) & (0.254) & (0.927) \end{array}$$

where standard errors are in the brackets. According to this equation, the long-run income elasticity of imports for period 1950-1973 is 1.385, that for period 1974-1999 is $1.385 + 0.631 = 2.016$, and that for period 2000-2017 is $1.385 + 0.39 = 1.775$.

As previously stated, we also employ ARDL model to confirm the robustness of the estimates, and the regression result is as below.

$$\begin{array}{llllll} \Delta m_t = & -4.076 & -0.07\Delta m_{t-1} & +1.634\Delta y_t & -0.439m_{t-1} & +0.671y_{t-1} \\ & (0.907) & (0.076) & (0.179) & (0.113) & (0.159) \\ & -2.95d_{74} & -0.659d_{00} & +0.217d_{74} \cdot y & +0.058d_{00} \cdot y & \\ & (0.934) & (1.316) & (0.069) & (0.094) & \end{array}$$

As we show in Appendix E, the F statistic is 10.29 and exceeds the upper bound at 1 % level 6.36. Therefore, we should reject the null hypothesis that no cointegration exists.

We calculate the elasticities from the ARDL using Equations (10), (11), and (12). As shown in Table 1 below, we have obtained similar results from both models: the estimated elasticities for period 1950-1973 are lowest, while those for period 1974-1999 are highest, for both cointegration methods. Therefore, we can confirm the robustness of estimated elasticities.

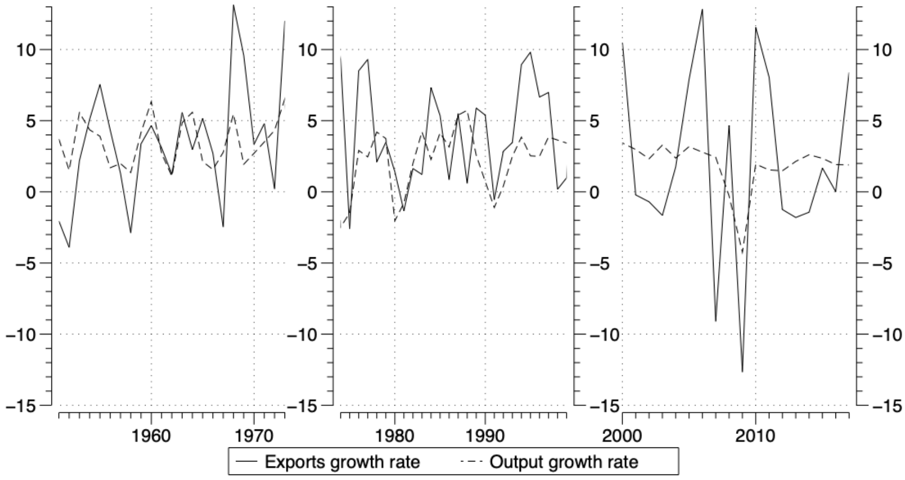
Table 1: Estimated Income Elasticities of Imports

Period	Johansen	ARDL
1950-1973	1.385	1.528
1974-1999	2.016	2.023
2000-2017	1.775	1.661

The increased long-run income elasticity of imports for the final quarter of the 20^{th} century can be attributed to several reasons. Foremost are the structural changes brought by the energy crises in the 1970s and the move towards a floating exchange rate regime. The upward adjustment may also be brought about by greater trade openness, and the rising standard of living and real income in the UK. Based on Annual Survey of Hours and Earnings (ASHE) data, median real wages grew by roughly 2% per annum between the late 1970s and early 2000s. The UK also enjoyed an expansion of product lines and varieties during this period, and this is reflected in the UK's increased share of intra-industry trade. Such a change in the composition of the UK's imports, could have resulted in a higher income elasticity of aggregate import demand, as explained in Krugman (1989) and Feenstra (1994).

On the other hand, the long-run income elasticity of import demand decreased in the new millennium. The weakened demand in the aftermath of the global financial crisis can be argued as a cyclical determinant of this downward adjustment. According to the ASHE data, real wage growth slowed down following the consistent growth since 1980s and dramatically fell in the aftermath of the global financial crisis. However, the decline in long-run income elasticity of imports may also have structural determinants. A recent paper by Constantinescu et al. (2020) attributes the slowdown in global trade and the decline in long-run import elasticities in early 2000s to the slowdown in the process of international production fragmentation. According to their analyses, more than half of the global trade slowdown was a result of this, while suggest the weakened global demand as a short term determinant.

