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Long memory and regime switching properties of current account deficits in the US

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ABSTRACT

Chen (2011) [Are current account deficits really sustainable in the G-7 countries? *Japan and the World Economy*, 23(3), 190–201.] examines whether or not the current account deficits of the US can be characterized by a unit root process with regime switching (MS-ADF). In this paper, we find that, if the empirical sample ends in 2008: Q4, the estimates obtained from the Markov switching unit root regression retain a reasonable two-state classification. If the sample is extended to 2009:Q1 or beyond, then the estimates of the Markov switching unit root regression become quite unreasonable and it is difficult to explain the results. We also find that this contradictory phenomenon can be resolved by estimating the Markov switching autoregressive fractionally integrated moving average model (MS-ARFIMA) proposed by Tsay and Härdle (2009) [A generalized ARFIMA process with Markov-switching fractional differencing parameter, *Journal of Statistical Computation and Simulation*, 79, 731–745.]. The estimates of the MS-ADF and MS-ARFIMA models show that there is a red signal that the current account deficits observed during the period were probably not on a sustainable path.

1. Introduction

A myriad of studies have devoted many efforts to the issue of current account sustainability.[1] One avenue to discuss this issue is to employ a linear unit root test, cointegration test, panel unit root and panel cointegration with a consideration being given to a structural break (e.g., Apergis et al., 2000; Arize, 2002; Baharumshah et al., 2003; Bergin and Sheffrin, 2000; Holmes, 2006, 2010; Ismail and Baharumshah, 2009; Lau and Baharumshah, 2005; Lau et al., 2006; Liu and Tanner, 2001). Basically, distinct results based on previous research are due to differences in methodology, approaches and samples and are subject to diverse interpretations, thus making it difficult to reach a corroborative position on the stationarity property of the current account.

Another avenue to examine this issue is adopting the nonlinear model. A good reason to explain this line of research is due to Chortareas et al. (2004) and Christopoulos and León-Ledesma (2010). Chortareas et al. (2004) point out that there are at least three channels that make the current account series a nonlinear process.[2] Christopoulos and León-Ledesma (2010) claim that changes in the current account affect agents' perceptions regarding risk, portfolio allocation decisions, and future policy changes; all these can also trigger adjustment dynamics that are not linear. Therefore, Chortareas et al. (2004), Christopoulos and León-Ledesma (2010) and Kim et al. (2009) have turned their attention to the adoption of more sophisticated nonlinear models to test the current account's sustainability. Readers are referred to Chen (2011) for a summary of recent contributions to current account sustainability after 2000.

The literature has so far typically provided a dichotomous answer: either they do, or they do not accept sustainability. Raybaudi et al. (2004) have proposed a different view on this issue. In particular, Raybaudi et al. (2004) pointed out that, given that the intertemporal national long-run budget constraint (LRBC) is a long-run condition, countries may face debt problems for periods when the long-run sustainability condition holds. Thus, their aim is to explore the situation in which countries might satisfy the LRBC, but face big enough short-run imbalances which might evolve into future violations of the LRBC. In doing so, they propose using a Markov switching unit root regression to identify periods under which the current account accumulates at a non-stationary rate. Chen (2011) picks up Raybaudi et al.'s (2004)

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[1] Intuitively, studies on the dynamic properties of the current account imply that, if stationarity is not observed, the country's current account will not be mean-reverting. If this behavior is perpetuated in the future, the country will end up in bankruptcy and will be cut off from international capital markets unless an unexpected shock brings it back into equilibrium.

[2] The first source of nonlinearity is the twin-deficit channel. A second channel that leads to nonlinearity is the level of a country's indebtedness, which reflects the willingness of foreign lenders to hold domestic assets. The third channel comes from the transaction cost.

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idea and re-examines whether or not the deficits in the current account of the G-7 and OECD countries are sustainable or not.

However, we find an interesting and contradictory phenomenon in examining the US current account deficit by using the Markov switching unit root regression. It is found that, if the empirical sample ends in 2008:Q4, the estimates from the Markov switching unit root regression retain a reasonable two-state classification. However, if the sample is extended to 2009:Q1 or beyond, the estimates of the Markov switching unit root regression become quite unreasonable and it is hard to explain the results (see the Data and results section for the details).

