Investigating the Determinants of the Trade Balance: The Case of the UK

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Summary

This paper examines the drivers of the trade balance in the United Kingdom by applying the innovative dynamic ARDL model, which offers the advantage of simultaneously identifying both short- and long-run interconnectedness. The endogenous variable is the trade balance, while the exogenous variables are the home country's GDP (UK), the foreign country's GDP (USA), FDI inflows, the exchange rate, and government expenditure. The existence of a long-run relationship between trade balance and the independent variables is confirmed through the ARDL approach-based bounds and Bayer–Hanch cointegration tests. There is a significant impact in the long-run for all variables. Except for the home GDP and exchange rate variables, there is a positive contribution of foreign GDP, government expenditures, and FDI to the trade balance in the long run. However, the home GDP and exchange rate have a positive and significant impact on the trade balance in the short run. Based on the outcomes of our study, we can suggest that to finance its current (and capital) account deficit, it is essential to increase the foreign exchange reserves and make new investments in the UK. The government designs and implements policies in a way that attracts net financial inflows to the country while improving the terms of trade through foreign direct investment. However, export-oriented production would stimulate both the home GDP and foreign exchange reserves.

Keywords: Trade Balance; Foreign direct investment; UK; Dynamic ARDL; USA

JEL Codes: F10, F20, C32

1. Introduction

The balance of trade and the balance of payments are key economic indicators that reflect a country's reputation and standing in the international economic and

financial landscape, as well as its competitiveness in the global economy. Factors that affect imports and exports asymmetrically can significantly influence the balance.

Over the past two decades, the globalization movement has removed trade barriers between countries and pushed countries to implement new strategies. The World Trade Organisation (WTO) (2018) states that the 2030 Agenda emphasises the role of trade in promoting sustainable development and acknowledges the WTO's potential contribution to this goal.

This paper aims to examine the determinants of the UK's trade balance and explore the interconnections between endogenous and exogenous variables in both the short and long run. These relationships are evaluated using the innovative dynamic ARDL model. Unlike the conventional ARDL approach recommended by Pesaran et al. (2001), which can only identify short- and long-run interconnectedness, we employ the dynamic ARDL method using STATA codes developed by Jordan and Philips (2018). This approach captures both short- and long-run associations and plots both positive and negative changes in the independent variables. The significance of the study stems from the fact that, the interconnections between endogenous and exogenous variables, both in the short and long run, determining the trade balance in the UK have not been studied to the best of authors' knowledge and identifying the elements that contribute to the trade balance is crucial for formulating effective trade policy and promoting long-term economic prosperity.

2. Literature Review

Analysing the causes of the trade deficit and reducing it is a subject that preoccupies the economics literature. There are two main approaches to studying real devaluation on a country's trade balance: the elasticities and the balance of trade approaches. Questions such as how and to what extent changes in the value of the national currency in terms of foreign currencies will affect the foreign trade balance have been a topic of discussion among academics for many years. Studies analysing the determinants of foreign trade have focused on evaluating the effects of exchange rate appreciation on current accounts. Marshall-Lerner's (Robinson) condition states that if the sum of the absolute values of foreign demand and domestic price elasticities for imports is greater than one, the depreciation or devaluation of the country's currency will improve the current account balance, provided that the trade balance is initially zero. The fact that many countries in the world have foreign trade relations and that countless goods are subject to foreign trade makes it impossible to explain such a complex activity with a few theories and approaches. For this reason, numerous hypotheses have been proposed, and theories have been developed to explain foreign trade, particularly after the Second World War.

According to Prasad and Gable (1998), globalisation has been a subject of intense focus for both academic and policy circles, reflecting the world's growing integration through financial and trade flows. As international trade plays a significant role in economic growth, the trade balance contributes substantially to a country's national accounts through positive net exports (Kuznets, 1967; Myint, 1977; Singh, 2002; Lynn, 2014). Although the subject of the short-term, medium-term, and long-term determinants of trade movements affecting the trade balance has been investigated in the literature, the negative implications of a persistent trade deficit on

economic performance are challenged (Cristanto & Bowo, 2021; Tarawalie & Kpana, 2022). Narayan and Narayan (2004) investigated the effect of the changes in the real exchange rate on the trade balance in Zealand's economy through the cointegration method and (Yamak & Korkmaz (2005) investigated the changes in the real exchange rate on the trade balance in Turkey using Granger causality test and VAR model-based impulse response analysis and, both studies found no correlation between the variables in the long run.

Even though there have been several studies investigating the main determinants of the trade balance, the results obtained showed varying outcomes, depending on the period under consideration, the independent variables included in empirical analysis, the sources from which the data is gathered, and the estimation techniques employed (Caporale et al., 2015; Kieu et al., 2020; Wahyudi & Sari, 2020; Cristanto & Bowo, 2021). Most studies in the literature investigate the impact of the real exchange rate as a core determinant of trade balance by testing the Marshall-Lerner condition and the J-curve hypothesis. Marshall-Lerner condition demonstrates that the devaluation of the domestic currency improves the country's trade balance if the sum of the price elasticities of exports and imports are greater than 1 (Wu, 2020), while the J-curve hypothesis states that devaluation of the domestic currency worsens the trade balance initially, and improves eventually generating a tilted J-shape (Magee, 1973). In an empirical study, Turkay (2014) calculated Turkey's M-L condition and determined that it is only effective in the long term. Bahmani-Oskooee and Ratha (2004) and Bahmani-Oskooee and Hegerty (2010) explored that export diversification and import composition are critical in determining the effect of the J-curve. Thus, they assumed that the impact of exchange rate changes on the trade balance is symmetric, indicating that while depreciation improves the trade balance, appreciation harms it. On the other hand, Bahmani-Oskooee and Fariditavana (2015) revisited the J-curve using both linear and nonlinear adjustment processes using an ARDL method to test whether exchange rate changes have symmetric or asymmetric effects on the trade balance. Findings suggest effects are asymmetric.

As evidenced above, the outcomes of those studies show contrasting results, which leaves an inconclusive demonstration of the determinants of the trade balance. Thus, the number of empirical studies investigating the determinants of the trade balance has been increasing in the literature. Several macroeconomic indicators have been proven to impact the trade balance, including domestic income, foreign income, real exchange rate, foreign direct investment, money supply, consumption expenditure, and government expenditure. Nevertheless, the results remain inconclusive regarding the impact of those macroeconomic indicators on the trade balance.