Figure 3: Output (GDP) and Export Growth Rates for
the Periods 1951-1973, 1974-1999 and 2000-2017



Source: Office of National Statistics and Authors' Calculations

The UK's export and output growth rates for the three periods are depicted in Figure 3, and these show that the output growth rate y moves closely with export growth rate. We will now calculate the balance of payments constrained growth rates y_B for these three periods using income elasticities estimated from Johansen Cointegration, and then use hypothesis testing to show whether the UK is constrained by its balance of payments. We present the UK's output growth rates and balance of payments constrained growth rates in Table 2 below.

Table 2: Output growth rates and BOP constrained growth rates

Period	y_t	y_B
1950-1973	3.470	2.545
1974-1999	2.244	1.971
2000-2017	1.897	1.207

We first regress y on y_B using both OLS and 2SLS. The OLS result is only a benchmark for comparison with the results from 2SLS. In 2SLS, we use different instruments in different periods in order to eliminate potential endogeneity of instruments. The Sargan test is applied to test for the endogeneity of instrumental variables, with the null hypothesis that all instruments are exogenous. Since p-values of the Sargan statistics are large, we should accept the null hypothesis. LM test is conducted to test for serial correlation, which is not observed. Results are presented in Table 3 below.

Table 3: OLS and 2SLS Results

Dependent Variable: y						
	1951-1973		1974-1999		2000-2018	
	OLS	2SLS*	OLS	2SLS*	OLS	2SLS*
	0.250	1.076	0.491	1.932	0.522	1.118
y_B	(0.139)	(0.425)	(0.256)	(0.671)	(0.127)	(0.304)
	[0.000]	[0.859]	[0.059]	[0.165]	[0.002]	[0.698]
	0.027	0.002	0.012	-0.019	0.009	-0.002
c	(0.006)	(0.014)	(0.007)	(0.015)	(0.004)	(0.007)
	[0.000]	[0.894]	[0.103]	[0.221]	[0.029]	[0.799]
Instruments		tot m c		m g		g c
Sargan		1.187		0.368		0.244
		[0.553]		[0.544]		[0.621]
LM		1.953		1.558		1.890
		[0.162]		[0.212]		[0.169]
R^2	0.133		0.133		0.515	
Obs	23	23	26	26	18	18

Standard errors are listed in parentheses.
p-values are listed in square brackets.
* denotes that the null hypothesis of $c = 0$ and $slope = 1$ is not rejected at 5 % level in 2SLS.

It is worth noticing that the results from OLS are substantially different from that of 2SLS, confirming the error-in-variable problem in the OLS estimation. We can confirm from the 2SLS that the null hypothesis of $c = 0$ and $slope = 1$ is not rejected at 5 % level in all 3 periods. However, the estimated slope coefficient for period 1974-1999 is 1.932 with standard error 0.671, which is quite large, and we need to reconsider the validity of the test. The partial correlations between y_B and instruments are similar in all three periods. Consequently, the large standard error in period 1974-1999 makes the one-to-one effect between y on y_B in this period questionable.

The second test is the reversed regression suggested by McCombie (1997), and the results are shown in Table 4. It's clear that balance of payments constraint is applicable in periods 1951-1973 and 2000-2017, but not applicable in period 1974-1999.

Table 4: Reversed Regression Result

Dependent Variable: y_B			
	1951-1973*	1974-1999	2000-2017*
	0.534	0.270	0.988
y	(0.297)	(0.141)	(0.240)
	[0.132]	[0.000]	[0.960]
	0.012	0.015	-0.000
c	(0.011)	(0.004)	(0.006)
	[0.313]	[0.002]	[0.984]
R^2	0.133	0.133	0.515
Obs	23	26	18

Standard errors are listed in parentheses.
p-values are listed in square brackets.
* denotes that the null hypothesis of $c = 0$ and $slope = 1$ is not rejected at 5 % level.

The final test we consider is a t test on π following McCombie (1989), and this produces a similar result. As presented in Table 5, the estimated income elasticities of imports, π_B, in periods 1951-1973 and 2000-2017 are not statistically different from the implied values of π calculated through real data that would make $y = y_B$, but that of period 1974-1999 is.

Table 5: Test on π

Period	π	π_B	Standard Error	t	p-value
1951-1973*	1.339	1.385	0.070	0.653	0.521
1974-1999	1.737	2.016	0.082	3.418	0.002
2000-2017*	1.667	1.775	0.245	0.442	0.664

* denotes that the null hypothesis $H_0 : \pi = \pi_B$ is not rejected at 5 % level.