The purpose of this paper is to attempt to provide a solution for this phenomenon. We take Dülger and Ozdemir's (2005) suggestion into account in building the model. They show that the US current account deficits are better characterized by the fractionally integrated process and should be included in the model. In order to incorporate this feature into the model, we adopt the Markov switching autoregressive fractionally integrated moving average model (hereafter, MS-ARFIMA) proposed by Tsay and Härdle (2009) to achieve this goal. The MS-ARFIMA model is a synthesis of the fractionally integrated and Markov switching models. Therefore, the advantage of this model is that it can catch not only the long memory property but also the regime switching property of the current account deficit.

The remainder of this paper is organized as follows. Section 2 briefly discusses the theoretical model of the current account. Section 3 introduces the econometric methodology that we employ, and Section 4 describes the data and the empirical test results. Section 5 presents the conclusions that we draw from this research.

2. Theoretical background

The intertemporal model of the current account provides the optimal current-account path based on the behavior of a representative agent who is infinitely-lived and smoothes consumption over time by lending or borrowing abroad. This approach considers the current account from a savings–investment perspective. Following earlier studies such as Trehan and Walsh (1991) and Hakkio and Rush (1991), let us consider an economy with the following two-period budget constraint:

$$C_t + I_t + G_t + B_t = Y_t + (1 + r_t)B_{t-1}, \quad (1)$$

where C_t, I_t, G_t, B_t, Y_t and r_t are the consumption, investment, government expenditure, net foreign assets, income, and the world interest rate, respectively. Rearranging Eq. (1) we have

$$B_t = (1 + r_t)B_{t-1} + Y_t - C_t - I_t - G_t = (1 + r_t) + NX_t \quad (2)$$

where NX_t is the country's net exports defined as $NX_t = Y_t - C_t - I_t - G_t$. Let $R_t = 1 + r_t$ with expected value $E(R_{t+j}|I_{t-1}) = R$ for all t and $i \geq 1$ and Ω_{t-1} be the information set available at time $(t-1)$. Following Trehan and Walsh (1991, p. 209), we may iterate this equation forward in time, solving recursively, to obtain the result that the current credit (debt) position must be offset, in expected value terms, by future deficits (surpluses). Iterating Eq. (2) forward, we can derive

$$B_{t-1} = -\sum_{j=0}^{\infty} R^{-(j+1)} E\left(NX_{t+j}|\Omega_{t-1}\right) + \lim_{j\to\infty} R^{-(j+1)} E\left(B_{t+j}|\Omega_{t-1}\right). \quad (3)$$

We define the LRBC hypothesis so that the last term in Eq. (3) must equal to zero,

$$LRBC : \lim_{j\to\infty} R^{-(j+1)} E\left(B_{t+j}|\Omega_{t-1}\right) = 0, \quad (4)$$

which states that the present discounted value of the stock of assets must converge to zero as t tends to infinity. Eq. (4) is also referred to as a Non-Ponzi game condition. Trehan and Walsh (1991) show that, given that the current account $CA_t = B_t - B_{t-1}$, a sufficient condition for Eq. (4) to hold is that the current account be stationary. If the growth rate of an economy is positive, then current-account sustainability holds if the ratio $y_t = \frac{CA_t}{Y_t}$ is stationary. This means that sustainability is possible with perpetual current account deficits as long as they do not grow faster than output in terms of expected value. In this case, the sustainability hypothesis implies that the

Table 1
Results from a battery of unit root tests.

	1970:Q1–2008:Q4	1970:Q1–2009:Q1	1970:Q1–2012:Q1	5% c.v.
ADF	−2.704	−2.586	−2.488	−3.15
Z_α	−8.505	−8.294	−8.020	−17.300
MZ_α	−8.261	−8.070	−7.828	−17.300
MZ_t	−2.029	−1.906	−1.894	−2.910
MSB	0.245	0.236	0.242	0.168
ERS–PT	11.075	11.538	11.751	5.480
MPT	11.039	11.600	11.870	5.480
ADF–GLS	−2.089	−1.959	−1.941	−2.910

ADF: augmented Dickey–Fuller test. Z_α: Phillips and Perron (1988). ERS–PT and ADF–GLS are proposed by Elliott et al. (1996). MZ_α, MZ_t, MSB and MPT are proposed by Ng and Perron (2001).