In the related literature, the main macroeconomic determinants of the trade balance are generally accepted to be the real exchange rate, domestic income, and foreign income. Considering real exchange rate as one of the macroeconomic indicators of trade balance, some studies confirmed the positive impact of domestic currency depreciation on trade balance (Lal & Lowinger, 2002; Yol & Baharumshah, 2007; Ng et al., 2008; Kakar et al., 2010; Igue & Ogunleye, 2014; Lucy et al., 2015; Caporale et al., 2015; Keho, 2021; Hunegnaw & Kim, 2017), while some studies fail

to confirm the long-run impact of real exchange rate on trade balance (Duasa, 2007; Yol & Baharumshah, 2007; Akpansung & Babalola, 2013; Hunegnaw & Kim, 2017; Shawa & Shen, 2013), whereas there are also some studies approving the negative impact of real exchange rate depreciation on trade balance (Yol & Baharumshah, 2007; Genemo, 2017; Shahbaz et al., 2011) depending on the country, econometric technique, economic model and time frame under consideration.

There are studies in the literature confirming the positive impact of domestic income on trade balance (Lal & Lowinger, 2002; Duasa, 2007; Baek, 2007), while some studies approve adverse effect of domestic income on trade balance (Wu, 2020; Akpansung & Babalola, 2013). The positive impact of domestic income on the trade balance is attributed to the promotion of exports resulting from an increase in domestic income, while the negative impact is due to a possible rise in imports (Hurley & Papanikolaou, 2018; Narayan & Narayan, 2004). The effect of domestic income on trade balance varies in the literature. Furthermore, in the same study investigating panel analysis for selected countries, the outcome varies according to different locations. For example, in the panel study of Yol and Baharumshah (2007) investigating the bilateral trade balance between the US and 10 African countries, there is positive impact of domestic income on the trade balance is confirmed in the case of Morocco, Uganda, and Tunisia, while the negative impact is approved for the case of Egypt, Ghana, Tanzania, and Kenya, whereas there is no significant effect of domestic income estimated for the case of other three countries which are Botswana, Senegal, and Nigeria.

Several studies in related literature approve the positive impact of foreign income on trade balance (Lal & Lowinger, 2002; Wu, 2020; Akpansung & Babalola, 2013; Shawa & Shen, 2013), while some studies assert the negative impact of foreign impact on trade balance (Ng et al., 2008; Dongfack & Ouyang, 2019), whereas there are also studies failing to approve significant impact of foreign income on trade balance (Yol & Baharumshah, 2007). The direction of the effect of foreign income on the trade balance is evident when an increase in foreign income stimulates demand for domestic goods, thereby increasing exports. In contrast, the trade balance is negatively affected by foreign income if the increase in foreign income stimulates domestic demand for foreign goods, thereby increasing imports (Hurley & Papanikolaou, 2018; Narayan & Narayan, 2004; Keho, 2021). Keho (2021) investigated the determinants of trade balance in the West African Economic and Monetary Union (WAEMU), which includes seven countries: Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Senegal, and Togo. According to the findings, foreign income hurts the trade balance in Benin, Burkina Faso, Mali, Niger, and Senegal. At the same time, there is no significant impact of foreign income approved for the case of Côte d'Ivoire and Togo. According to the findings of Yol & Baharumshah (2007), the trade balance improves through increased foreign income in Senegal, Tunisia, and Uganda, while it worsens in Egypt and Ghana. In contrast, no significant impact of foreign income on the trade balance is confirmed in the case of Morocco, Tanzania, Kenya, Botswana, and Nigeria.

Recent studies in the literature have included further macroeconomic variables in the economic model to address the omitted variable problem. Foreign direct investment (FDI) is one of those macroeconomic indicators that is considered a control

variable in various studies in the related literature, as the impact of FDI on trade remains inconclusive. On the one hand, FDI might have a positive impact on exports and thus on trade balance through increasing economic growth as a result of technology transfers, creation of jobs, and capital accumulation, while on the other, FDI might lead to a negative impact on imports thus on trade balance for example as a result of increased demand for imports. Shawa and Shen (2013) confirm that FDI has a positive impact on the trade balance in Tanzania, in line with the studies of Osoro (2013) for Kenya and Keho (2020) for Côte d'Ivoire. According to the study by De Mello (1997), the impact of FDI on the trade balance is more substantial in Southeast Asian countries than in Latin American economies. On the other hand, studies in the literature also assert the negative impact of FDI on the trade balance (Nga, 2020; Hailu, 2010; Tran & Dinh, 2014). Moreover, there are also studies stating the neutrality of FDI to trade balance (Lin, 1995). As the studies in the literature yield different outcomes, it is not possible to draw an inference about the impact of FDI on the trade balance, which underscores the importance of including FDI in the empirical analysis as a control variable when investigating the determinants of the trade balance. In addition, according to economic theory, government expenditures influence the trade balance position through the S-I identity, where S represents private savings and I represents private investment. However, trade balance (TB) is expressed by the sum of private and government savings. This explains the relationship between government expenditures and the trade balance. The theoretical link between TB and public and/or private expenditures is that increasing government expenditures and investments would deteriorate TB (Harberger, 1950; Meade, 1951). However, some studies have found a positive impact of government expenditure on the trade balance (Saruni, 2007; Nienga, 2010; Akoto & Sakyi, 2019). Thus, another vital macroeconomic indicator included in the empirical analysis is government expenditure, which is used to investigate the determinants of the trade balance, as it has considerable importance for developing fiscal policies related to government purchases.

As mentioned in the literature review, several studies have displayed the effects of various variables separately on different time scales, using differentiated methods; however, the nature of the determinants of the trade balance remains an open empirical issue. This paper contributes to the related literature by re-examining the determinants of the UK's trade balance, employing the most recent developed econometric techniques and selecting macroeconomic variables that have not been applied jointly previously, to the best of the authors' knowledge.

3. Data and Methods

3.1 Data

This paper assesses the drivers of the trade balance in the United Kingdom. The endogenous variable is the trade balance, and the exogenous variables are home country GDP, foreign country GDP, FDI inflows, exchange rate, and government expenditure on the trade balance in the United Kingdom (UK) using yearly data spanning between 1979 and 2020, all sourced from the World Bank database (World Bank, 2022). The trade balance (TB) is measured by dividing the export of goods and services by the import of goods and services in the home country, both measured in

constant 2015 US$. The economic growth of both the home country (the UK) and the foreign country (the USA) is approximated using real GDP, measured in constant 2015 US$ to eliminate the inflation effect of nominal GDP. The real effective exchange rate index (2010=100) is used to represent the exchange rate used for the empirical analysis. FDI inflows is selected as net inflows (BoP, current US$. Government expenditure refers to the general government's final consumption expenditure (in constant 2015 US$). Table 1 presents the data source, measurement, and units. Moreover, variables are transformed into their natural logarithms to ensure that the data conform to normality. This paper adopts the trade balance model based on the theoretical framework explained in our theoretical literature review, so the functional form of the economic model of the paper is presented as follows:

$$TB_t = f(GDPH_t, GDPF_t, FDI_t, EXCH_t, GE_t) \quad (1)$$

Table 1: Description of Variables

Variables	Sign	Measurement	Source
Trade Balance	TB	Exports of goods and services (constant 2015 US$)/ Imports of goods and services (constant 2015 US$)	World Bank
Economic Growth Home	GDPH	GDP (constant 2015 US$)	World Bank
Economic Growth Foreign	GDPF	GDP (constant 2015 US$)	World Bank
Exchange Rate	EXCH	Real effective exchange rate index (2010 = 100)	WDI
Foreign Direct Investment	FDI	Foreign direct investment, net inflows (BoP, current US$)	World Bank
Government Expenditure	GE	General government final consumption expenditure (constant 2015 US$)	World Bank