Among all the tests, we discover that all three confirm the balance of payments constraint in the UK for periods 1951-1973 and 2000-2017. Only the 2SLS suggests that the UK is balance of payments constrained between 1974 and 1999 with a high standard error, while the other tests show that the UK is not constrained by its balance of payments in this period. Therefore, we should reject the existence of balance of payments constraint in this period. Our findings are the same as that of McCombie (1997). As summarised in Table 6, our results are robust allowing us to make a firm conclusion.

Table 6: Summary of Tests

Is the UK balance of payments constrained?			
Period	2SLS	Reversed Regression	t Test
1951-1973	YES	YES	YES
1974-1999	YES	NO	NO
2000-2017	YES	YES	YES

V.A Reserve Accumulation and Balance of Payments Constraint

Currencies with strong reserve status often enjoy an excess return on external assets over liabilities. In particular, the foreign demand for reserve assets relaxes the reserve currency provider's balance of payments constraint and makes it easier to run current account deficits (Gourinchas et al. 2010). Furthermore, reserve currencies earn a safety premium as they act as a safe haven in times of crises (Maggiori 2013). Unlike other countries, the reserve currency provider will also have a higher tolerance to debt given its stronger institutions and financial system (see Reinhart et al. 2003, Mendoza et al. 2009, Maggiori 2013). And in the long-run, the reserve currency provider enjoys higher consumption and runs a larger trade deficit by taking a greater risk (Maggiori 2017).

We can therefore argue that reserves will serve the same role as capital inflows, and reserve accumulations can become a primary constraint for the reserve currency provider. Consequently, we can resort to Equation (3) to evaluate the changing reserve currency status of the pound sterling and how this may have affected UK's external constraint and growth. In particular, we can interpret θ and $(1-\theta)$ as the shares of exports and reserve accumulations in total receipts financing imports, and $(c_t - p_{dt})$ as the growth of reserve accumulations. It is worth noting when a country has no ability to issue an international reserve currency, hence $\theta = 1$, the relationship simplifies to Thirlwall's Law.

The pound sterling lost its dominance as a reserve currency in the aftermath of World War II. Yet reserves denominated in pounds declined only gradually until the early seventies and the pound held its role as a secondary reserve currency. Krugman (1984) describes this as a surprising persistence and argues that the displacement of the pound by the dollar was the result of the invisible hand processes sanctioned by international agreements. That being said, both the international monetary system and the global interest towards the continuation of the pound's role contributed to its prolonged status as a reserve currency (Schenk 2009). The share of pound sterling in foreign exchange reserves was over 55% in 1950 and fell gradually until the abrupt collapse in 1970. This was due to increased dollar reserves arising from large US balance of payments deficits and the fall in the value of the pound sterling reserves resulting from the UK's central bank assistance repayments. And by 1977, the pound's formal role as a reserve currency ended through the replacement of sterling reserves with UK liabilities denominated in other currencies (Schenk 2009). This decline in the pound reserves would have tightened the balance of payments on the current account, and constrained growth as predicted by Equation (3).

The pressure on the pound sterling was relieved in the aftermath of Bretton Woods. In particular, the move from a fixed to a floating exchange rate regime allowed countries to not only save on resources that would otherwise be used to increase reserve holdings (Frenkel 1978), but also granted diversification in the composition of reserves (Eichengreen 1998). The dollar became less favourable over the next quarter of a century and its share in global reserves declined while making way for other currencies, in particular the Deutsche mark and Japanese yen, as reserve denominations (see Dooley et al. 1989, Eichengreen 1998, Eichengreen & Mathieson 2000, Eichengreen et al. 2016, for the historical changes in the composition of reserves). However, unlike the US, both Germany and Japan used policies to discourage the holdings of their currencies as international reserves, while the UK's Big Bang in 1986 supported the pound's international role. With a more diversified world trade and financial system, countries held a mixture of reserves and the pound sterling remained as a favoured reserve currency. Unlike the previous period, we should not expect a tightening of the external constraint.

