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Evaluating the Twin Deficit Hypothesis in the United Kingdom.

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Abstract

This paper analyses the causal relationship between current account deficits and fiscal deficits in the United Kingdom over the period 1979:q1 to 2021:q2. The twin divergence view is more valid for the United Kingdom in the long run. In contrast to the traditional twin deficit theory for causality from FD→−CAD the findings suggest reverse causality from the current account deficit to the fiscal deficit.A Vector Error Correction Model(VECM) was employed to analyse the long run relationship and a Structural Vector Auto Regression(SVAR) was employed to study the dynamics in the short run using Impulse Response Functions(IRFs). Cointegration holds even after considering a single structural break and the reverse causality result is supported by the Toda and Yamamoto causality test.

Keywords:Fiscal Deficits, Current Account Deficits, Cointegration, Reverse Causality, Structural Breaks, Structural Vector Auto Regressions(SVARs), Impulse Response Function Analysis(IRFs), Vector Error Correction Model(VECM),

Introduction

Current account balance and fiscal balance are two important macroeconomic variables, and the theory which postulates a relationship between them is known as the Twin deficit hypothesis.The hypothesis states that fiscal deficits and current account deficits move one to one.The traditional framework in which this hypothesis is set is known as the Mundell-Fleming framework which ar-gues an increase in fiscal deficits puts upward pressure on interest rates leading to exchange rate appreciations due to capital inflows, resulting in a current account deficit.

The origin of this theory dates back to the early 1980's in the United States of America, since then it has been explored empirically across many countries and various time periods. The results obtained for the United States cannot be generalised for the United Kingdom due to their relative size difference i.e United Kingdom is a relatively small open economy. The studies on United Kingdom are limited and are restricted to the early 2000's with conflicting results Corsetti and Müller (2005) suggest twin deficits and Bagnai (2006) suggesting twin divergences. The methodologies and variables employed across literature are different and the underlying theoretical framework is different (Mundell-Fleming vs Ricardian). Initial exploration of data suggests lack of a clear pattern.

The two deficits seem to be moving together in the early 2000's however they seem to diverge otherwise. The United Kingdom has run persistent current account deficits since the year 2000, with the deficit reaching as high as 5% of GDP in 2016. The Fiscal deficit also reached a sample high of 10% of GDP during the financial crisis. Post the early 1990's recession there is a divergence in the two deficits and the pattern seems similar after the financial crisis. Will we observe similar patterns post the COVID-19 crises? Answering this question has important policy implications as it enables us to understand the impact of the increase in fiscal deficits post COVID on the external balance.

This paper aim's to ascertain the relationship between the two deficits, using Vector Error Cor-rection Models(VECM) in the United Kingdom for the period 1979:Q2 to 2021:Q2. The sample selection and application of Vector Error Correction Model in the United Kingdom setting to the best of my knowledge is unique in the literature. Structural breaks are beyond the scope of this paper, thus this is a limitation, however given the limited no of studies on the United Kingdom, understanding the basic nature of the two deficits is prioritised.

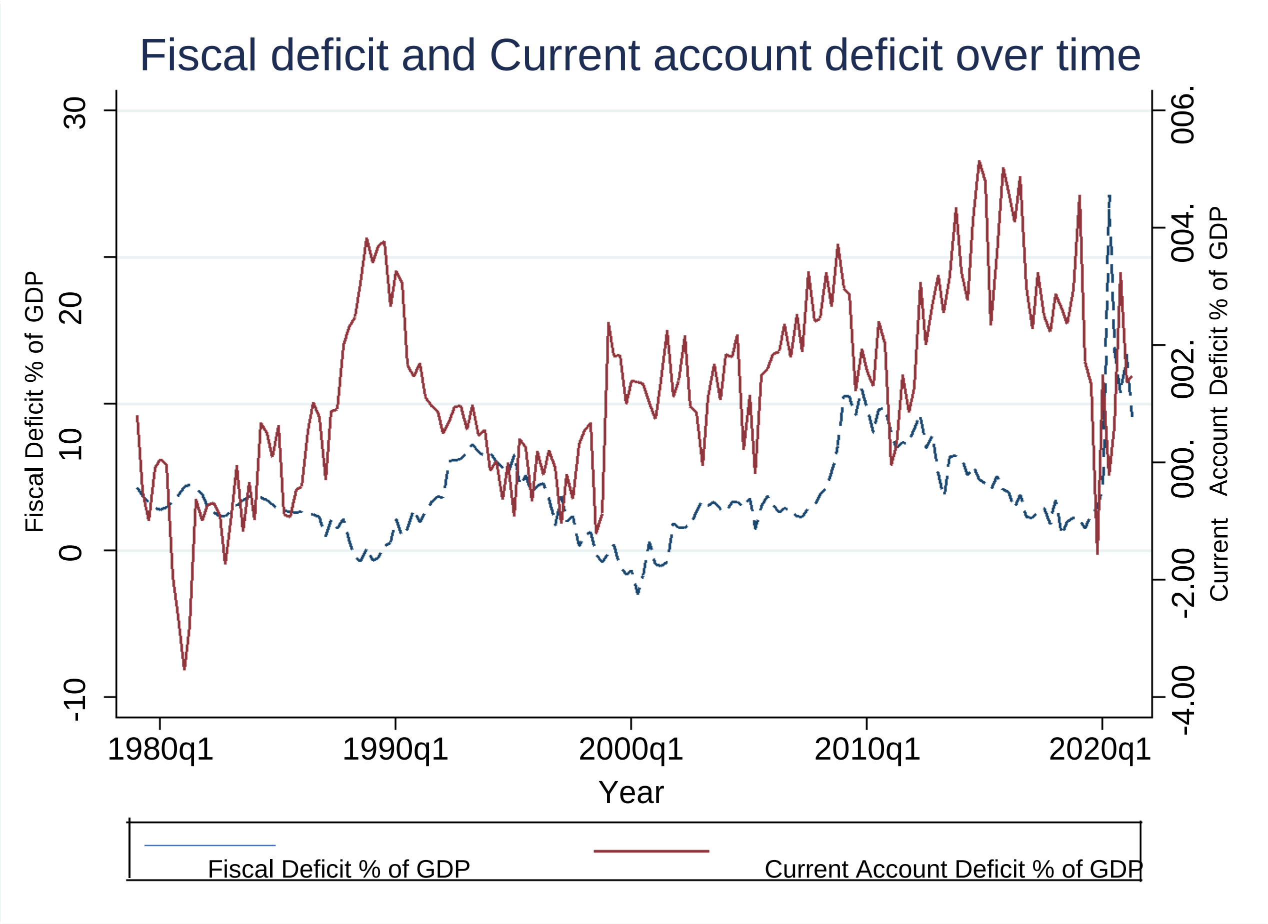

Figure 1: Current Account Deficit and Fiscal Deficit over time

Literature review

The link between current account deficits and fiscal deficits can be derived from a simple accounting procedure using the National income accounting Identity:

$$Y^N = C + I + G + NX + NII \tag{1}$$

Current account(CA) is defined as Sum of net Exports and net investment income(income on net foreign assets)Schmitt-Grohé et al. (2008).Equation (1) can be rearranged to get the following equation:

$$CA = S - I \tag{2}$$

Here (S) is National savings and (I) is private investment expenditure. Savings can be further divided into the sum of private savings(S^p) and Government savings (S^g) i.e fiscal surplus. Private Savings is defined as private disposable income(GDP plus income on net foreign assets, less taxes net of transfers T), and Government savings as taxes net of transfers, T minus Government spending, G, (Corsetti and Müller (2005)). Therefore we get the following equation:

$$CA = (S^p - I) + (T - G) \tag{3}$$

$$CurrentAccount\ Deficit = Investment - PrivateSavings + BudgetDeficit$$

Equation (3) is the basis of the relation between the two deficits, holding savings and investments constant, we can see how the two deficits affect each other.

