The budget and current account balance: a case of twin deficits, twin divergence or Ricardian equivalence?

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Abstract

This study contributes to the debate concerning the nature of relationship between the budget and current account balance. Using a regime-switching framework applied to US data over a 1960-2008 study period, twin deficits or twin divergence best describes their long-run relationship. Whereas the budget and current account balance may exhibit short-run divergent behavior resulting from a positive technological shock, such shocks also increase the probability of being in a regime characterized by a long-run positive equilibrium relationship consistent with a Keynesian viewpoint of twin deficits.

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1. Introduction

For many, macroeconomic stability and well-being is judged on the behavior of the budget and current account deficits (*BDEF* and *CADEF*). While compliance with an intertemporal budget constraint and therefore sustainability may be revealed by their time-series properties (see, for example, Sarno (2001) and Raybaudi et al (2004)), how the two deficits might be related is also of interest. The standard Mundell-Fleming analysis argues that a deficit-financed expansionary fiscal policy will lead to an increased trade deficit through either stimulated income growth (under a fixed exchange rate) or exchange rate appreciation. This gives rise to *twin deficits* based on a positive co-movement. This leads to the possibility of using the *BDEF* as a means of influencing the *CADEF*. By contrast, a Ricardian equivalence scenario suggests there is no positive co-movement. Domestic residents may anticipate the government raising taxes in the future to close the fiscal gap in order to pay back the accumulated debt. There is also a third scenario that portrays the possibility of a negative relationship between the deficits where, for example, output shocks give rise to endogenous movements of the *BDEF* and *CADEF* that are divergent [see, for example, Kim and Roubini (2008)].

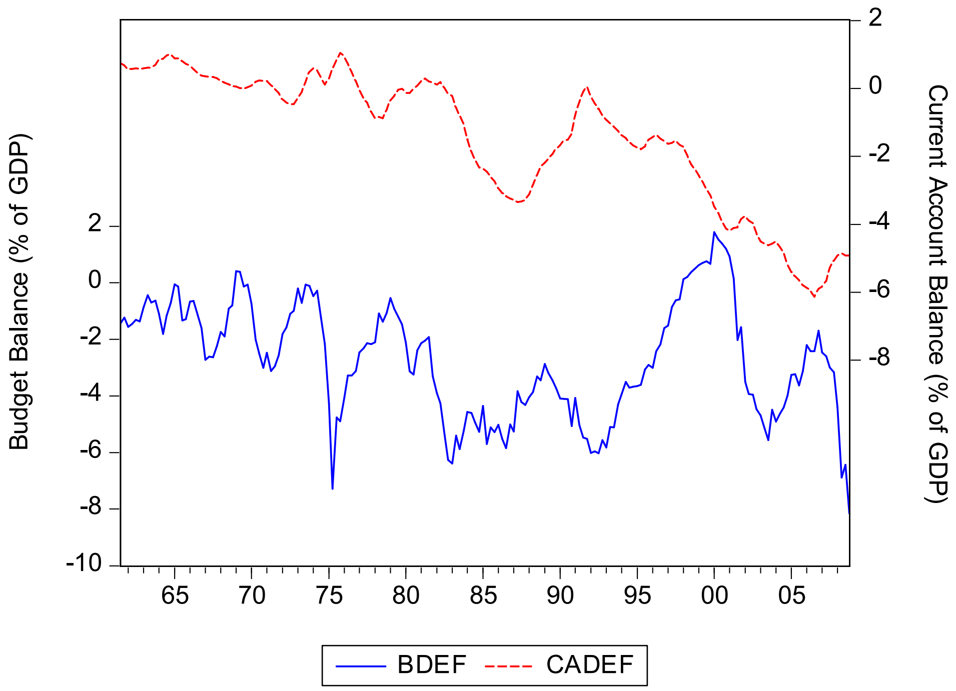
As indicated by Cavallo (2005) and Kim and Roubini (2008), existing studies employ a variety of modeling approaches. In addition to standard Keynesian models, these approaches include calibrated international real business cycle models and general equilibrium endowment economy models. A further dimension to the debate is that the relationship may also depend on factors such as the nature of the government budget deficit, the characteristics of countries under consideration, the international asset market structure, and the specifications of the model. A large number of studies confirm either in a time series, cross section, or panel setting, the budget balance-external balance nexus (see, for example, Chinn and Prasad (2003), Bartolini and Lahiri (2006), Bagnai (2006), Salvatore (2007)). These studies generally focus on the medium- to long-run, and control for other variables (typically, the rate of growth, private saving, private investment and so on). Almost invariably, a coefficient around 0.3 is found to tie the two deficits in the long-run. In contrast to this, studies such as Leachman and Francis (2002) assess the long-run relationship between the two deficits for the US but provide mixed evidence. Using a range of cointegration techniques, they find that fiscal deficits contribute towards current account deficits. However, the relationship is time-specific and generally rather weak. More recently, Grier and Ye (2009) argue that the difficulty pinning down a statistically robust relationship between the budget and current account deficits has been largely due to the failure to allow for structural breaks in the series when (either explicitly or implicitly) modeling their time series properties.