Table 2
Estimation results of the MS-ADF model without the lagged Δy_t.

	1970:Q1–2008:Q4	1970:Q1–2009:Q1	1970:Q1–2012:Q1
μ_0	−0.006 (0.058)	1.171 (0.376)	1.165 (0.356)
μ_1	−0.203 (0.096)	−0.092 (0.039)	−0.093 (0.038)
σ_0	0.341 (0.020)	0.326 (0.019)	0.320 (0.018)
p_{00}	0.960 (0.038)	0.000[a] (0.001)	0.000[b] (0.000)[c]
p_{11}	0.975 (0.020)	0.980 (0.013)	0.981 (0.012)
ϕ_0	−0.128 (0.064)	−0.102 (0.129)	−0.104 (0.122)
ϕ_1	−0.042 (0.025)	−0.022 (0.013)	−0.023 (0.013)
L^*	−60.565	−59.711	−60.629
Diagnostic test of the residuals			
LB_0	264.946 [0.00]	96.991 [0.00]	120.612 [0.00]
$ARCH_0(4)$	4.531 [0.00]	8.739 [0.00]	8.518 [0.00]
LB_1	20.077 [0.69]	22.973 [0.52]	22.714 [0.54]
$ARCH_1(4)$	0.344 [0.85]	0.341 [0.85]	0.319 [0.86]

(1) $S_t = 0$ is the stable regime. $S_t = 1$ is the unstable regime. (2) Figures in parentheses are standard errors. The numbers in square brackets are p-values. (3) 0.000[a] indicates that this figure equals 0.000005. (4) 0.000[b] indicates that this figure is less than 0.000001. (5) (0.000)[c] indicates that this figure equals (0.00004). (6) L^* denotes the log-likelihood function of the MS-ADF model. (7) LB_i, $i = 0, 1$, denotes the Ljung–Box test in regime i. (8) $ARCH_i(4)$, $i = 0, 1$, denotes the ARCH test of order 4 in regime i.

Table 3
Estimation results of the MS-ADF model with one-order of lagged Δy_t.

	1970:Q1–2008:Q4	1970:Q1–2009:Q1	1970:Q1–2012:Q1
μ_0	0.342 (0.139)	0.391 (0.116)	0.400 (0.124)
μ_1	−0.116 (0.044)	−0.126 (0.040)	−0.121 (0.039)
σ_0	0.316 (0.019)	0.292 (0.020)	0.292 (0.019)
p_{00}	0.979 (0.013)	0.867 (0.060)	0.890 (0.051)
p_{11}	0.714 (0.191)	0.000[b] (0.000)	0.000 (0.000[b])
ϕ_0	−0.822 (0.230)	−0.118 (0.043)	−0.116 (0.045)
ϕ_1	−0.027 (0.014)	−0.019 (0.013)	−0.021 (0.013)
$\gamma_{1,0}$	0.862 (0.274)	1.466 (0.245)	1.473 (0.253)
$\gamma_{1,1}$	−0.083 (0.078)	−0.046 (0.071)	−0.014 (0.066)
L^*	−54.234	−53.417	−55.035
Diagnostic test of the residuals			
LB_0	2204.134 [0.00]	58.241 [0.00]	61.928 [0.00]
$ARCH_0(4)$	432.627 [0.00]	1.824 [0.12]	1.119 [0.34]
LB_1	21.139 [0.63]	24.984 [0.40]	23.221 [0.50]
$ARCH_1(4)$	0.157 [0.96]	0.316 [0.87]	0.352 [0.84]

(1) $S_t = 0$ is the stable regime. $S_t = 1$ is the unstable regime. (2) Figures in parentheses are standard errors. The numbers in square brackets are p-values. (3) 0.000[a] indicates that this figure equals 0.000005. (4) 0.000[b] indicates that this figure is less than 0.000001. (5) (0.000)[c] indicates that this figure equals (0.00004). (6) L^* denotes the log-likelihood function of the MS-ADF model. (7) LB_i, $i = 0, 1$, denotes the Ljung–Box test in regime i. (8) $ARCH_i(4)$, $i = 0, 1$, denotes the ARCH test of order 4 in regime i.