The two major schools of thought on the nature of the relationship between fiscal and current account balances have traditionally been Keynesian or Mundell-Fleming and Ricardian. The twin deficits are postulated by both the Keynesian and the Mundell-Fleming theories, but the transmission channels are different. Following an expansionary fiscal policy, resulting in increased budget deficits, leads to an increase in domestic absorption and thus national income, which leads to an increase in the trade deficit, and thus a deterioration of the current account, according to the Keynesian paradigm. A fiscal expansion will lead to an increase in domestic interest rates, increased capital inflows, and exchange rate appreciation, resulting in a fall in net exports and thus the current account deficit in the Mundell-Fleming framework under a flexible exchange rate regime. (Catık et al. (2015)).

The Ricardian equivalence framework put forward by Barro (1989), rejects the twin deficits theory and argues that there does not exist a link between the two deficits. The Ricardian theory argues that as consumers perceive an increase in fiscal deficits as differed future taxes, therefore following a tax cut(or spending increase), consumers increase saving to provide for future tax payments, thereby leaving the total savings unchanged and no change in the current account.(Trachanas and Katrakilidis (2013)).

Outside the traditional framework, there is a third view/ hypothesis of twin divergence i.e an increase in fiscal deficits improves the current account balance and vice versa.Kim and Roubini (2008) state that there may exist a twin divergence and this twin divergence can be explained by the endogenous movements of the fiscal deficit and current account deficit caused by output shocks. During economic recessions(or booms), output falls(or rises) and fiscal balance worsens(or im-proves) and at the same time, the current account will improve when fall in output leads to a fall in investment sharper than the fall in national savings. This divergence may also hold after controlling for effects of output shocks.(Kim and Roubini (2008)).

Summers (1986) proposed that an inverse relationship exists between the two deficits i.e the causality runs from current account to the fiscal deficit, this is known as the Current Account Tar-geting Hypothesis.The twin deficits are an area of interest as persistent double deficits can cause currency depreciation’s which can be severe, for example the 1991 crisis in India. In addition the literature mainly deals with twin deficits in the United States, and the results cannot be generalised to the United Kingdom, on the account of their relative economic size.

Empirical Literature

The empirical literature has mixed results on the twin deficit hypothesis. Earlier studies have primarily used OLS on cross country data, with most finding a positive and direct relationship between the two deficits(Bernheim (1987);Darrat (1988);Salvatore (2006)) however Anderson(1990) reports no such relationship.

Vector Auto Regression(VAR) models have been one of the most extensively used methods, with studies like Abell (1990) ;Enders and Lee (1990);Baharumshah et al. (2005) ;Corsetti and Müller (2005);Kim and Roubini (2008), using VAR techniques to analyse the twin deficits. The results have been Mixed, with Abell (1990), Corsetti and Müller (2005)(UK,Canada), Baharumshah et al. (2005) concluding in favour of the twin deficits, with Abell (1990), providing evidence for the indirect relation between the two deficits through interest rates and exchange rates in the US. Corsetti and Müller (2005) argue about the role of openness and conclude in favour(against) of the twin deficits for relative more open(closed) economies UK(USA) and Canada(Australia) from 1979-2005. Enders and Lee (1990) found inconclusive results for the direct relation between the two deficits in USA from 1947 to 1989. Kim and Roubini (2008) conclude against the twin deficit and in favour of twin divergences in USA (1973-2004), they observe a partial ricardian effect following an increase in budget deficit. Therefore, the results in the literature are mixed.The mixed results can be attributed to sensitivity of results to demographics such as time period,country,structural breaks, techniques applied etc.

Cointegration techniques have been another extensively used method to analyse the twin de-ficits(Tang (2013);Bahmani-Oskooee (1992, 1995);Miller and Russek (1989); Banday and Aneja (2015); Leachman and Francis (2002)). However the results have been mixed as well. Leach-man and Francis (2002) conclude that the twin deficit relationship is time specific and weak in the USA(post Bretton woods). Authors like Bagnai (2006) suggest that inconclusive results stem from ignoring structural Breaks, they analyse the impact of change in Government budget deficit on cur-rent account deficit in 22 OECD member countries from 1960-2005, they find for the UK, the long run relation is not significant, after considering for a single structural break in regime, but suggest twin divergences after considering multiple structural breaks.

Ignoring structural breaks leads us to faulty results, however there exists another angle which needs to be considered. Since output fluctuations are the most important driver of the two defi-cits(Kim and Roubini (2008)) and as many macroeconomic variables exhibit non linear behaviour in the area of business cycles(Falk (1984);Neftci (1984)),Trachanas and Katrakilidis (2013) suggests that deficits should also be expected to exhibit non linearity, i.e the response of current account to positive shocks to fiscal balance might differ from negative shocks.Trachanas and Katrakilidis (2013) apply both linear cointegration and asymmetric cointegration methodology(developed by Schorderet (2003)) for Portugal, Ireland, Greece and Spain(1971-2009) and find no evidence of cointegration in their linear model, but concluded non linearity i.e negative fiscal shocks have a more profound effect on current account deficit than positive shocks. Trachanas and Katrakilidis (2013), view is valid, and can be argued along the lines of Kahneman and Tversky (1979), that agents respond differently to Good news(Positve Shocks) and Bad News (Negative Shocks), but Afonso and Coelho (2021) find contradictory results.

Extending on Kim and Roubini (2008) result that business cycle fluctuations drive the deficits, Catık et al. (2015) estimated a VAR and a Threshold VAR(Developed by Tsay, 1998) for Turkey from 1994 to 2012 where the threshold variable was output gap, which split the economy into two regimes-Upper and Lower, using an indicator function and find that negative budget deficit shocks lead to deterioration of current account only when the economy is operating in the upper regime.

The results in the literature are mixed, even for the United Kingdom, Corsetti and Müller (2005) suggests twin deficits in the short run and Bagnai (2006) suggests twin divergences in the long run relationship. Thus foremost it is necessary to investigate the relationship between the two deficits in the context of a Vector Error Correction Model, before considering non linearity’s, structural breaks etc. Considering Kim and Roubini (2008) view that output is the main driver of the two series which is inline with international macroeconomic theory, the traditional Mundell-Fleming framework is extended to include output in the analysis.

Data

In this paper quarterly data from 1979:Q1 to 2021:Q2 is used. The variables employed are current account deficit (%), fiscal deficit(%), real interest rate, real effective exchange rate and real GDP. Current account deficit(CAD) has been defined as the sum of negative net exports and negative net primary income balance, fiscal deficit(FD) is general Government net borrowing as a percent-age of GDP, real interest rate(RINT)(ex-post) has two specifications: (i)The Bank of England bank rate(RBINT) and (ii) Ten Year Bond Rate (RTEN_YR). Real effective exchange rate(REER) is nom-inal effective exchange rate(NEER) deflated by consumer price index this particular series was chosen based on availability. Details regarding the data sources of the variables are mentioned in the appendix.

	Mean	SD	Median	Skewness	Kurtosis	N
Current Account deficit	1.27	1.63	1.26	-0.00	2.89	170
Fiscal Deficit	3.78	3.29	3.12	1.90	11.33	170
Real Exchange Rate	116.63	12.95	117.91	0.12	2.16	170
Real Bank Rate	5.03	4.23	4.80	0.06	2.33	170
Real Bond Rate	5.49	3.55	4.80	-0.15	2.96	170
Log Real GDP	12.86	0.27	12.92	-0.31	1.79	170

Table 1: Descriptive Statistics

Current account deficit(CAD) and fiscal deficit(FD) are our main variables of interest. The cur-rent account is defined as the negative of the sum of net primary balance and trade balance, as according to (1) the external balance is trade balance plus net investment income, and since net investment income is the main component of net primary income balance, the current account has been defined in this manner to be in line with the theoretical model. Real interest rate and real effective exchange rate are included in the model as they are important macroeconomic variables, and help us understand the transmission channel of budget shocks, as postulated in the traditional Mundell-Fleming framework, detailed above. The three month treasury bill rate has been used more often in the literature as the interest rate variable, but the UK data is not available for the past five years, thus the bank rate has been used as a proxy. The ten year bond rate has been used as we would typically expect the Government to finance the deficit through issuing bonds.Real GDP is the log of real GDP, and has been included in the model as Kim and Roubini (2008) argue that GDP fluctuations are the main driver of fiscal deficits.