Bearing in mind the above discussion, this paper investigates the nature of the relationship between the *BDEF* and *CADEF*. In doing so, a significant contribution to the twin deficits debate is made in two ways. First, there is consideration of the possibility of non-linearities in their relationship. Existing studies have relied on linear-based methodologies and have neglected the possibility of structural breaks. Using a Markov-switching framework, there is an assessment of how the relationship may have been subject to regime-shifts thereby changing over time. Second, there is an evaluation of the hypothesis entertained by Kim and Roubini (2008) that the lack of strong positive correlation between government budget deficits and current account deficits may be explained by endogenous movements in the *BDEF* and *CADEF*. For example, in the event of positive technological shocks, the *CADEF* might worsen as the *BDEF* improves. In other words, we may observe a *twin divergence*, rather than a twin deficit, as a result of this. This hypothesis is tested through modeling the transition probabilities between regimes as endogenous and dependent on the Solow residual.

2. Estimation, Data and Results

Quarterly data are obtained from the *Bureau of Economic Analysis* for the *BDEF* and *CADEF* (both expressed as a percentage of GDP) for the study period 1960Q1-2008Q4. The two deficits are plotted in Figure 1 which points to periods where they have moved together as well as drifted apart. While both deficits have generally increased in size over the study period, the episodes of sharp swings in their relationship makes it very likely that regime switches and structural breaks exist. For example, Kim and Roubini (2008) hypothesize that a technology shock associated with the U.S. New Economy and IT boom in the 1995–2000 period led to an investment boom that worsened the current account. At the same time, they suggest that the economic boom led to an improvement of the fiscal balance (given automatic stabilizers on the tax and spending side). This, they argue, may explain why the current account worsened in the U.S. in the 1990s while the fiscal balance was improving (as shown in Figure 1).

Figure 1. US Budget and Current Account Balances, 1960-2008.



Now, suppose the two deficits are part of a long-run cointegrating relationship described as

$$CADEF_t = \upsilon + \omega BDEF_t + \mu_t \,. \tag{1}$$

where μ_t denotes the cointegrating residual. If both the *CADEF* and *BDEF* are non-stationary with μ_t following a mean-reverting process and $\omega > 0$, then this is consistent with the two deficits moving together in the long-run and therefore supportive of a Keynesian view of the twin deficits relationship. If, however, μ_t is non-stationary, then this scenario is consistent with either the Ricardian equivalence view of no long-run relationship or twin divergence where the deficits are drifting apart.

Table 1. Unit root tests on US budget and current account balance

	ADF	DF-GLS
BDEF	-0.806	0.382
CADEF	-1.340	-0.619

Notes: These are ADF and Elliot *et al*. (1996) DF-GLS unit root tests conducted on the US budget balance, current account balance (excluding a deterministic trend). The lag lengths are based on the modified SIC where the respective 10% critical values are -2.57 and -1.62.