The descriptive statistics of the variables used for the empirical analysis are provided in Table 2, given below.

Table 2. Descriptive Statistics

	TB	GDPH	GDPF	EXCH	FDI	GE
Mean	1.075693	2.23E+12	1.31E+13	116.809	6.47E+10	4.45E+11
Median	1.037655	2.27E+12	1.35E+13	119.075	3.17E+10	4.14E+11
Maximum	1.323478	3.19E+12	2.00E+13	143.820	3.25E+11	6.06E+11
Minimum	0.944426	1.34E+12	7.08E+12	97.0800	-2.51E+10	3.26E+11
Std. Dev.	0.108017	5.78E+11	4.08E+12	12.6356	8.00E+10	9.60E+10

Skewness	0.670129	-0.044640	0.019737	0.05028	1.674683	0.249494
Kurtosis	2.244919	1.679772	1.674123	2.04948	5.033775	1.408116
J-Bera	4.141262	3.064201	3.079137	1.59878	26.8703**	4.870399*
Probability	0.126106	0.216081	0.214474	0.44960	0.000001	0.087580

Note: the 5% and 10% statistical significance levels are denoted by ** and *, respectively. The Jarque-Bera test represents the normality test.

Table 2 presents an initial overview of the distribution and central tendencies of the variables considered for this study. The mean values indicate the average level of each variable, where GDPF exhibits the highest scale, reflecting the size of the foreign economy, specifically the USA. The TB exhibits moderate variability, with a standard deviation of 0.108, indicating relatively stable trade performance. Both GDPH and GDPF are characterised by high standard deviations, indicating considerable fluctuations in economic output. High standard deviations, indicative of significant volatility in economic production, characterise GDPH and GDPF. FDI shows a strong right-skewed distribution (skewness = 1.67) and high kurtosis (5.03), indicating a leptokurtic distribution and the presence of outliers or extreme values, which may reflect volatile investment patterns. The Jarque-Bera test confirms that FDI and GE deviate from normality at the 5% and 10% significance levels, respectively. The remaining variables are verified to be normally distributed.

3.2 Methodology

Using non-stationary data for the econometric analysis creates a spurious regression problem (Granger and Newbold, 1974). Thus, the stationarity test is the first step in econometric analysis. Therefore, to test for the level of integration of the variables, the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Zivot-Andrews unit root tests, developed by Zivot and Andrews (1992) to capture a single structural break, are applied. When using the ARDL bounds test, I(1) or I(1) or both I(1) and I(0) are utilized; however, the I(2) series is not permitted. Furthermore, the dependent variable must be I(1) before the ARDL testing is initiated. The further advantage of the Bounds test is that it provides relatively more robust results for small sample case analysis (Narayan and Narayan, 2005) and unbiased estimates for long-run models (Harris, 2003). Since it is estimated that the series are integrated at mix order as either I(0) or I(1), and the dependent variable is estimated to be I(1), the ARDL-based bounds test developed by Pesaran et al. (2001) to test for the long run co-integration among the variables is employed. Equation 2 represents the ARDL-based bounds test for cointegration as follows:

$$\begin{aligned}\Delta TB_t = \delta_1 + \sum_{i=1}^{a} \beta_1 \Delta TB_{t-1} + \sum_{i=1}^{b} \beta_2 \Delta GDPH_{t-i} + \sum_{i=1}^{c} \beta_3 \Delta GDPF_{t-i} + \sum_{i=1}^{d} \beta_4 \Delta FDI_{t-i} \\ + \sum_{i=1}^{e} \beta_5 \Delta EXCH_{t-i} + \sum_{i=1}^{e} \beta_6 \Delta GE_{t-i} + \gamma_1 TB_{t-1} + \gamma_2 GDPH_{t-1} \\ + \gamma_3 GDPF_{t-1} + \gamma_4 FDI_{t-1} + \gamma_5 EXCH_{t-1} + \gamma_6 GE_{t-1} \\ + \varepsilon_t \qquad (2)\end{aligned}$$

where Δ and δ_1 stand for the difference operator and intercept. Moreover, a, b, c, d, e, and f depict the optimal lag, $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ and β_6 represent the short-run

coefficients, $\gamma_1, \gamma_2, \gamma_3, \gamma_4, \gamma_5,$ and γ_6 denote the long-run coefficients, and ε_t represents the error term. Furthermore, null and alternative hypotheses are given below as follows:

$H_0: \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = \gamma_6 = 0.$

$H_a: \gamma_1 \neq \gamma_2 \neq \gamma_3 \neq \gamma_4 \neq \gamma_5 \neq \gamma_6 \neq 0.$

The bounds test follows an F-distribution where the critical values are elaborated by Pesaran and Timmermann (2005) and Narayan and Narayan (2005). The null hypothesis stating that no long-run relationship exists between variables is rejected if the F-statistic estimated exceeds the upper critical value and not rejected if the F-statistic is estimated to be below the lower bound of essential importance. If the estimated F-statistic falls between the upper and lower bounds of critical values, the test results remain inconclusive.

In ARDL modelling, complex specifications such as first differences, lagged differences of variables, and different lag structures are prevalent. To put that another way, utilising an ARDL model with first differences and different lag lengths, determining the long and short-run impacts of exogenous variables on the dependent variable is challenging. As a result, Jordan and Philips (2018) introduced dynamic ARDL, which incorporates a dynamic ECM, to mitigate this issue. The dynamic ARDL provides several advantages for the empirical analysis of the relationship between economic variables. One of the main advantages of the dynamic ARDL is the ability to generate a more accurate representation of the relationships between the time series variables that are stationary at level, I(0), at first difference, I(1), or a combination of both. Furthermore, the dynamic ARDL model enables the simultaneous investigation of both short-run and long-run relationships, which is crucial for this study to understand the immediate and long-term effects of the selected variables on the UK's trade balance.