Model

The Basic model to study the relationship between fiscal deficits and current account deficits is:

$$CAD = f(LRGDP, FD, RINT, REER) \tag{4}$$

Where our variables are as specified in the DATA section. This specification is chosen as it investigates the relationship between the two series in the traditional Mundell-Fleming framework and allows us to test the validity of the twin deficit hypothesis. This model extends Baharumshah et al. (2005) model to include RGDP as suggested by Kim and Roubini (2008). In order to invest-igate the relationship between fiscal deficit and current account deficit, the following techniques have been used:

- A Vector Error Correction Model(VECM) to investigate the long run relationship between the two series in the system above (4)
- A Structural Vector Auto Regression (SVAR) to study the short run dynamics using Impulse Response Functions(IRFs)

The Vector Auto Regression(VAR) is specified as follows:

$$Y_t = A_0 + \Sigma_{i=1}^{p} A_i Y_{t-i} + \epsilon_t \tag{5}$$

Where our vector of endogenous variables is:

$$Y_t = [LRGDP_t \quad FD_t \quad RBINT_t \quad REER_t \quad CAD_t]' \tag{A}$$

$$Y_t = [LRGDP_t \quad FD_t \quad RTEN\_YR_t \quad REER_t \quad CAD_t]' \tag{B}$$

.

(5) is a VAR(2) for model (A) and a VAR(3) for model(B).

Unit Root Tests

The Standard Augmented Dickey-Fuller test was run for all variables in order to ascertain the time series properties of the variables.The choice of lag length was made by testing down, and deterministic trends were chosen after evaluating the time plots.

	Z	CV-1%	CV-5%	CV-10%	P-value	Lags	
CA	-2.72	-3.49	-2.89	-2.58	0.07	2	I(1)
FD	-2.22	-3.49	-2.89	-2.58	0.20	2	I(1)
LRGDP	-1.75	-4.02	-3.44	-3.14	0.73	1	I(1)
RBINT	-1.13	-3.49	-2.89	-2.58	0.70	2	I(1)
RTEN YR	-0.85	-3.49	-2.89	-2.58	0.80	2	I(1)
REER	-2.28	-3.49	-2.89	-2.58	0.18	1	I(1)

LRGDP was tested with H_0: Unit root vs H_A: Trend Stationary

Table 2: ADF test results

Model B(a)(Null of random walk without a drift) was used for all series except LRGDP, where model C was used. The ADF test results conclude that all series are I(1), with only current account deficit having ambiguous results, suggesting it is I(0) at the 10% level. Given the low power of ADF test, the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test was conducted as a cross check. The KPSS test, tests the null hypothesis of stationarity against the alternative of a unit root.

	Test Statisitc	CV-1%	CV-5%	CV-10%	Lags	Remark
CA	1.9	0.739	0.463	0.347	3	I(1)
FD	0.828	0.739	0.463	0.347	3	I(1)
LRGDP	0.684	0.216	0.146	0.119	3	I(1)
RBINT	3.9	0.739	0.463	0.347	3	I(1)
RTEN_YR	4.1	0.739	0.463	0.347	3	I(1)
REER	1.83	0.739	0.463	0.347	3	I(1)

KPSS test the null of level/ trend stationary against the alternative of unit root LRGDP was tested with H_0: Trend Stationary vs H_A: Unit root.

Table 3: KPSS test results

The KPSS test results confirm that all the variables are I(1). The interest rate variables despite having some trend in the time series plot were not tested for trend stationarity as it is economically incorrect to state a time trend helps in predicting interest rates.

Cointegration

Given the conclusion that all variables are I(1), the next step was to test if there exists a long run relationship among them i.e test for co-integration. The VAR in (5) can be re parameterised as follows:

$$\Delta Y_t = \Pi Y_{t-1} + \Sigma_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \epsilon_t \tag{6}$$

Where $\Pi = \Sigma^p_{i=1} A_i - I_n$ and $\Gamma_i = -\Sigma^p_{j=i+1} A_j$. To find the number of co integrating vectors 'r', we test for rank(Π)=r. The Johansen procedure (Johansen (1991)) is employed, which provides two test statistics for testing the co-integrating rank: (i) rank is at most r(<k) against the alternative that the rank is at least k+1 (trace test).The second one tests the alternative that the rank is equal to k+1 (Maximal eigenvalue test). For the Johansen procedure the underlying VAR must be specified, which for Model (A) is $Y_t = A_0 + \Sigma^2_{i=1} A_i Y_{t-i} + \epsilon_t$, and for Model(B) is $Y_t = A_0 + \Sigma^3_{i=1} A_i Y_{t-i} + \epsilon_t$.The lag length was chosen after minimising AIC, SBIC and choosing the lag with no serial correla-tion.For the choice of deterministic components, an unrestricted constant was chosen as this al-lows for a linear trend in the levels data and we restricts the co-integrating equation to be stationary around a constant mean.

The Johansen Trace Statistic reports the presence of single co-integrating vector in our sys-tem.The null of r=0 is rejected in both the models, whereas the null of r<=1 cannot be rejected, suggesting the presence of a single co-integrating vector in our system and this vector is unique up to a scalar multiple.

Johansen's cointegration tests			
Model A			
Null	Alternative	Trace	CV-5%
r=0	r>=1	79.47	68.52
r<=1	r>=2	45.10	47.21
r<=2	r>=3	25.15	29.68
r<=3	r>=4	9.03	15.41
r<=4	r>=5	1.01	3.76
lags=2 Trend=constant			
chosen rank			
Model-B			
Null	Alternative	Trace	CV-5%
r=0	r>=1	69.39	68.52
r<=1	r>=2	37.03	47.21
r<=2	r>=3	16.97	29.68
r<=3	r>=4	7.02	15.41
r<=4	r>=5	0.64	3.76
lags=3 Trend=constant			
chosen rank			

Table 4: Johansen's co-integration test results

Results

Vector Error Correction Model

The Johansen tests suggest there is a unique co integrating vector i.e rank(Π)=1. $\Pi_{5.5} = \alpha_{5.1}\beta_{1}{}'_{.5}$ where β' is our co-integrating vector, and α is the vector of adjusting parameters. Since, $\Pi_{5.5}$ is rank deficient it can be represented as follows: $\Pi = \alpha\Lambda\Lambda\beta' = \alpha\ \beta\ '$, where Λ is a r.r(1.1) matrix. Thus, the economic interpretation of $\alpha\beta'$ and $\alpha\ \beta\ '$ is different, we need to impose r^2 to identify β' as Λ has r^2 elements. In our model just one restriction is sufficient as r=1. For both specifications the restriction imposed is CAD=1 in the long run equation as per (4).

For Model (A) there exists a significant negative relationship between the two deficits in the long run, contradicting the twin deficit hypothesis, however the two lag VECM suffers from first order serial correlation thus these results are biased and inconsistent and we estimate the VECM with three lags.

In the three lag VECM labeled as Model A(i), the long run relationship between the deficits

Model A: VECM results with RINT

	Model A	Model A(i)	Model A(ii)
Adjustment Parameters			
D_LRGDP			
L._ce1	0.005	0.004	0.001
	(0.001)	(0.001)	(0.000)
D_FD			
L._ce1	-0.488	-0.376	-0.040
	(0.113)	(0.125)	(0.029)
D_RBINT			
L._ce1	0.360	0.343	0.091
	(0.093)	(0.099)	(0.022)
D_REER			
L._ce1	-0.431	-0.339	-0.160
	(0.222)	(0.238)	(0.055)
D_CA			
L._ce1	0.081	0.059	0.022
	(0.059)	(0.065)	(0.015)
Lags	2	3	3
Long run estimates			
LRGDP	-9.595	-11.190	-50.307
	(1.881)	(2.313)	(9.782)
FD	0.177	0.099	-1.000
	(0.090)	(0.112)	(0.000)
RBINT	-0.539	-0.621	-3.569
	(0.136)	(0.169)	(0.709)
REER	0.088	0.072	-0.099
	(0.023)	(0.028)	(0.125)
CA	1.000	1.000	1.000
	(0.000)	(0.000)	(0.000)
Identification	CA=1	CA=1	CA=1
			FD=-1
LR Test			$\chi_1^2 = 4.411$