Table 2. Perron (1997) unit root tests

4	IO1		IO2		AO	
	T_b	$t_{\hat{\alpha}}$	T_b	$t_{\hat{\alpha}}$	T_b	$t_{\hat{\alpha}}$
CADEF	2001Q3	-4.379	1971Q4	-3.968	1971Q1	-3.747
BDEF	1992Q4	-3.463	1996Q1	-4.191	2006Q2	-3.528

The models are the *Innovational Outlier model* (IO1) incorporating a change in the intercept, *the Innovational Outlier model* (IO2) incorporating a change in the intercept and the slope, and the *Additive Outlier* (AO) model incorporating a change in the slope only, but both segments of the trend function are joined at the time break. T_b denotes the time of the break and $t_{\hat{\alpha}}$ denotes the test statistic for a unit root. The respective 10% critical values are -4.82, -5.25 and -4.38.

Table 3. Cointegration tests on US budget and current account balance

τ (Engle-Granger)	τ (Phillips-Ouliaris)	*Trace* (Johansen)
-1.943 (0.559)	-1.263 (0.842)	13.239 (0.106)

Notes: τ (Engle-Granger) and τ (Phillips-Ouliaris) refer to the non-cointegration tests advocated by Engle and Granger (1987) and Phillips and Ouliaris (1990). *Trace* refers to the Trace statistic advocated by Johansen (1991) for the null hypothesis of no cointegrating vectors involving CADEF and BDEF. In each case, *p*-values are reported in parentheses.

Table 1 reports Augmented Dickey Fuller (ADF) and DF-GLS unit root tests conducted on *BDEF* and *CADEF*. In each case, the non-stationary null cannot be rejected at the 10% significance level. Table 2 reports results based on the Perron (1997) unit root tests that allow for a single (unknown) structural break. Three models are considered for both series, but the non-stationary null is still accepted throughout at the 10% significance level. Estimation of equation (1) as a potential cointegrating relationship by fully modified OLS (FMOLS) provides the result $CADEF_t = -0.789 + 0.238BDEF_t + \mu_t$. Table 3 reports tests for non-cointegration based on equation (1) using procedures advocated by Engle-Granger

(1987), Phillips and Ouliaris (1990) and Johansen (1991). In each case, the non-cointegration null is accepted at the 10% significance level and implies a lack of support for the Keynesian viewpoint of the deficits relationship.

It can be argued that this approach towards testing for cointegration or the non-stationarity of μ_t is too restrictive. Suppose μ_t is generated by the autoregressive process, $\mu_t = \varsigma + \phi\mu_{t-1} + v_t$. Following a transformation, the usual test for linear adjustment towards mean value is based assessing the unit root properties of μ_t through the OLS estimation of ADF regressions such as

$$\Delta\mu_t = \varsigma + \rho\mu_{t-1} + \sum_{i=1}^{k}\psi_i\Delta\mu_{t-i} + v_t \tag{2}$$

where v_t is a white noise residual and $\rho = (\phi - 1)$. Here we find that $-2 < \rho < 0$ (consistent with $|\phi| < 1$) indicates stationarity of μ_t and therefore is an indicator of twin deficits that are moving together over time. However, the dynamic behavior of μ_t in terms of the autoregressive parameter ϕ might be subject to regime shifts and if so, it is possible to improve on econometric approaches based on equation (2) that make no allowance for this. This provides a case for examining the stationarity of μ_t within a regime-switching context.

Suppose a discrete random variable S_t takes two possible values [S_t=(0,1)] and serves as an indicator for the state of the world regarding μ_t at time *t*. The expected component of $\Delta\mu_t$, conditional on the value of S_t, is given as follows:

$$\begin{aligned} E(\Delta\mu_t \mid S_t) = {} & [(1-S_t)\alpha_0 + S_t\alpha_1] + (1-S_t)\lambda_0\mu_{t-1} + S_t\lambda_1\mu_{t-1} \\ & + \sum_{i=0}^{l}\gamma_i y_{t-i} + + \sum_{i=0}^{l}\pi_i sav_{t-i} + \sum_{i=1}^{l}\xi_i\Delta\mu_{t-i} + \varepsilon_t \end{aligned} \tag{3}$$