The introduction of the euro did not impact the big picture. In fact, the share of the euro as an international reserve currency corresponds roughly to the aggregate of the shares of individual currencies it replaced (Steiner 2016). Nevertheless, increased liquidity and breadth of European financial markets improved the status of the euro as a reserve currency, while it still remains behind the dollar in terms of its size, credit quality, liquidity as well as inertia (Galati & Wooldridge 2009). With these two strong international currencies to compete against, there is ever-growing pressure on the pound and its role as a reserve currency. Consequently, we can argue that there could have been a further tightening of the external constraint in the new Millennium. Overall, the changing status of the pound sterling as a reserve currency and the associated effects on the UK's balance of payments position and growth as per our interpretation of Thirlwall & Hussain (1982) is consistent with our findings as summarised in Table 6.

VI Conclusion

It is well documented a country cannot grow faster than permitted by its balance of payments on the current account, unless it can finance ever growing deficits. The UK, which is often characterised as balance of payments constrained following the postwar period, did enjoy surpluses in the 1970s, and its growth was no longer constrained by its balance of payments. However, the UK's balance of payments position has changed continuously. Our estimations confirm that the UK has suffered from a high degree of balance of payments constraint in the past 67 years, with two structural breaks. In particular, we show that after the trade surplus brought by the North Sea Oil, it was offset by massive demand for imports, the UK went back to the balance of payments constrained position again in the new millennium. The test for structural breaks reveals that the current account played a more critical role in balance of payments position compared to the financial crisis.

In addition to its changing balance of payments position, the UK also had a changing role as a reserve currency provider. Reserves will relax the balance of payments on the current account if they are used to finance imports. In this respect they serve the same role as capital inflows. When evaluated with the changing role of the pound during the same period, the extended constraint of Thirlwall & Hussain (1982) supported our initial findings. The next step would be to formally test the extended constraint. However, we still expect exports to be the governing variable of growth performance. The basic model fits well to at least two of the time periods we consider and this suggests reserve movements and/or capital inflows would have little role in relaxing the constraint and no role when there was no constraint.

Unlike the gold standard era, we cannot expect the balance of payments to correct itself. Furthermore, it is not likely for the pound to compete against the dollar and the euro, which would have allowed it to improve its balance of payments. This brings us to the fundamentals of the model. When a country is constrained by its balance of payments, it ought to take measures to either improve its exports or reduce its π. Developing exporting sectors that have high income elasticity of export demand (e.g. high-tech products) should be a key policy objective for the UK. The high value of π is usually linked with the lack of necessary raw materials that are used intensively in domestic production, and a potential solution for cases where necessary raw materials are technology-intensive, is to introduce new technology from abroad.

On the other hand, the UK's main import lines are in machinery and transportation equipment, and the latter recipe may not be applicable. Auboin & Borino (2018) estimate the import content of aggregate demand for 38 countries between 1994 and 2014, and UK has the highest share in investment followed by private consumption and then exports. The first component includes imported capital goods plus imported intermediate inputs into domestic investment, while the third component signifies UK's engagement in global value chains, which may not be easily substituted domestically. Improving the competitiveness of British products in domestic markets can be a first step in relaxing the UK's balance of payments constraint. The downward trend in the pound will likely to help with this. Also, protection of strategic industries through tariffs is an option that the UK can consider.

References

Alencar, D. A. & Strachman, E. (2014), 'Balance of payments constrained growth in Brazil: 1951-2008', *Journal of Post Keynesian Economics* **36**(4), 673–698.

Alonso, J. A. (1999), 'Growth and the external constraint: Lessons from the Spanish case', *Applied Economics* **31**(2), 245–253.

Araujo, R. A. & Lima, G. T. (2007), 'A structural economic dynamics approach to balance of payments constrained growth', *Cambridge Journal of Economics* **31**(5), 755–774.

Auboin, M. & Borino, F. (2018), 'The falling elasticity of global trade to economic activity: testing the demand channel', *CESifo Working Paper* **7228**.

Bairam, E. I. (1993), 'Static versus dynamic specifications and the Harrod foreign trade multiplier', *Applied Economics* **25**(6), 739–742.

Britto, G. & McCombie, J. S. (2009), 'Thirlwall's law and the long-term equilibrium growth rate: an application to Brazil', *Journal of Post Keynesian Economics* **32**(1), 115–136.

Constantinescu, C., Mattoo, A. & Ruta, M. (2020), 'The global trade slowdown: Cyclical or structural?', *The World Bank Economic Review* **34**(1), 121–142.

Dooley, M. P., Lizondo, J. S. & Mathieson, D. J. (1989), 'The Currency Composition of Foreign Exchange Reserves', *IMF Staff Papers* **36**(2), 385–434.