Standard errors in parentheses
$p < 0.10$, $p < 0.05$, $p < 0.01$

Table 5: VECM results RINT Specification

LM test for Auto Correlation Model A

p-value			
Lags	Model A	Model A(i)	Model A(ii)
1	0.0077	0.3163	0.2083
2	0.1123	0.4965	0.3422
3	0.5893	0.3840	0.2039
4	0.6892	0.7132	0.6565

Table 6: Auto Correlation Test results Model A

is no longer significant providing evidence against the twin deficit hypothesis. Over-identifying restrictions are placed on the VECM by imposing FD=-1 in the long run equation and the over-identifying restriction is tested in Model A(ii).The over identifying restriction that the deficits move 1 to 1, is soundly rejected at the 5% level, confirming that twin deficit hypothesis is not valid. The Mundell-Fleming transmission chain breaks at RBINT, which is the Bank rate, and although it is highly correlated with other interest rates it is not the direct rate which is affected as result of an increase in budget deficit.Testing zero restrictions fails to reject the null that RBINT=0 in the co-integrating vector with a p-value of 0.055, however there is twin divergences suggesting the twin deficit hypothesis does not hold. (Result in appendix(11))

The three month treasury bill rate or equivalent has been used more often in the literature, however some papers such as Banday and Aneja (2015) use the deposit rate, Baharumshah et al. (2005) use the inter bank rate. In the UK the data on this series is limited to the year 2016 and the bank rate has been used as a proxy, but it fails to capture the transmission mechanism. Thus for Model (B) the ten year Government bond rate has been used as the interest rate variable, since Government bonds are the main instrument through which Governments raises deficits.

Model B: VECM results with RTEN_YR

	Model B(i)	Model B(ii)	Model B(iii)	Model B(iv)	Model B(v)	Model B(vi)
Adjustment Parameters						
D_LRGDP						
L._ce1	0.001	0.0001	0.000	0.002	0.001	0.002
	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
D_FD						
L._ce1	-0.112	-0.037	-0.000	-0.152	-0.111	-0.150
	(0.050)	(0.018)	(0.000)	(0.064)	(0.049)	(0.063)
D_RTEN_YR						
L._ce1	0.178	0.063	0.064	0.223	0.176	0.221
	(0.031)	(0.011)	(0.012)	(0.039)	(0.031)	(0.039)
D_REER						
L._ce1	-0.005	0.004	0.017	-0.010	0.000	-0.000
	(0.096)	(0.034)	(0.041)	(0.121)	(.)	(0.000)
D_CAD						
L._ce1	0.021	0.014	0.015	0.000	0.021	0.000
	(0.026)	(0.009)	(0.011)	(.)	(0.025)	(0.000)
Lags	3	3	3	3	3	3
Long run estimates						
LRGDP	-35.860	-92.801	-85.689	-27.844	-36.291	-28.234
	(6.330)	(17.344)	(15.602)	(4.961)	(6.393)	(5.012)
FD	0.416	-1.000	0.129	0.366	0.414	0.363
	(0.207)	(0.000)	(0.511)	(0.162)	(0.209)	(0.164)
RTEN_YR	-2.700	-7.425	-6.887	-2.030	-2.732	-2.059
	(0.517)	(1.425)	(1.274)	(0.405)	(0.522)	(0.409)
REER	0.136	0.327	0.202	0.110	0.135	0.109
	(0.023)	(0.140)	(0.142)	(0.045)	(0.058)	(0.045)
CA	1.000	1.000	1.000	1.000	1.000	1.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Identification	CA=1	CA=1	CA=1	CA=1	CA=1	CA=1
		FD=1	FD_{α} =0	CA_{α} =0	$REER_{\alpha}$ =0	CA_{α} =0
						$REER\alpha$ =0
LR Test		$\chi 1^2$ = 0.9148	$\chi 1^2$ =3.373	$\chi 1^2$ =0.392	$\chi 1^2$ =0.002	$\chi 2^2$ =0.396

Standard errors in parentheses
$p < 0.10$, $p < 0.05$, $p < 0.01$

VECM does not converge in Model B(ii) and Model B(iii)

Table 7: VECM results with RTEN_YR specification

The same identification restriction CAD=1 is employed for all versions of model B. Model B(i) reports results with just identification and suggests there exists a significant and negative long run relationship between the fiscal deficits and current account deficit, supporting the twin divergence hypothesis. However this long run relationship is not one to one. Model B(ii) reports the over identifying restriction that FD=1 i.e the two deficits diverge one to one, we cannot reject the over-identifying restriction but the vector error correction model does not converge in this specification suggesting this restriction does not fit the data well. While the co-integrating vector gives us the long run relationship between CAD and FD, it does not provide us an inference on the direction of causality in the system. $\alpha 5.1$ which contains the adjustment parameters i.e how our variables adjust to disequilibrium, enables us to interpret the direction of causality.If a variable is not adjusting to disequilibrium (Y_{α}=0) then it would imply it is driving our system, this is often refereed to as the weak exogenity condition. Model B(iii-v) test this condition for FD, CAD, REER. Weak exogenity is tested for FD as in the traditional Mundell-Fleming framework, it is the fiscal deficits which cause current account deficits. We test weak exogenity for CAD and REER, as CAD and REER are not adjusting in Model B(i).The null hypothesis that FD is driving the system is rejected only at the 10% level, but the vector error correction model is not converging thus it fits our data poorly.Further in Model B(iii) FD becomes insignificant in the long run equation.The null of weak exogenity for CAD and REER cannot be rejected as per model B(iv) and model B(v).Imposing weak exogenity for one of CAD and REER, still leaves the other not adjusting to disequilibrium, thus in Model B(vi) both CAD and REER are tested for jointly driving the system, and are unable to reject the null.

Fiscal deficits are adjusting to 15% of the disequilibrium in one quarter, suggesting half life of disequilibrium is around 17 quarters.All the other variables carry the expected sign in the long run. A percentage point(ppt) increase in Real GDP leads to a 0.28 ppt increase in CAD in the long run.1 ppt increase in Fiscal deficit leads to a 0.36 ppt improvement in current account deficit in the long run.1 ppt increase in real bond rate leads to a 2.05 ppt increase in current account deficit in the long run.1 ppt increase in real exchange rate i.e exchange rate depreciation leads 0.1 ppt improvement of the current account in the long run, which is consistent as exchange rate depreciation leads to increase in value of exports and an improvement in the current account.

In the United Kingdom the twin divergence hypothesis is more appropriate, and this result is inline with Bagnai (2006). The Causality runs CA→−FD suggesting that there is current account targeting.

Impulse Response Function Analysis

The Vector error correction model provided us with the long run relationship, the Impulse Response Functions (IRFs) enable us to study the the short run dynamics. In order to study the dynamics of the relationship between variables a structural vector auto-regression(SVAR) has been estimated. The SVAR has been used, as after estimating a vector auto-regression(VAR), the errors are likely to be correlated and in order to plot impulse responses we need to decompose the error into mutually orthogonal shocks.We must identify the purely exogenous shocks to trace out its dynamic effects. It is essential to recover the structural model in order to properly identify the underlying mechanisms as a VAR model does not allow for contemporaneous relationships among the variables. .

The following reduced form VAR is estimated:

$$Y_t = A_0 + A_1 Y_{t-1} + A_2 Y_{t-2} + A_3 Y_{t-3} + e_t \tag{7}$$

where Y_t is our of vector of endogenous variables defined in (B). We wish to estimate the following SVAR:

$$AY_t = C_0 + C_1 Y_{t-1} + C_2 Y_{t-2} + C_3 Y_{t-3} + z_t \tag{8}$$

Here matrix A defines the contemporaneous relationship among variables in the VAR. z_t are un-correlated errors. The following equation is obtained after algebraic simplifications:

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \beta_3 Y_{t-3} + \epsilon_t \tag{9}$$

Where $\beta_0 = A^{-} C_0, \beta_1 = A^{-} C_1, \beta_2 = A^{-} C_2, \beta_3 = A^{-} C_3$ $\epsilon_t = A^{-} B z_t$. In line with Corsetti and Müller (2005) and Kim and Roubini (2008), a recursive identification scheme is employed and A is defined to be lower triangular. In defining A to be lower triangular we are imposing that output contemporaneously effects fiscal deficits, whereas fiscal deficits effects output only after one quarter. Kim and Roubini (2008) provide support regarding output contemporaneously effecting fiscal deficits say through sales and income taxes, which are effected by current level of economic activity within the quarter. The ordering of the remaining variables is set according to the Mundell-Fleming transmis-sion chain.