where $\varepsilon_t \sim i.i.d.N(0,\sigma_\varepsilon^2)$. The impact of technological shocks (*y*) is incorporated through γ_i where $\gamma_i < 0$ corresponds to a scenario where economic recessions (booms) lead to falls (rises) in output and a worsening (improvement) in fiscal balances. At the same time, the current account might improve (worsen) when the fall (rise) in output leads to a fall (rise) in investment that is sharper than the fall (rise) in national savings. Therefore, economic recessions (booms) might be associated with a rise (fall) in μ_t. This enables us to address the possibility that the lack of strong positive correlation between the deficits might be explained by endogenous movements of the *BDEF* and the *CADEF*. The impact of private saving (*sav*) is incorporated through π_i where $\pi_i > 0$. It can be argued that the behavior of US households has been instrumental in the behavior of the current account. This is manifested in a high correlation between the current account and private saving and reflects the boost in recent years of deficit-financed private consumption that has propelled household debt such that it is significantly above annual disposable income. The unobserved indicator variable S_t is assumed to evolve according to the first-order Markov-switching process described in Hamilton (1989):

$$\begin{aligned} &P[S_t = 0 \mid S_{t-1} = 0] = p = \Phi(\delta_0) \\ &P[S_t = 1 \mid S_{t-1} = 0] = 1 - p \\ &P[S_t = 1 \mid S_{t-1} = 1] = q = \Phi(\delta_1) \\ &P[S_t = 0 \mid S_{t-1} = 1] = 1 - q \end{aligned} \tag{4}$$

where *p* and *q* are the fixed transition probabilities of being in Regime 0 or 1 respectively with $0 < p, q < 1$, and $\Phi(\ )$ is the cumulative normal distribution function ensuring that the transition probabilities lie in the open interval $(0,1)$.

The model defined by equations (3) and (4) can be denoted as the Model I. Stationarity in both regimes is confirmed if $-2 < \lambda_0, \lambda_1 < 0$. If $-1 < \lambda_0, \lambda_1 < 0$, the half-life associated with a deviation from long-run equilibrium may be approximated as $HL_0 = (\ln 0.5)/(1+\lambda_0)$ and $HL_1 = (\ln 0.5)/(1+\lambda_1)$ for Regimes 0 and 1 respectively. In this scenario, $\lambda_0 \neq \lambda_1$ is supportive of the Keynesian twin deficits relationship in both regimes albeit with autoregressive coefficients and speeds of adjustment towards long-run equilibrium that are different. On the other hand, we may only be able to confirm that either λ_0 or λ_1 is negative and significantly different from zero. In this case, μ_t is switching between regimes of stationarity (or Keynesian twin deficits) and non-stationarity (Ricardian equivalence).

This modeling approach enables us to consider an additional channel through which technological shocks might affect the deficits relationship through extent to which technological shocks are responsible for influencing any switching into Regime 0 or Regime 1. Extending the fixed two-state Markov-switching chain to allow for the possibility of time-varying transition probabilities enables us to specify:

$$P[S_t = 0 \mid S_{t-1} = 0, \Omega_{t-1}, \Omega_{t-2}, \cdots] = p_t = \Phi\left(\delta_0 + \sum_{i=0}^{m} \vartheta_i \Omega_{t-i}\right)$$

$$P[S_t = 1 \mid S_{t-1} = 1, \Omega_{t-1}, \Omega_{t-2}, \cdots] = q_t = \Phi\left(\delta_1 + \sum_{i=0}^{n} \kappa_i \Omega_{t-i}\right) \quad (5)$$

where Ω denotes the candidate variable driving the transition probabilities namely the Solow residual. This gives rise to Model II characterized by equations (3) and (5).