Moreover, the dynamic ARDL model includes lagged dependent variables to control for potential endogeneity issues, accounting for potential feedback effects, and ensuring reliable results. In addition, the dynamic ARDL is relatively robust to misspecifications. In essence, the flexibility in handling mixed integrated variables, the ability to capture both short-run and long-run dynamics, and the robustness of the dynamic ARDL make it an ideal method for examining how the selected variables affect the UK's trade balance. In other words, all things being equal, this technique allows for the visual and quantitative investigation of the effect of positive (or negative) changes in exogenous variables on the dependent variable. Therefore, the dynamic ARDL framework offers a one-to-one evaluation of the association between endogenous and exogenous variables.

The dynamic ARDL model framework with ECM is depicted as follows.

$$\Delta TB_t = \theta_0 + \pi_0 TB_{t-1} + \tau_1 \Delta GDPH_t + \pi_1 GDPH_{t-1} + \tau_2 \Delta GDPF_t + \pi_2 GDPF_{t-1} + \tau_3 \Delta FDI_t + \pi_3 FDI_{t-1} + \tau_4 \Delta EXCH_t + \pi_4 EXCH_{t-1} + \tau_5 \Delta GE_t + \pi_5 GE_{t-1} + \vartheta ECT_{t-1} + \mu_t \quad (3)$$

where; the constant term is illustrated by θ_0, coefficient of error correction term is shown by $\pi_0, \tau_1, \tau_2, \tau_3, \tau_4$, and τ_5 illustrates short-term coefficients. The coefficients of the long-run are illustrated by $\pi_1, \pi_2, \pi_3, \pi_4,$ and $\pi_5,$ and μ_t depicts the error term.

After determining the long- and short-run impacts of exogenous variables on the dependent variable, diagnostic tests for the estimation model, such as serial correlation, model misspecification, heteroscedasticity, and normality, are conducted. Moreover, CUSUM and CUSUM-SQ tests are used to verify the stability of the long-run coefficient.

Finally, a frequency-domain causality approach is employed to examine the causal impact of explanatory variables on the UK trade balance at various frequencies. Hence, the frequency domain causality test developed by Breitung & Candelon (2006) is applied, as it allows for the evaluation of the range of a particular variation in the series.

Figure 1, provided below, illustrates the summary of the theoretical framework of the study.

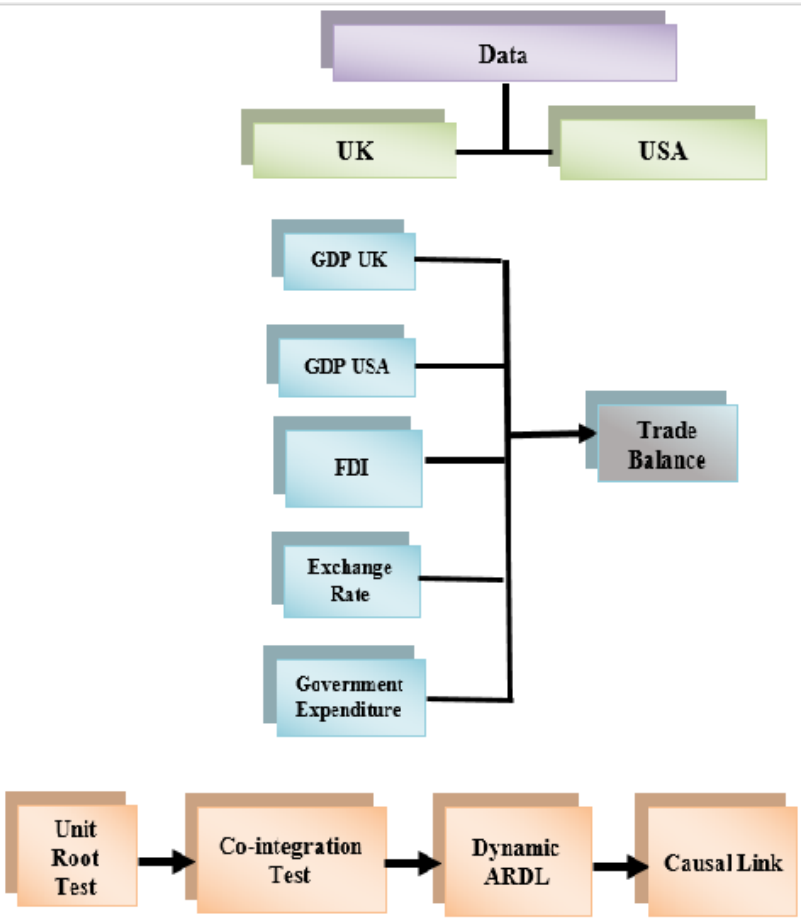


Figure 1: Theoretical Framework

4. Results and Discussion

Prior to the primary empirical investigation, it is vital to identify the variables' order of integration. In doing so, traditional unit root tests (ADF and PP) and ZA, which can detect both unit roots and single breaks, were employed. Table 3 presents the ADF and PP outcomes, and the results disclosed that all the variables are *I*(1) variables. Moreover, the ZA results show that all the variables are *I*(1) except FDI, which is stationary at the level. Additionally, we examine the lag selection criteria using the FPE, LR, SC, HQ, and AIC tests. The results of these experiments indicate that lag 1 is the most appropriate (see Table 4).

Table 3: Unit Root test outcomes

	ADF		PP		ZA			
	Level	Δ	Level	Δ	Level	Break	Δ	Break
TB	-2.8696	-5.1620*	-2.2428	-5.3245*	-3.5490	2001	-6.6419*	2003
GDPF,	-0.1422	-4.3371*	-0.4731	-3.8264**	-4.8953	2005	-5.8624*	2005
GDPH	-2.4083	3.9132*	-2.5597	4.0132*	-3.4684	2008	-6.0071*	2012
FDI	-2.3107	-8.2215*	-2.3380	-11.916*	-5.1108**	2009		
GE	-1.0433	-3.4785***	-1.5608	-3.7536**	-3.8101	2014	-6.2953*	2012
EXCH	-3.1007	-5.5596*	-2.7290	-5.4418*	4.3065	1997	-6.8202*	1997

Note: **, ** and ** denotes 1%, 5% and 10% significance level

Table 4: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	224.8692	NA	5.38e-13	-11.22406	-10.96813	-11.13224
1	453.0912	374.5181*	2.88e-17*	-21.08160	-19.29007*	-20.43881*
2	485.9912	43.86670	3.87e-17	-20.92262	-17.59550	-19.72888
3	532.5611	47.76405	3.30e-17	-21.46467*	-16.60195	-19.71997

Note: **, ** and ** denotes 1%, 5% and 10% significance level

To investigate the existence of a long-run relationship between trade balance and the independent variables (GDPF, GDPH, FDI, GE, and EXCH) in the UK, the ARDL approach-based bounds test is utilized. Table 5 below represents the test results which confirm the existence of a long-run relationship between the variables under consideration. To validate the ARDL approach-based bounds test, we utilized the Bayer–Hanch cointegration test, and the outcome validates the ARDL approach-based bounds test (see Table 6).