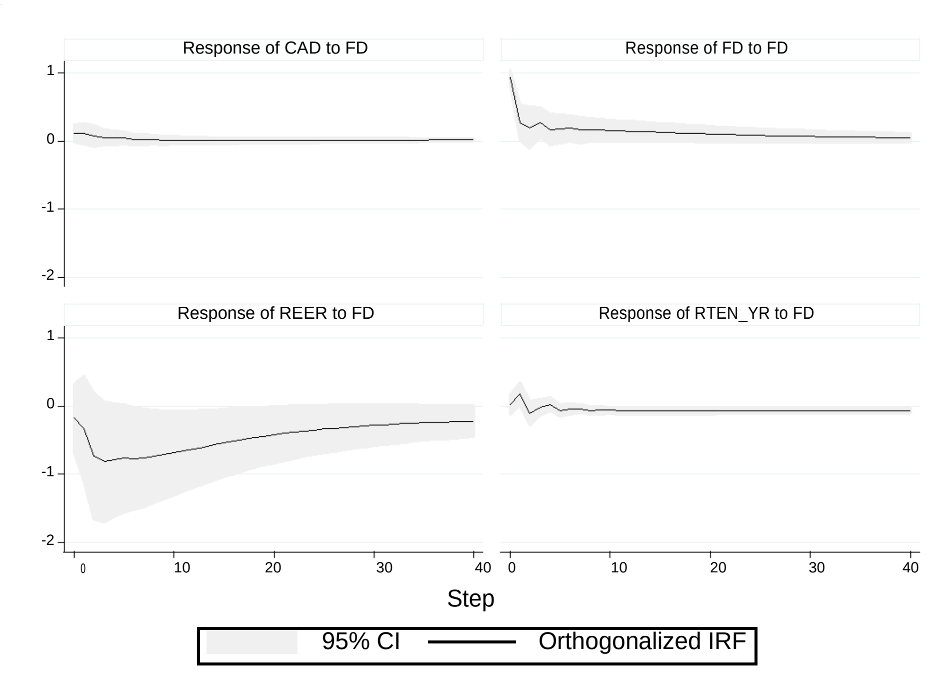

Figure 2: Impulse Response function, impulse FD

The impulse response function in figure 2 show in response to a one standard deviation shock to fiscal deficit, fiscal deficit increases by 1 ppt.In response to a 1 ppt increase in fiscal deficit current account deficit increases by 0.1 ppt and this increase dies quite rapidly, providing weak support for the twin deficits in the short run.The Bond rate increases by a maximum of 0.2 ppt at two quarters in response to the FD shock and the real exchange rate appreciates by a maximum of 0.81 ppt at three quarters.The IRF plot suggests some evidence towards twin deficits in the short run in response to a exogenous fiscal policy shock, however this may be due to the temporary increase in output after the expansionary fiscal policy.

Figure 3 shows the response to a one standard deviation shock to current account deficit which

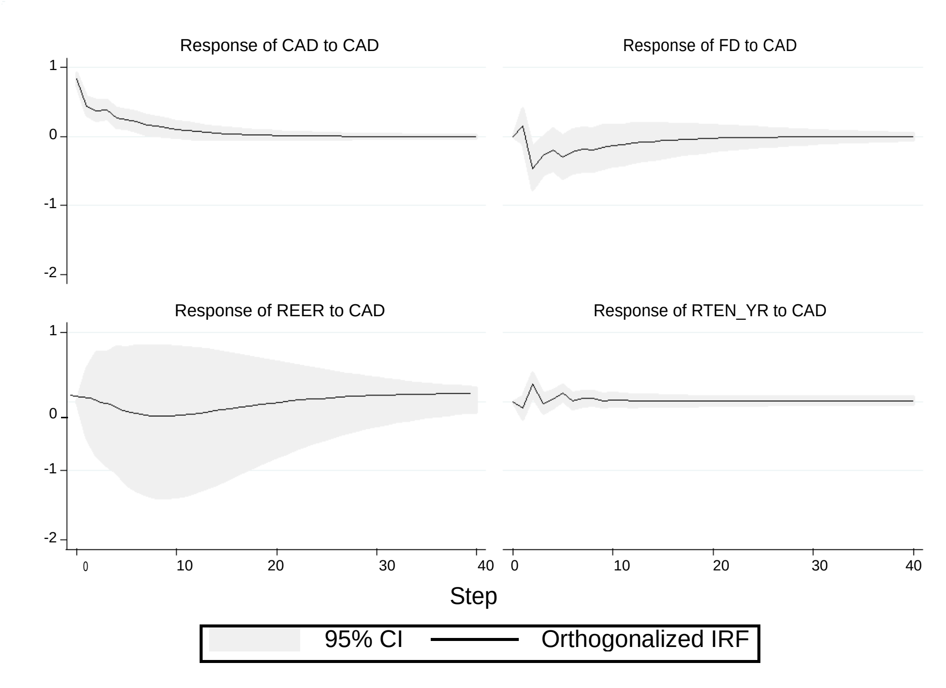

Figure 3: Impulse Response function, impulse CAD

translates to a 0.83 ppt increase in CAD, leads to a maximum of 0.46 ppt fall i.e improvement in the fiscal deficit at four quarters. This suggests that an increase in CAD leads to an improvement in FD, providing support for twin divergences.A plausible transmission channel for this would be an increase in current account deficit, leads to an increase in demand for foreign currency causing exchange rate depreciation. In order to stabilise the currency, the Central Bank sells bonds pushing bond prices down and increasing the interest rate this constrains the Government from raising deficit through bonds.

However, all these IRFs seem to be converging back to zero at long run horizons which is not what you would expect given the I(1) nature of our variables.The VECM-IRFs are plotted as they impose the long run condition and provide better long run impulse responses.

Figure (4) shows impulse responses for a one standard deviation shock to CAD in Model B(vi).A one standard deviation shock to CAD translates to 0.90 ppt increase in CAD, leads to a maximum fall of 0.49 ppt at two lags for FD and this fall stabilise to 0.36 ppt around twelve quarters. A depreciation in real exchange rate is observed and this depreciation peaks at 0.37 ppt around ten

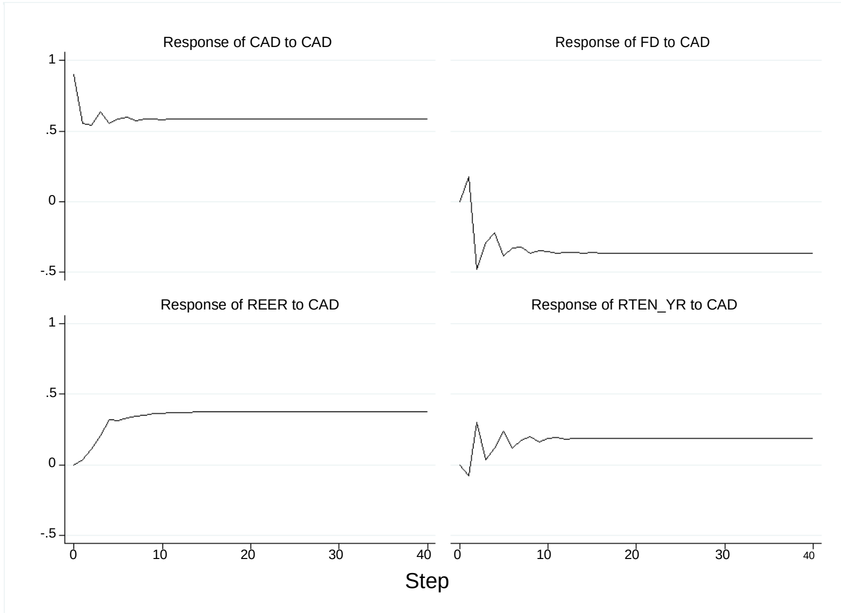

Figure 4: Impulse Response function Model B(vi), impulse CAD

quarters.A maximum of 0.30 ppt increase in real bond rates at two quarters is observed.These results indicate that we observe twin divergences as a result of a current account deficit shock.