Table 3. Estimation of the regime-switching model

Regime-variant coefficients			
Regime 0		Regime 1	
Mean equation			
α_0	0.021 (0.020)	α_1	0.003 (0.019)
λ_0	0.028^{***} (0.009)	λ_1	-0.055^{***} (0.010)
Transition probabilities			
δ_0	-1.310 (1.594)	δ_1	-8.929^{*} (4.975)
ϑ_0	-1.920^{**} (0.814)	κ_0	4.093^{*} (2.268)
Regime-invariant coefficients			
γ_0	-0.012^{**} (0.005)		
π_0	0.163^{***} (0.020)		
ξ_1	0.499^{***} (0.056)		
σ	0.027^{***} (0.003)		
Hypothesis tests			
$\alpha_0 = \alpha_1$	0.405		
$\lambda_0 = \lambda_1$	59.014^{***}		
HL_0	N/A		
HL_1	12.159		

Notes: Estimates are for the regime-switching model described by equations (3) and (5) where $\mu_t = CADEF_t - 0.238BDEF_t + 0.789$ is obtained through the FMOLS estimation of equation (1). Standard errors are reported in parentheses. The superscripts ***, ** and * denote rejection of the zero null at the 1, 5 and 10% significance levels respectively. Chi-squared (1) are reported for these hypothesis tests.

Table 3 reports results for Model II.[i] Having started with a maximum of eight lags, the inclusion of one lagged value of $\Delta\mu$ and contemporaneous *y* and *sav* in equation (3) and contemporaneous Ω in equation (5) was found to be acceptable using various model selection procedures. The estimates of the log likelihood values associated with the estimation of a regime-invariant OLS version of equation (3) then Model II were respectively computed as 29.730 and 63.132 leading to the strong rejection of the single-regime model in favor of the regime-switching Model II. The significance of the estimated transition probabilities coefficients $\delta_1, \vartheta_0, \kappa_0$ further indicates the presence of regime-switching in the behavior of μ_t.

The nature of the relationship between the *CADEF* and *BDEF* can be initially assessed through an examination of the mean equation. In terms of estimated regime-invariant coefficients, it can be noted that $\gamma_0 < 0$ and is significantly different from zero. This suggests that a positive technological shock leads to a decline in μ_t as the *CADEF* and *BDEF* respectively worsen and improve. In this respect, twin divergence, at least in the short-run, is confirmed. In addition to this, $\pi_0 > 0$ and is significantly different from zero thereby confirming the positive relationship between the domestic private savings ratio and the current account balance. In terms of estimated regime-variant coefficients, the nature of the estimated autoregressive coefficients in the mean equation provides a further important insight into the deficits relationship. While λ_0 is positive and significantly different from zero, λ_1 is both negative and significant at the 1% level. There is also a clear rejection of the null $\lambda_0 = \lambda_1$. Regime 1 is therefore associated with the stationarity of μ_t with the implication that the two deficits move together in the long-run consistent with a Keynesian viewpoint. Following a shock to equilibrium, the estimate $\lambda_1 = -0.055$ provides an approximated half-life of 12.2 quarters as μ_t adjusts towards long-run equilibrium. Conversely, the non-stationarity of μ_t that characterizes Regime 0 is consistent with twin divergence insofar as the *CADEF* and *BDEF* drift apart over time. If we now turn to the estimated transition probabilities coefficients, $\kappa_0 > 0$ suggests that a positive technological shock will lead to an increase in the probability of remaining in Regime 1 that is characterized by cointegration between the *CADEF* and *BDEF*. Conversely, $\vartheta_0 < 0$ suggests that a positive technological shock will also lead to a decrease in the probability of remaining in non-stationary Regime 0. Although the positive technological shock initially drives the deficits apart in the short-run through $\gamma_0 < 0$, there is evidence that they are then more likely to move towards a long-run equilibrium relationship through a Regime switch.

Figure 2. Inferred Probability of Regime 1 and the Solow Residual.