Table 5: ARDL bound cointegration test

ARDL Bounds test	
Null Hypothesis: No levels relationship	
Model estimation	TB = *f*(GDPF, GDPH, FDI, GE, EXCH)
F-statistics	4.4835**

Note: ** denotes 5% significance level

Table 6 below represents the test results of Bayer–Hanch cointegration, which confirms the existence of a long-run relationship supporting the results obtained from the ARDL approach-based bounds test.

Table 6: Bayer–Hanch Outcomes

	Fisher statistics	Fisher statistics	Cointegration decision
	EG-JOH	EG-JOH-BAN-BOS	Yes
TB = f(GDPF, GDPH, FDI, GE, EXCH)	26.739	36.729	
	Critical value	Critical value	
	10.576	20.143	

In Table 7, dynamic ARDL results are presented. The correct lag structures are applied to our exogenous variables to determine the long and short-run impacts of exogenous variables on the dependent variable. The results indicate a significant long-term effect for all variables, except for the GDP home and exchange rate variables. There is a positive contribution of foreign GDP, government expenditures, and FDI to the trade balance in the long run. However, the home GDP and exchange rate have a positive and significant impact on the trade balance in the short run, at 5 per cent and 10 per cent, respectively.

Table 7: Dynamic ARDL Results

	Coefficients	Std. Error	t-statistics	P-values
$GDPH_{t-1}$	-1.6767*	0.5843	-2.870	0.008
ΔGDP	-1.0567**	0.4060	-2.600	0.014
$GDPF_{t-1}$	1.1361**	0.4408	2.580	0.015
$\Delta GDPF$	0.3239	0.4290	0.750	0.456
FDI_{t-1}	0.5123*	0.0076	3.690	0.000
ΔFDI	0.0027	0.0062	0.440	0.661
GE_{t-1}	0.0875*	0.1090	0.800	0.000
ΔGE	0.2861	0.4477	3.640	0.528
$EXCH_{t-1}$	-0.1294**	0.0828	2.560	0.018
$\Delta EXCH$	0.0735***	0.0949	1.970	0.078
ECT(-1)	-0.520804	0.14147	-3.680	0.001

Note: Δ depicts short-run. *P<1%, **P<5% and ***P<10%

Table 8 below presents the test results for diagnostic checks of normality, serial correlation, heteroscedasticity, and model misspecification, respectively. The test results confirmed that the ARDL model is not suffering from normality, serial correlation, heteroscedasticity, or misspecification problems. Furthermore, the test results of Cusum and Cusumsq, illustrated in Figure 2 below, confirm the model's stability over the period under consideration at a 5% significance level.

Table 8: Diagnostic test for ARDL model

J–B normality test (Prob-value)	1.284 (0.643)
Breusch–Godfrey LM test (Prob-value)	0.689 (0.580)
Breusch-Pagan Heteroskedasticity test (Prob-value)	0.704 (0.822)
Ramsey RESET (Prob-value)	0.819 (0.739)

Note: 1%, 5% and 10% levels of significant are denoted as $*$, $**$ and *** respectively

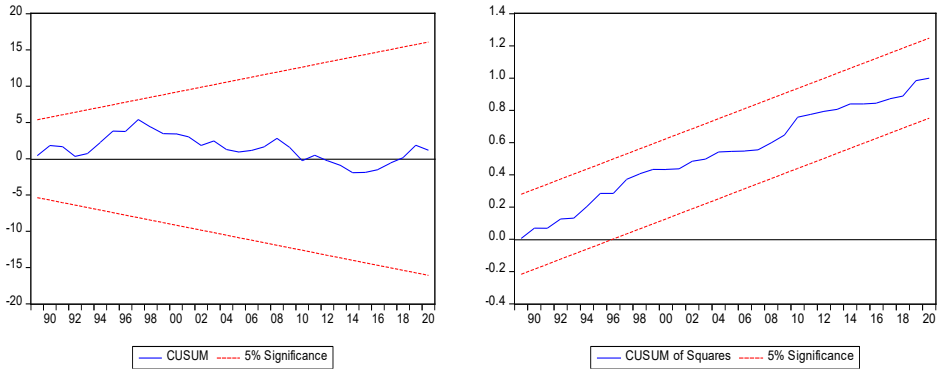
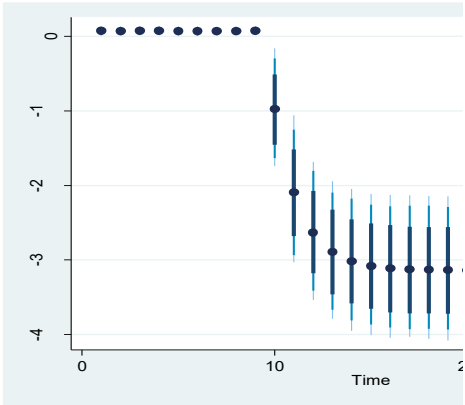


Figure 2: Stability Test

After estimating the short- and long-run impacts of the trade balance determinants and verifying the model's diagnostic and stability, the next stage is to examine the trade balance's reaction to a counterfactual change in a single macroeconomic variable while keeping the other indicators constant at a particular moment in time. Figure 3 (a-e) displays the graphs generated by running 5,000 simulations for the parameter vector in the dynamic ARDL technique, as specified below. These plots illustrate the shift in the trade balance resulting from a shock of ±1% in the exogenous variable. Figure 3a shows that a +1% shift to GDPH decreases the trade balance, whilst a −1% change in GDPH expands the trade balance. Figure 3b illustrates that the negative and positive shifts in GDPF result in reduced and increased trade balances. Figure 3c shows that a +1% shift to FDI increases the trade balance, whilst a -1% change in FDI decreases the trade balance. Furthermore, a 1% positive shift in the exchange rate intensifies the trade balance, while a negative change in the exchange rate reduces it (see Figure 3d). Lastly, a +1% shift in government expenditure increases the trade balance, whilst a −1% change in government expenditure decreases the trade balance (see Figure 3e). According to the dynamic ARDL diagrams, government expenditure, foreign growth, and foreign direct investment increase the trade balance, while the exchange rate and economic growth at home decrease the trade balance.