Robustness

Granger Causality Analysis

As a robustness check the Toda and Yamamoto (1995) causality test was applied to check the direction of causality. The Granger Causality test is generally applied to ascertain if a series X_t can help predict a series Y_t. The Traditional Granger Causality test is a test of predictive power rather than actual economic causality.However since co-integration exists we should expect our granger causality analysis to support our VECM results. For Granger causality the following equations are generally estimated:

$$Y_t = \Sigma_{i=1}^{p} A_i X_{t-i} + \Sigma_{j=1}^{p} B_j Y_{t-j} \tag{10}$$

$$X_t = \Sigma_{i=1}^{p} C_i Y_{t-i} + \Sigma^{p} \quad D_j X_{t-j} \tag{11}$$

A joint test that ΣA_i and ΣC_i are different from zero is conducted using the F-Test.A rejection of null means we reject the null that X_t does not granger cause Y_t and vice versa i.e X_t granger causes Y_t. However as Lütkepohl (2007) explained with non-stationary data a Wald test does not follow its usual asymptotic chi square distribution under the null. Therefore the traditional Granger causality test cannot be employed here as our data is co-integrated. Toda and Yamamoto (1995) have suggested the modified WALD(MWALD) for testing Granger non causality when our data contains non stationary variables.Under the null the MWALD follows usual asymptotic chi square distribution regardless of co-integration.

The Toda and Yamamoto (1995) Granger non causality test is conducted by determining the order of integration of the variables and running a VAR(p+d_{max}) where d_{max} is the maximum order of integration for the variable. Since all the concerned variables are I(1) d_{max} here is one. The usual Granger causality test is applied after running the augmented VAR in levels.(B) is estimated with four lags and the Granger causality results are follows:

Dependent Variable	Null	P-value
Fiscal Deficit	LRGDP does not Granger Cause FD	0.034
Fiscal Deficit	RTEN_YR does not Granger Cause FD	0.296
Fiscal Deficit	REER does not Granger Cause FD	0.024
Fiscal Deficit	CAD does not Granger Cause FD	0.000
Current Account Deficit	LRGDP does not Granger Cause CAD	0.236
Current Account Deficit	RTEN_YR does not Granger Cause CAD	0.205
Current Account Deficit	REER does not Granger Cause CAD	0.910
Current Account Deficit	FD does not Granger Cause CAD	0.783

Table 8: Granger Non Causality Results

For fiscal deficits the Granger non causality is not rejected only for the real bond rate. The null that Current account deficit does not granger cause fiscal deficit is strongly rejected with a p-value of 0.000.The null that fiscal deficits do no Granger cause current account deficit cannot be rejected.These results suggest the direction of causality runs from current account deficits to fiscal deficits supporting the results we found in the vector error correction model.

Vector Error Correction Model

The VECM is re-estimated with nominal exchange rate and nominal bond rate as a robustness check. Twin divergence is still reported, although the relationship is less profound as it does not consider inflation, which is a key variable for capital inflow decisions.

In models with nominal exchange rate and nominal interest rate, the twin divergence and current account targeting is still valid, however exchange rates do not seem to be driving the system. This result is not surprising as the basis of the twin deficit theory is capital inflows lead to exchange rate appreciation and a deficit in the current account, one would expect capital inflows to be affected by the real interest rate and real exchange rate rather than the nominal exchange rate, as the latter

VECM results with Nominals

	Model A	Model B(i)	Model B(iii)	Model B(iv)	Model B(v)
Adjustment Parameters					
D_LRGDP					
L._ce1	0.005	0.003	0.001	0.003	0.003
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
D_FD					
L._ce1	-0.376	-0.205	0.000	-0.202	-0.169
	(0.117)	(0.094)	(.)	(0.092)	(0.082)
D_BANKRATE					
L._ce1	0.141				
	(0.046)				
D_NEER					
L._ce1	-0.360	-0.263	-0.152	-0.260	0.000
	(0.222)	(0.181)	(0.128)	(0.175)	(.)
D_CAD					
L._ce1	-0.123	-0.003	0.020	0.000	-0.000
	(0.059)	(0.048)	(0.034)	(.)	(0.041)
D_TEN_YR					
L._ce1		0.083	0.058	0.082	0.068
		(0.023)	(0.016)	(0.023)	(0.020)
Lags	2	3	3	3	3
Long run estimates					
LRGDP	-11.422	-24.941	-37.566	-25.323	-30.968
	(2.003)	(5.107)	(7.703)	(5.172)	(6.04)
FD	0.035	0.208	-0.001	0.209	0.157
	(0.085)	(0.123)	(0.101)	(0.25)	(0.146)
TEN_YR		-1.626	-2.600	-1.655	-1.994
		(0.361)	(0.544)	(0.365)	(0.247)
Bank Rate	-0.581				
	()				
NEER	0.051	0.083	0.099	0.084	0.065
	(0.022)	(0.033)	(0.050)	(0.034)	(0.039)
CA	1.000	1.000	1.000	1.000	1.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Identification	CA=1	CA=1	CA=1	CA=1	CA=1
			FD_{α} =0	CA_{α} =0	$NEER_{\alpha}$ =0
LR Test			$\chi 1^2$ = 3.038	$\chi 1^2$ =0.0015	$\chi 1^2$ =1.522

Standard errors in parentheses

$p < 0.10$, $p < 0.05$, $p < 0.01$

Table 9: VECM results nominal specification

omits inflationary information, which is a key factor in foreign capital inflow decisions.

Model B(iii) may provide some intuition to the weakly twin deficit result obtained in figure 2, as when we impose fiscal deficits is driving the system, we see a slight increase in the current account deficit in the short run, due to impact of expansionary fiscal policy on output, however this increase is not significant in the long run, thus it dies away quickly. The result of twin divergences and current account targeting is robust and valid for the United Kingdom.

Cointegration

The Gregory Hansen test for co-integration with an unknown break date is conducted, however this was conducted just to provide robustness to the result that co-integration exists but no further models were estimated considering this break as it is beyond the scope of the paper.Figure 1 suggests the possibility of a break in slope and intercept either in 1989 or around 2010, thus the Gregory Hansen Test for break in regime was conducted, which tests the null hypothesis of no co-integration against the alternative of co-integration with a structural break.

	Test Statisitc	Break Date	CV-1%	CV-5%	CV-10%
ADF	-7.31	1996q1	-6.92	-6.41	-6.17
Z_t	-9.37	1989q2	-6.92	-6.41	-6.17
Z_a	-120.95	1989q2	-90.35	-78.52	-75.56

Table 10: Gregory-Hansen Test results.

The absolute value for all test statistics is higher then the critical value even at the 1% level suggesting that there is co-integration even after considering a structural break at 1989q2.

Conclusion

In the United Kingdom, the twin divergence hypothesis seems to be valid in the long run and this divergence is driven by the current account deficit rather than the fiscal deficit series. In the short run one can observe a temporal and negligible increase in current account deficit following an expansionary fiscal policy due to the temporary increase in output.The result obtained is consistent with Bagnai (2006) that there is twin divergence in the long run, who employed the Engle and Granger methodology from 1975-2005 in the Ricardian Framework. The hypothesis has been tested using multiple specifications and the result is similar although weaker in the nominal transmission chan-nel.The Toda and Yamamoto Causality test backs up the CAD to FD causality result obtained in the VECM.Given the impact of COVID-19 lockdown on the current account deficit i.e improvements in current account deficit, we should expect the Government to make use of this cushion to reduce the high fiscal deficit raised during the pandemic by allowing the current account deficit to rise for the foreseeable future.Further robustness could have been conducted by considering the theory in the Ricardian or Keynesian framework by including domestic savings and private investment, however data limitation on private investment restricted it.The co-integrating relation exists even after considering a single structural break, thus the next step is to estimate the long run relationship after considering the structural breaks.