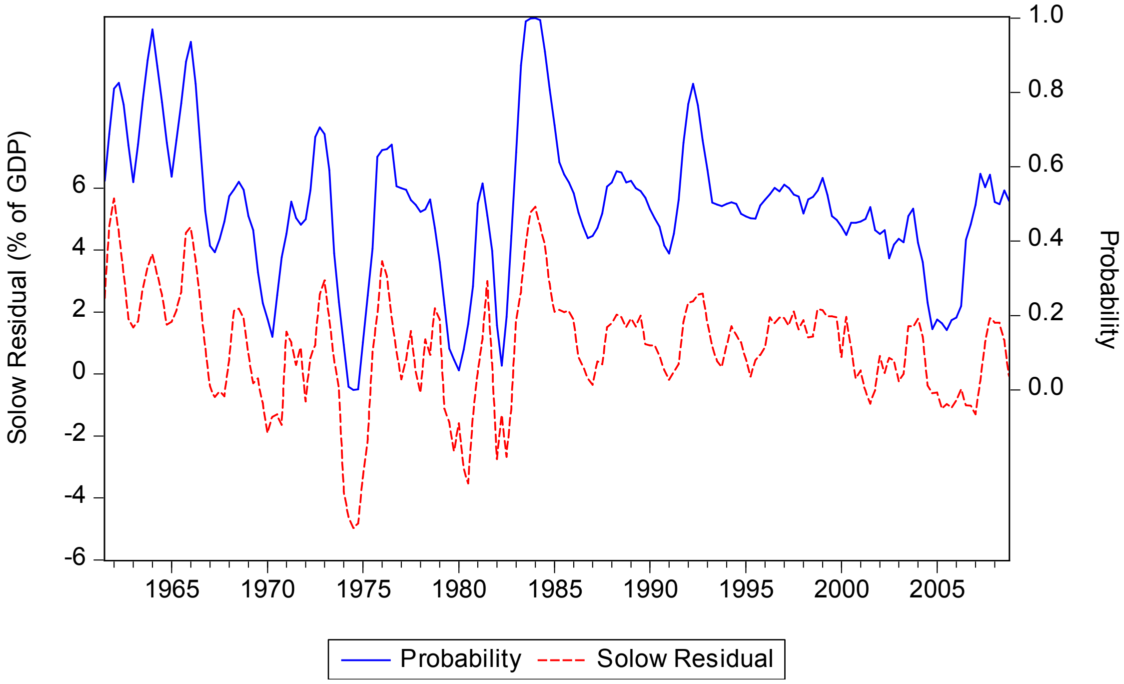


Figure 2 plots the inferred probabilities of being in stationary Regime 1 against the Solow residual. The mean value of the inferred probability is 0.49. This suggests that there is balanced support for the stationarity and non-stationarity of μ_t and in particular, for long-run twin deficits and twin divergence behavior. However, there are periods where the inferred probability rises noticeably such as the mid-1960s, mid-late 1970s, mid-1980s, and near the end of the study period prior to the recent global recession. Most of these periods are associated with relatively large positive spikes in the Solow residual which have served to increase the probability of being in the stationary or Keynesian regime. Conversely, declines in the Solow residual are generally associated with relatively higher inferred probabilities of being in non-stationary Regime 0. These periods include the mid-1970s, 1980 and early-mid 1980s and mid-2000s.

3. Conclusion

The existing theoretical literature on the relationship between the budget and current account balances provides mixed reasoning on whether or not, or how, they are related. This paper has contributed to this debate by examining the deficits relationship within a Markov regime-switching framework. Using a model that allows for endogenous switching between cointegration and non-cointegration regimes, there is a balanced tendency for the deficits to be characterized as being in a twin deficit or divergence regime. We find two roles for technological shocks to influence the deficits relationship. First, there is evidence consistent with a positive technological shock leading to an improvement in the budget deficit while worsening the current account. This is suggestive of short-run divergence as the deficits move apart. However, there is also evidence that such a shock increases the probability of the shifting to a Keynesian regime where the deficits act as twins being cointegrated and moving together in the long-run. This finding has an important implication for policy. In cases where positive technological or income shocks serve to worsen the current account, fiscal policy is likely to become more effective as a tool for controlling the size of the external imbalance in the long-run.

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Endnotes

[i] GDP, employment and capital stock data used to compute for the Solow residual, and data used to compute the private sector saving ratio are obtained from *Bureau of Economic Analysis*.