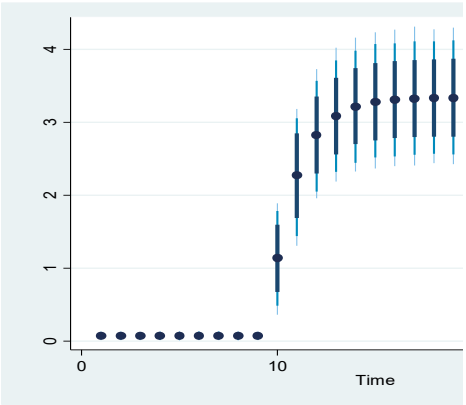
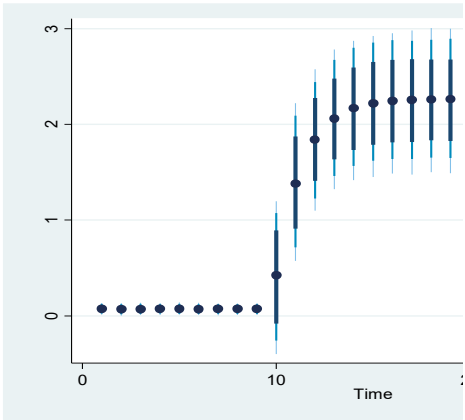


Figure 3a: (±1%) changes in predicted GDPH and its impact on Trade Balance.



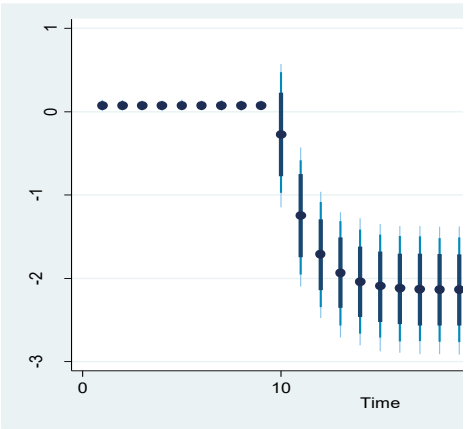
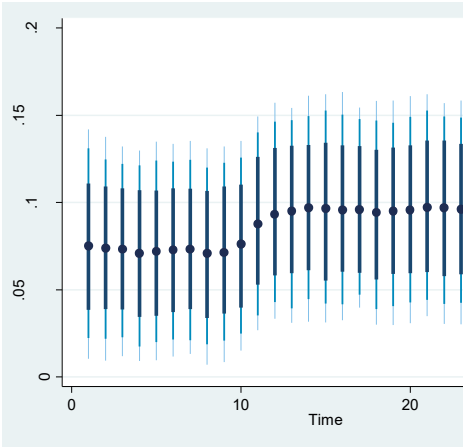


Figure 3b: (±1%) changes in predicted GDPF and its impact on Trade Balance



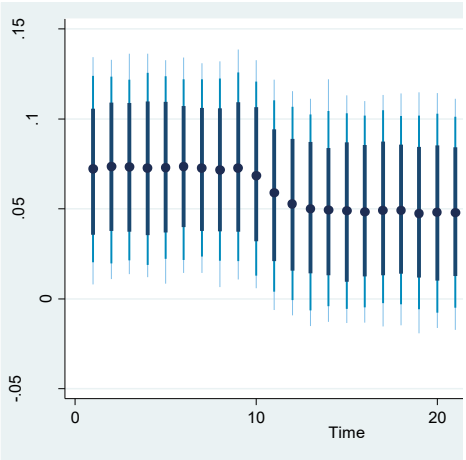
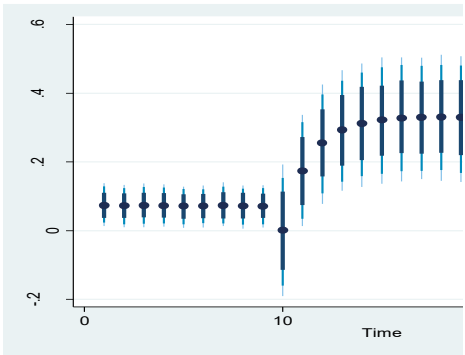


Figure 3c: (±1%) changes in predicted FDI and its impact on Trade Balance



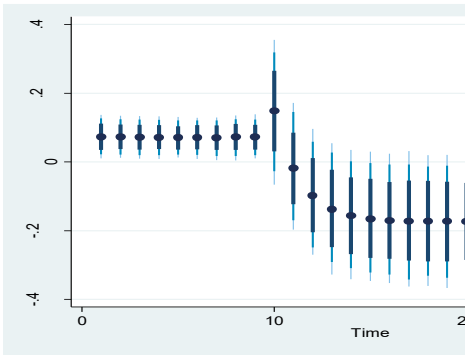
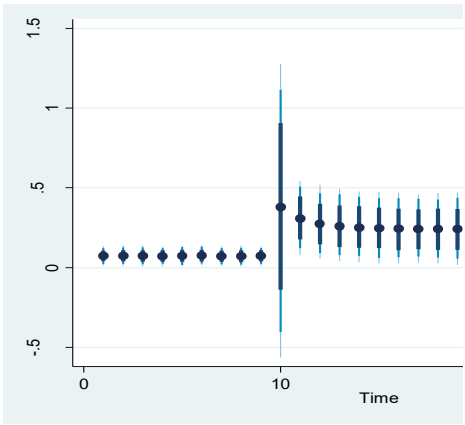