Bibliography

Abell, J. D. (1990). Twin deficits during the 1980s: An empirical investigation. *Journal of Macroe-conomics*, 12(1):81–96.

Afonso, A. and Coelho, J. C. (2021). Current account targeting hypothesis versus twin deficit hypothesis: The emu experience of portugal. *EconPol Working Paper*, 68.

Bagnai, A. (2006). Structural breaks and the twin deficits hypothesis. *International Economics and Economic Policy*, 3(2):137–155.

Baharumshah, A. Z., Lau, E., and Khalid, A. M. (2005). Testing Twin Deficits Hypothesis: Using VARs and Variance Decomposition. International Finance 0504001, University Library of Munich, Germany.

Bahmani-Oskooee, M. (1992). What Are the Long-Run Determinants of the U.S. Trade Balance? *Journal of Post Keynesian Economics*, 15(1):85–97.

Bahmani-Oskooee, M. (1995). The Long-Run Determinants of the U.S. Trade Balance Revisited. *Journal of Post Keynesian Economics*, 17(3):457–465.

Banday, U. J. and Aneja, R. (2015). The Link between Budget Deficit and Current Account Deficit in Indian Economy. *Jindal Journal of Business Research*, 4(1-2):1–10.

Barro, R. J. (1989). The Ricardian Approach to Budget Deficits. *Journal of Economic Perspectives*, 3(2):37–54.

Bernheim, B. D. (1987). Ricardian Equivalence: An Evaluation of Theory and Evidence. (2330).

Catık, A. N., Gök, B., and Akseki, U. (2015). A nonlinear investigation of the twin deficits hypothesis over the business cycle: Evidence from Turkey. *Economic Systems*, 39(1):181–196.

Corsetti, G. and Müller, G. J. (2005). Twin Deficits: Squaring Theory, Evidence and Common Sense. (ECO2005/22).

Darrat, A. F. (1988). Have large budget deficits caused rising trade deficits? *Southern Economic Journal*, 54(4):879–887.

Enders, W. and Lee, B.-S. (1990). Current Account and Budget Deficits: Twins or Distant Cousins? *The Review of Economics and Statistics*, 72(3):373–381.

Falk, B. (1984). Further Evidence on the Asymmetric Behavior of Economic Time Series over the Business Cycle. ISU General Staff Papers 198409010700001146, Iowa State University, Department of Economics.

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in gaussian vector autoregressive models. *Econometrica*, 59(6):1551–1580.

Kahneman, D. and Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, 47(2):263–291.

Kim, S. and Roubini, N. (2008). Twin deficit or twin divergence? Fiscal policy, current account, and real exchange rate in the U.S. *Journal of International Economics*, 74(2):362–383.

Leachman, L. and Francis, B. (2002). Twin Deficits: Apparition or Reality? *Applied Economics*, 34(9):1121–1132.

Lütkepohl, H. (2007). *New Introduction to Multiple Time Series Analysis*. Springer Berlin Heidelberg.

Miller, S. M. and Russek, F. S. (1989). Are The Twin Deficits Really Related? *Contemporary Economic Policy*, 7(4):91–115.

Neftci, S. N. (1984). Are Economic Time Series Asymmetric over the Business Cycle? *Journal of Political Economy*, 92(2):307–328.

Salvatore, D. (2006). Twin deficits in the G-7 countries and global structural imbalances. *Journal of Policy Modeling*, 28(6):701–712.

Schmitt-Grohé, S., Uribe, M., and Ramos, A. (2008). *International macroeconomics*. Duke University Durham, NC, USA.

Schorderet, Y. (2003). Asymmetric cointegration.

Summers, L. H. (1986). Tax policy and international competitiveness. Working Paper 2007, National Bureau of Economic Research.

Tang, T. C. (2013). Twin Deficits: An Alternative Framework from General Equilibrium Perspective with U.S. Results. Monash Economics Working Papers 41-13, Monash University, Department of Economics.

Toda, H. Y. and Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics*, 66(1-2):225–250.

Trachanas, E. and Katrakilidis, C. (2013). The dynamic linkages of fiscal and current account deficits: New evidence from five highly indebted European countries accounting for regime shifts and asymmetries. *Economic Modelling*, 31(C):502–510.

references

Appendix

Data Specification and Sources

GDP data collected from the Office for National Statistics (ONS) website. FD_t is General Govern-ment net borrowing(% of GDP), collected from OECD Stat(Economic Outlook no 110).$RBINT_t$ is the real interest rate, which is have calculated as the difference between end of quarter Bank of England- Bank Rate and quarter on quarter growth rate of the GDP deflator, collected from the Bank of England website and ONS website respectively. $RTEN\_YR_t$ is the real bond rate calu-lated in a similar fashion as $RBINT_t$, the ten year bond rate is collected from collected from OECD Stat(Economic Outlook no 110).$REER_t$ CPI-based real effective exchange rate, $NEER_t$ is the nom-inal effective exchange rate, both collected from the International Financial Statistics database of the IMF. CA_t is Trade balance plus net primary income(% of GDP), CAD_t is defined as the negative of CA_t, collected from the ONS website.