Eichengreen, B. (1998), 'The euro as a reserve currency', *Journal of the Japanese and International Economies* **12**(4), 483–506.

Eichengreen, B., Chitu, L. & Mehl, A. (2016), 'Stability or Upheaval? The Currency Composition of International Reserves in the Long Run', *IMF Economic Review* **64**(2), 354–380.

Eichengreen, B. J. & Mathieson, D. J. (2000), The currency composition of foreign exchange reserves; retrospect and prospect, IMF Working Papers 2000/131, International Monetary Fund.

Feenstra, R. C. (1994), 'New product varieties and the measurement of international prices', *American Economic Review* **84**(1), 157–177.

Felipe, J., McCombie, J. S. & Naqvi, K. (2010), 'Is Pakistan's growth rate balance of payments constrained? Policies and implications for development and growth', *Oxford Development Studies* **38**(4), 477–496.

Frenkel, J. A. (1978), 'Pegged exchange rates and managed float', *Carnegie-Rochester Conference Series on Public Policy* **9**, 111–140.

Fugarolas Álvarez-Ude, G. & Matesanz Gómez, D. (2008), 'Long-and short-run balance of payments adjustment: Argentine economic growth constrained', *Applied Economics Letters* **15**(10), 815–820.

Galati, G. & Wooldridge, P. (2009), 'The euro as a reserve currency: a challenge to the pre-eminence of the US dollar?', *International Journal of Finance & Economics* **14**(1), 1–23.

Gourinchas, P. O., Rey, H. & Govillot, N. (2010), 'Exorbitant privilege and exorbitant duty', *IMES Discussion Paper Series* **10-E**(20).

Hussain, M. N. (1999), 'The balance of payments constraint and growth rate differences among African and East Asian economies', *African Development Review* **11**(1), 103–137.

Jeon, Y. (2009), 'Balance of payment constrained growth: the case of China, 1979–2002', *International Review of Applied Economics* **23**(2), 135–146.

Johansen, S. (1988), 'Statistical analysis of cointegration vectors', *Journal of Economic Dynamics and Control* **12**(2-3), 231–254.

Krugman, P. (1989), 'Differences in income elasticities and trends in real exchange rates', *European Economic Review* **33**(5), 1031–1046.

Krugman, P. R. (1984), The international role of the dollar: theory and prospect, *in* 'Exchange Rate Theory and Practice', NBER Chapters, National Bureau of Economic Research, Inc, pp. 261–278.

Leon-Ledesma, M. A. (1999), 'An application of Thirlwall's law to the Spanish economy', *Journal of Post Keynesian Economics* **21**(3), 431–439.

Maggiori, M. (2013), The U.S. Dollar safety premium, 2013 Meeting Papers 75, Society for Economic Dynamics.

Maggiori, M. (2017), 'Financial intermediation, international risk sharing, and reserve currencies', *American Economic Review* **107**(10), 3038–3071.

McCombie, J. S. (1989), ''Thirlwall's Law' and balance of payments constrained growth–a comment on the debate', *Applied Economics* **21**(5), 611–629.

McCombie, J. S. (1993), 'Economic growth, trade interlinkages, and the balance of payments constraint', *Journal of Post Keynesian Economics* **15**(4), 471–505.

McCombie, J. S. (1997), 'On the empirics of balance of payments constrained growth', *Journal of Post Keynesian Economics* **19**(3), 345–375.

McCombie, J. & Thirlwall, A. P. (1994), *Economic growth and the balance of payments constraint*, Springer.

McCombie, J. & Thirlwall, A. P. (1997), Economic growth and the balance of payments constraint revisited, *in* P. Arestis, G. Palma & M. Sawyer, eds, 'Markets, Unemployment and Economic Policy: Essays in Honour of Geoff Harcourt, Volume Two', Routledge, London, chapter 38, pp. 498–511.

McGregor, P. G. & Swales, J. K. (1985), 'Professor Thirlwall and balance of payments constrained growth', *Applied Economics* **17**(1), 17–32.

Mendoza, E. G., Quadrini, V. & Ríos-Rull, J. V. (2009), 'Financial integration, financial development, and global imbalances', *Journal of Political Economy* **117**(3), 371–416.

Moreno-Brid, J. C. (1998), 'Balance of payments constrained economic growth: The case of Mexico', *BNL Quarterly Review* (207), 413–433.