Figure 3d: (±1%) changes in predicted EXCH and its impact on Trade Balance



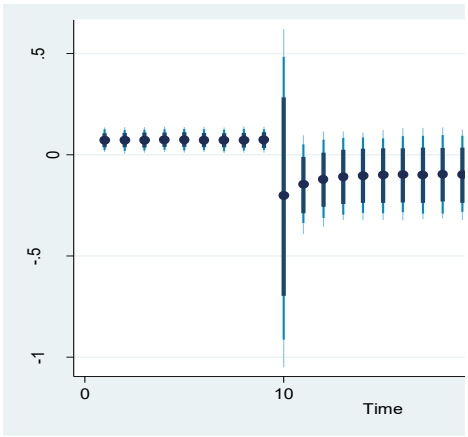


Figure 3e: (±1%) changes in predicted GE and its impact on Trade Balance

To identify short, medium, and long-term causal interrelationships from the exogenous variables to the dependent variable, we utilised the Breitung & Candelon (2006) test. Unlike other causality tests, this test can identify causality at various frequencies. Moreover, 0-1, 1-2, and 2-3 stand for long, medium, and short-term causality, respectively. Figure 3 (a-e) presents the causality results. Figure 4a offers causality from GDPH to TB. In the long-term, the null hypothesis of "no causality" is refuted at 5% and 10% significance levels, respectively. Therefore, GDPH can forecast TB in the long-term but not in the medium and short-term. Similar causality flows from GDPF to TB in the long and medium term (See Figure 4b). Therefore, in the long-term and medium term, the null hypothesis of "no causality" is refuted at 5% and 10% levels of significance, respectively. Therefore, GDPF can forecast TB in the long-term and medium-term, but not in the short term. Figure 4c presents causality from FDI to TB. In the long-term, the null hypothesis of "no causality" is refuted at 5% and 10% levels of significance, respectively. Therefore, GE can forecast TB in the long-term but not in the medium and short-term. Figure 4d presents causality from GE to TB. In the long-term, the null hypothesis of "no causality" is refuted at 5% and 10% levels of significance, respectively. Therefore, GE can forecast TB in the long-term but not in the medium and short-term. Lastly, Figure 4e presents causality from EXCH to TB. In the long-term, medium and short-term, the null hypothesis of "no causality" is dismissed at 5% and 10% levels of significance, respectively. Therefore, EXCH can forecast TB in the long-term, medium and short-term.