VECM Stability

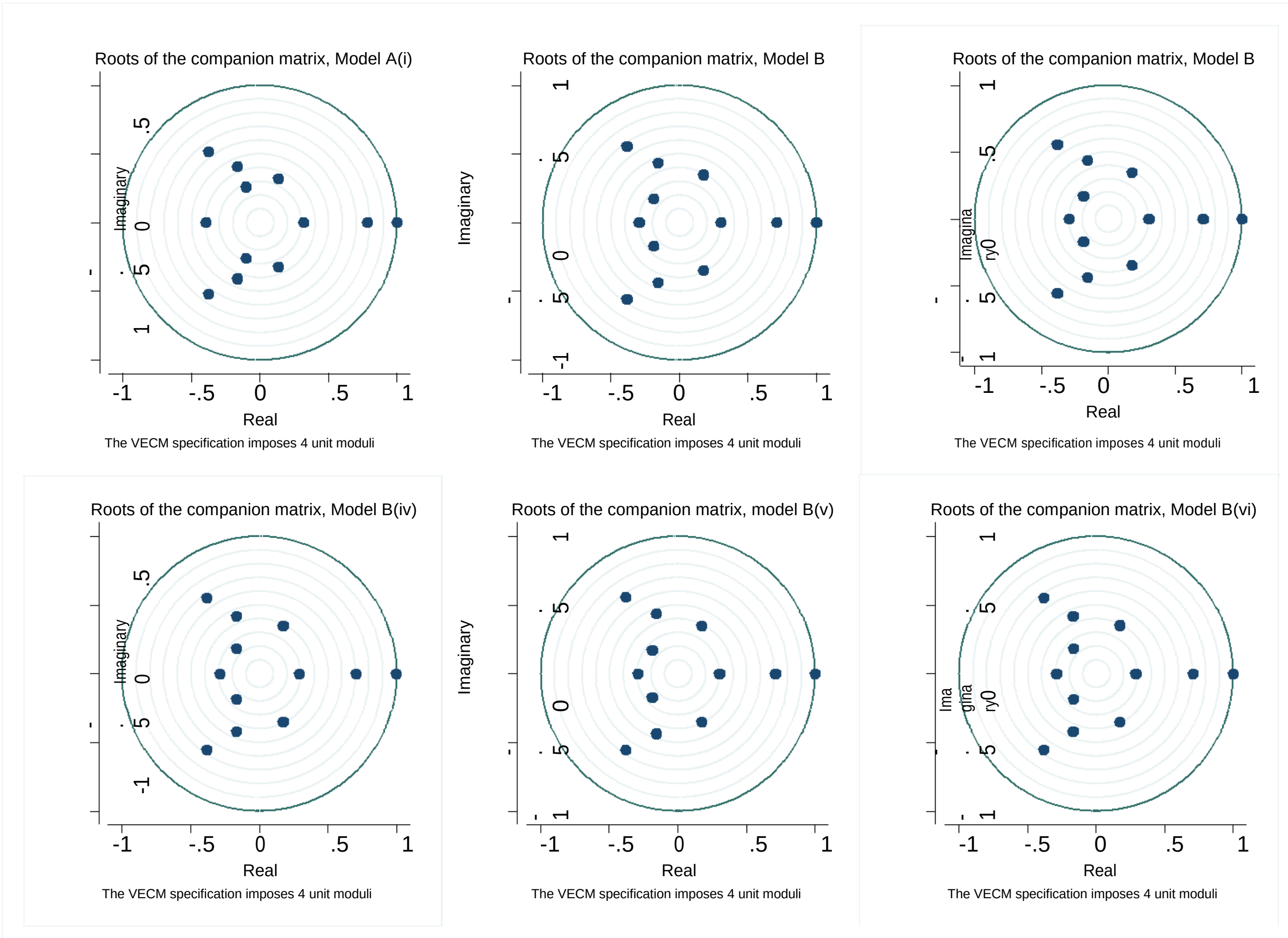

Figure 5: VECM Stability Main models

All VECMs satisfy the stability condition

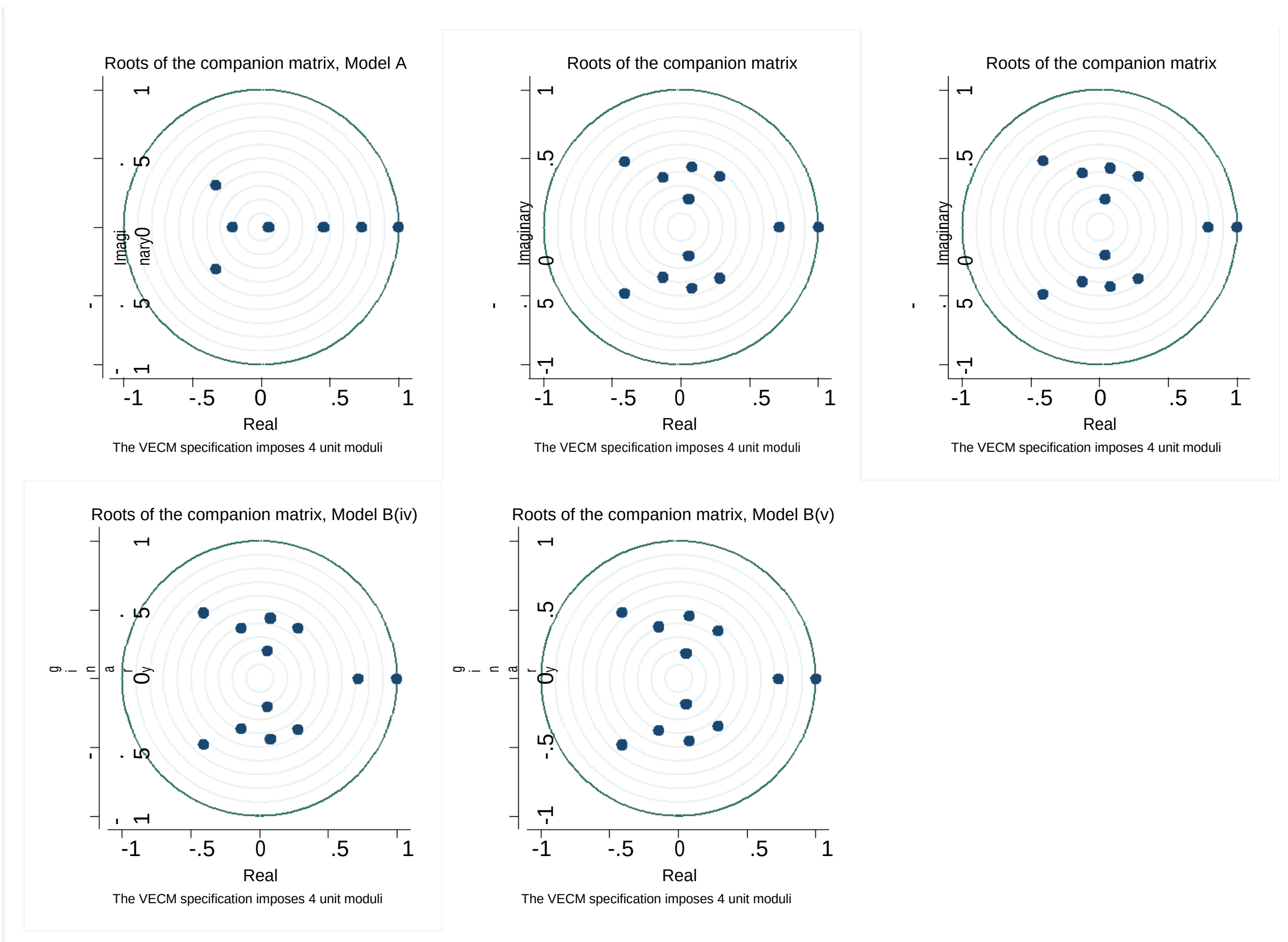

Figure 6: VECM Stability Robustness Section
All VECMs satisfy the stability condition

	Model A (Zero Restriction)
Adjustment Parameters	
D_LRGDP	
L._ce1	0.002
	(0.001)
D_FD	
L._ce1	-0.322
	(0.123)
D_RBINT	
L._ce1	0.065
	(0.101)
D_REER	
L._ce1	-0.353
	(0.233)
D_CAD	
L._ce1	-0.148
	(0.063)
Long run estimates	
LRGDP	-3.111
	(1.246)
FD	0.369
	(0.109)
RBINT	0.000
	(0.000)
REER	0.071
	(0.030)
CA	1.000
	(0.000)
Identification	CA=1
	RBINT=0
LR Test	
$\chi^2_1 = 3.678$	

Standard errors in parentheses
$p < 0.10$, $p < 0.05$, $p < 0.01$

Table 11: Model A Zero Restriction.

VECM autocorrelation tests

LM test for Auto Correlation Model A			
Model A(i)			
Lags	chi2	df	P-value
1	27.82	25	0.3163
2	24.40	25	0.4965
3	26.45	25	0.3840
4	20.63	25	0.7132
Model A(ii)			
1	28.93	25	0.2667
2	29.65	25	0.2376
3	28.57	25	0.2822
4	24.40	25	0.4962
LM test for Auto Correlation Model B			
Model B(i)			
1	18.25	25	0.8315
2	28.86	25	0.2699
3	34.13	25	0.1051
4	22.54	25	0.6043
Model B(ii)			
1	18.41	25	0.8243
2	28.81	25	0.2720
3	33.57	25	0.1174
4	22.76	25	0.5916
Model B(iii)			
1	14.26	25	0.9571
2	30.90	25	0.1923
3	31.50	25	0.1731
4	25.18	25	0.4523
Model B(iv)			
1	17.54	25	0.8614
2	28.84	25	0.2705
3	34.23	25	0.1032
4	21.69	25	0.6535
Model B(v)			
1	18.21	25	0.8333
2	28.91	25	0.2677
3	34.02	25	0.1074
4	22.58	25	0.6019
Model B(vi)			
1	17.34	25	0.8693
2	28.87	25	0.2694
3	34.21	25	0.1035
4	21.73	25	0.6514

Table 12: LM test for Auto Correlation: Main Models.

LM test for Auto Correlation Model A

Model A			
Lags	chi2	df	P-value
1	30.38	25	0.2105
2	31.84	25	0.1627
3	13.70	25	0.9668
26.59	25	0.3765	

LM test for Auto Correlation Model B

Model B(i)			
1	28.84	25	0.2706
2	28.65	25	0.2787
3	26.41	25	0.3859
4	33.17	25	0.1268
Model B(iii)			
1	26.71	25	0.3705
2	29.85	25	0.2299
3	30.01	25	0.2239
4	33.34	25	0.1228
Model B(iv			
1	28.83	25	0.2711
2	28.18	25	0.2997
3	25.16	25	0.4534
4	32.95	25	0.1322
Model B(v			
1	31.40	25	0.1762
2	29.46	25	0.2452
3	25.28	25	0.4467
4	33.87	25	0.1108

Table 13: LM test for Auto Correlation: Robustness section.