Moreno-Brid, J. C. (2003), 'Capital flows, interest payments and the balance of payments constrained growth model: A theoretical and empirical analysis', *Metroeconomica* **54**(2-3), 346–365.

Pesaran, M. H., Shin, Y. & Smith, R. J. (2001), 'Bounds testing approaches to the analysis of level relationships', *Journal of Applied Econometrics* **16**(3), 289–326.

Reinhart, C. M., Rogoff, K. S. & Savastano, M. A. (2003), 'Debt intolerance', *Brookings Papers on Economic Activity* **34**(1), 1–74.

Schenk, C. (2009), 'The retirement of sterling as a reserve currency after 1945: Lessons for the US dollar?'.

Steiner, A. (2016), *Global imbalances, financial crises, and central bank policies*, Elsevier.

Thirlwall, A. P. (1979), 'The balance of payments constraint as an explanation of the international growth rate differences', *PSL Quarterly Review* **32**(128).

Thirlwall, A. P. (2011), 'Balance of payments constrained growth models: History and overview', *PSL Quarterly Review* (259), 307–351.

Thirlwall, A. P. & Hussain, M. N. (1982), 'The balance of payments constraint, capital flows and growth rate differences between developing countries', *Oxford Economic Papers* **34**(3), 498–510.

Appendices

A Unit Root Test

Table 7: Unit Root Test

	Level				First Difference			
	t	p-value	lag		t	p-value	lag	
m	-2.118	0.525	1	Intercept and Trend	-6.033	0.000*	0	Intercept
y	-2.762	0.217	1	Intercept and Trend	-5.246	0.000*	0	Intercept
tot	-2.953	0.155	1	Intercept and Trend	-6.358	0.000*	0	Intercept
c	-2.267	0.444	1	Intercept and Trend	-4.855	0.000*	0	Intercept
g	-2.125	0.521	1	Intercept and Trend	-4.185	0.002*	0	Intercept

The null hypothesis is that unit root exists.
* indicates significance at 1 % level.

B Lag Order Criteria

Table 8: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	410.29	N/A	6.49E-15	-12.80	-12.56	-12.71
1	1045.14	1108.47	5.49E-23*	-31.40*	-29.50*	-30.65*
2	1092.06	71.50*	6.20E-23	-31.34	-27.76	-29.93
3	1140.35	62.85	7.36E-23	-31.31	-26.07	-29.25
4	1184.00	47.11	1.19E-22	-31.14	-24.24	-28.43
5	1236.31	44.83	1.89E-22	-31.25	-22.68	-27.88

* indicates lag order selected by the criterion.
LR: sequential modified LR test statistic (at 5% level)
FPE: final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

C Structural Break Test

Table 9: Structural Break Test

	Johansen Cointegration LR Test				ARDL F Test		
Restricted Variable	Log-likehood	LR	DF	P-value	F	DF	P-value
d_{08}, $d_{08} \cdot y_t$	1203.72	0.10	2	0.953	2.92	2, 55	0.062
d_{00}, $d_{00} \cdot y_t$	1171.55	64.44	2	0.000*	3.93	2, 55	0.025*

Null hypothesis are both restricted variables are 0.
* indicates significance at 5 % level.

D Johansen Cointegration Test

Table 10: Johansen Cointegration Test

		Trace			Maximum Eigenvalue		
	Eigenvalue	Statistic	Critical	p-value	Statistic	Critical	p-value
None *	0.828	291.96	103.85	0.000	117.75	40.96	0.000
At Most 1 *	0.625	174.22	76.97	0.000	65.71	34.81	0.000
At Most 2 *	0.561	108.51	54.08	0.000	55.11	28.59	0.000
At Most 3 *	0.348	53.39	35.19	0.000	28.69	22.30	0.006
At Most 4 *	0.220	24.71	20.26	0.011	16.65	15.89	0.038
At Most 5	0.113	8.06	9.16	0.081	8.06	9.16	0.081

H_0: at most i cointegration equations exist for the i^{th} test.
All critical values are taken at 5 % level.
* denotes rejection of the hypothesis at 5 % level.

E ARDL Bound Test

Table 11: ARDL Bound Test

	Value	k	I(0)	I(1)
F	10.29	2	5.15	6.36

k is the number of elements in cointegration vector.
I(0) is the lower bound for unrestricted intercept and no trend at 1 % level.
I(1) is the upper bound for unrestricted intercept and no trend at 1 % level.