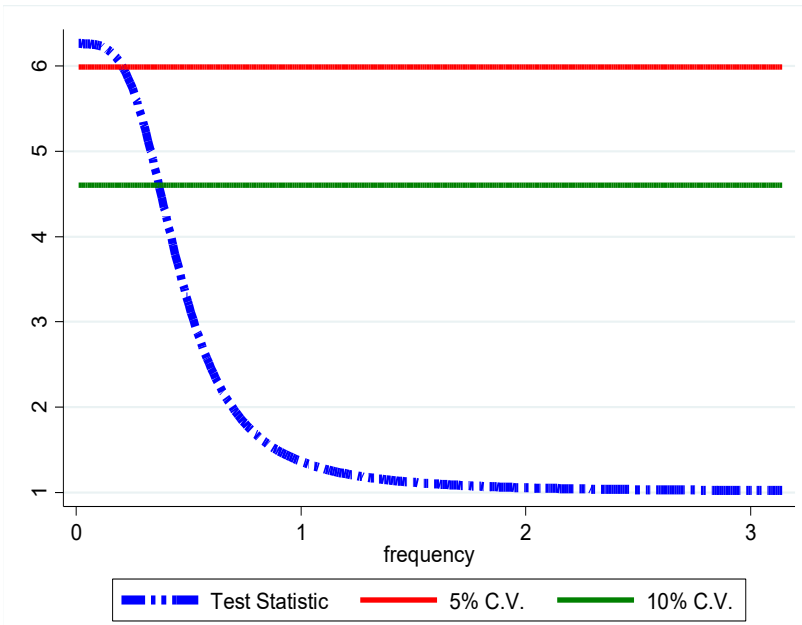


Figure 4a: Causality from GDPH to TB

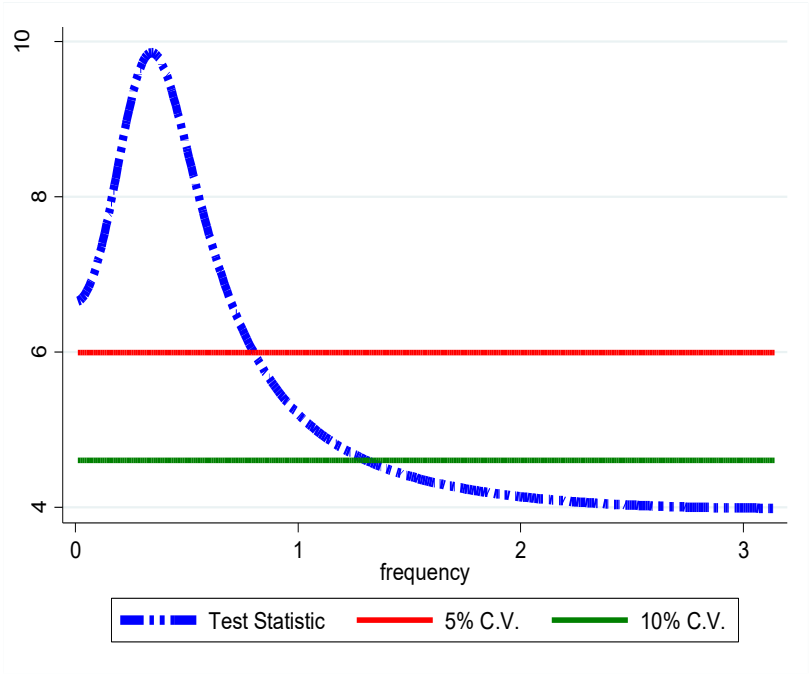


Figure 4b: Causality from GDPF to TB

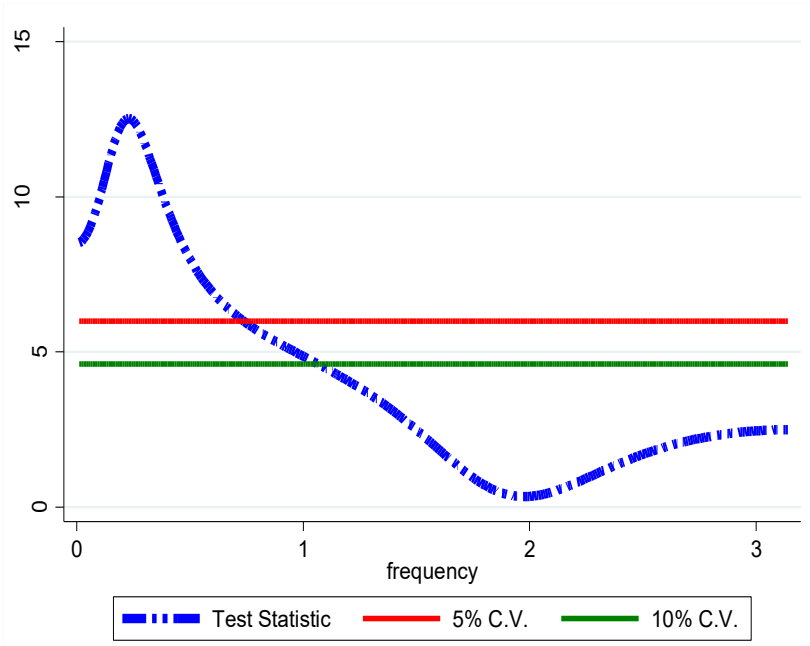


Figure 4c: Causality from FDI to TB

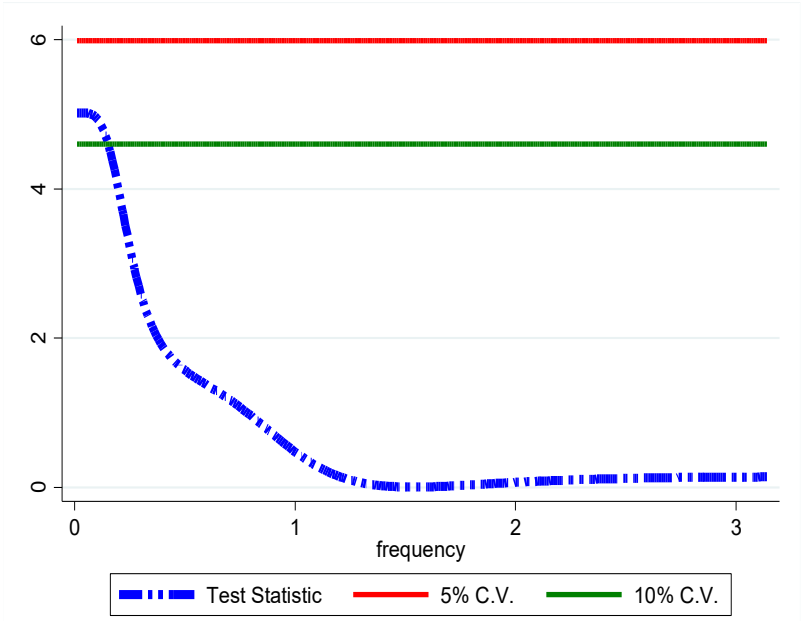


Figure 4d: Causality from GE to TB

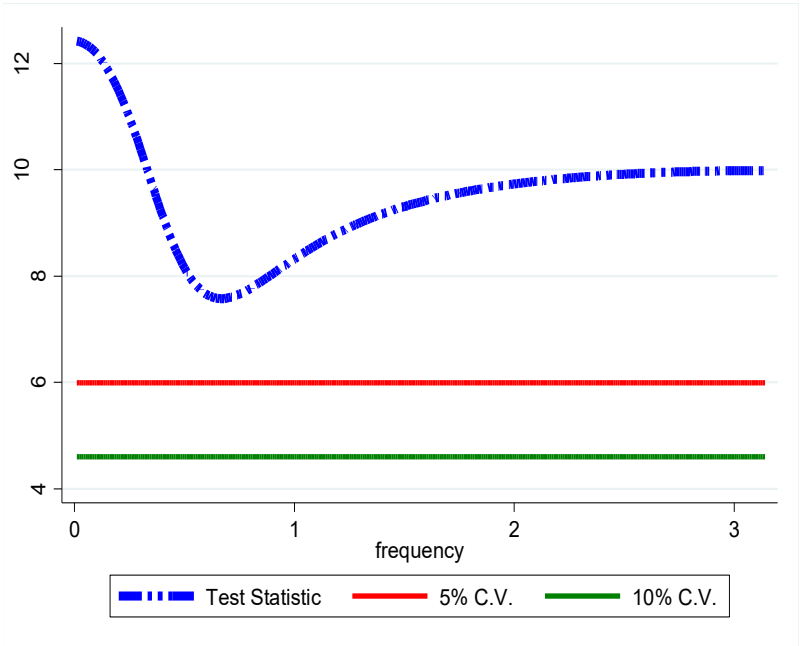


Figure 4e: Causality from EXCH to TB

5. Conclusion and Policy Recommendations

In our study, a method that has not been previously employed in the literature for the UK was used to determine the determinants of the UK's trade balance and investigate the extent to which these determinants affect the foreign trade balance across different periods. With the UK leaving the EU, the regulations on how the UK trades with the EU and the rest of the world have also changed. For example, changes in the way the data are recorded when the EU imports from the UK also affect foreign trade and current accounts. In addition, changes in the sample framework for foreign direct investment (FDI) statistics may introduce uncertainty in the FDI inflow data. However, during the transition period, negative developments, including the impact of the COVID-19 pandemic, global recession, volatile energy prices, the Russia-Ukraine war, labour supply shortages, and increased input costs, negatively affected the UK's trade balance in the short term. Still, it is not possible to distinguish which of these mixed factors are the medium and/or long-term factors to determine the trade balance in the UK. However, it is challenging to identify the factors that affect the trade balance in the medium and long-term, or to evaluate the extent to which long-term supply chain arrangements are reflected in recent developments. In this context, the method we used in our research, covering the period from 1979 to 2020, not only determines the factors influencing the trade balance in the UK but also reveals the extent of the short-, medium-, and long-term relationships between the factors that determine the trade balance. From the various traditional tests performed in the methodology section, our results reveal that the GDP of the foreign country significantly determines the trade balance in the UK, and a long-run positive relationship exists between the trade balance of the UK and the GDP of the foreign country with which the UK trades. On the other hand, our test results reveal that the trade balance of the UK deteriorates with its GDP in the long run, and our outcome is similar (Wu, 2020; Akpansung and Babalola, 2013). This outcome could be due to the high cost of production resulting from energy and labour costs, or insufficient capital inflows, and requires further investigation. The rest of our model variables, FDI, exchange rate, and government expenditures, positively and significantly improve the UK trade balance based on the simulations for the parameter vector in the dynamic ARDL technique. To identify causality at different frequencies, the Breitung & Candelon (2006) test is performed, and the results reveal that the home GDP cannot forecast the UK's trade balance, neither in the medium nor in the short run. Conversely, foreign GDP can forecast the trade balance in both the medium and long run, but not in the short run. FDI and government expenditures only forecast the trade balance in the long run, and finally, the exchange rate significantly forecasts the trade balance in the short, medium, and long run.

All variables except GDP at home positively contribute to the trade balance, but at varying frequencies. The current account deficit, where overall expenditure in the UK exceeds national income, makes the UK a net borrower with the rest of the world, according to the national accounts' statistics. The UK must attract net financial inflows to finance its current (and capital) account deficit. Improving the terms of trade through foreign direct investment is essential for increasing foreign exchange reserves and attracting new investments to the country. On the other hand, export-oriented production would stimulate both the home GDP and foreign exchange reserves.

Therefore, new regulations should be made to increase exports, and this should be done within the framework of the foreign direct investment policy. Protecting the existing foreign direct capital in the country and making new foreign direct investments will benefit the economy. Our research also highlighted the need for an investigation into the sectoral decomposition of FDI to identify the sectors that make the most significant contribution to the UK's trade balance.

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