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Red signals: current account deficits and sustainability

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Abstract

This paper proposes a method to asses the potential problems of sustainability of a country's sovereign debt. We claim that the relevant variables used for this analysis are typically subject to changes that are associated with changes in macroeconomics policies. We propose a procedure for identifying periods under which the current account accumulates at a non-stationary rate. Our approach is based on imposing identifying restrictions on Markov switching type models. Empirical applications of the procedure to Argentina, Brazil, Japan, UK and USA are examined and discussed.

Keywords: Deficits sustainability; Markov switching ADF

JEL classification: C22; E31; G12

1. Introduction

The persistence of trade deficits has been the focus of study of many academics and has been a main concern of policy makers. One view is that trade deficits are, to some extent, irrelevant since they only represent the ability of a country to borrow from abroad (countries with more-developed capital markets are more likely to be able to borrow). The crucial question, however, is whether accumulating debt over time (as a result of the existence of the trade deficits) is sustainable. Different tests have been developed to provide an answer to this question. These tests basically assume as 'given' the rate of growth of the

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economy (and the pattern for the trade balance), thus implying that the economy will continue to evolve as it did in the past. For example, Trehan and Walsh (1988, 1991) and Taylor (2002) have argued that for the debt to be sustainable the current account has to be mean reverting. This type of tests (see Trehan and Walsh, 1991 for a survey) typically provide a dichotomous answer: they do (or do not) reject sustainability.

This paper proposes an alternative, complementary procedure, motivated by the fact that the stochastic properties of the variables in question are typically subject to breaks which are a reflection of policy changes taking place over the sample. Since the problem is essentially one of distinguishing the stationary periods from the non-stationary ones, we propose the use of a switching augmented Dickey Fuller (ADF) model as in Hall et al. (1999). In our application, we impose identifying restrictions which characterize a state as associated with periods where the current account is non-stationary, and the other state as associated with periods under which it is stationary, and therefore, it appears to be consistent with the long-run budget constraint.

A nice feature of our analysis is that it can accommodate situations when the economy may depart for several sub-periods from the sustainable path even though the debt might be sustainable (in the long-run). Visual inspection based on filter probabilities is used to select periods during which a change in policy is required for the economy not to enter into an unsustainable path.

1.1. A simple sustainability condition

Consider an economy which grows at a rate g_t, with $E(g_t)=g$, where the nominal interest rate is r_t, with $E(r_t)=r$. Also, $b_t=B_t/y_t$ denotes the level of real debt, where y_t denotes output and b_t-b_{t-1} is the current account. A country's external balance constraint can be written as

$$b_t = i_t b_{t-1} + m_t - x_t, \tag{1}$$

where $x_t=X_t/y_t$ is exports as a percentage of output, $m_t=M_t/y_t$ is imports as a percentage of output, and $i_t=(1+r_t)/(1+g_t)$. Solving forward Eq. (1), we obtain the following expression for the level of debt:

$$b_{t-1} = -\sum_{j=0}^{\infty} E(t\rho_{t+j}^{-1}(x_{t+j}-m_{t+j})\,|\,I_{t-1}) + \lim_{j\to\infty} E(t\rho_{t+j}^{-1} b_{t+j}\,|\,I_{t-1}), \tag{2}$$

where $t\rho_{t+j}=\prod_{v=0}^{j} i_{t+v}$.

Trehan and Walsh (1988, 1991) have shown that a sufficient condition for the intertemporal national long-run budget constraint (LRBC) to hold (when $\lim_{j\to\infty} E(t\rho_{t+j}^{-1}b_{t+j}|I_{t-1})=0$) is that i_t is a stochastic process strictly bounded from below by $\delta>0$ in expected value, and that b_t-b_{t-1} is stationary.

This condition can easily be derived by noticing that if b_t-b_{t-1} is stationary, it has a moving average representation

$$b_t - b_{t-1} = \delta + \psi(L)\varepsilon t,$$

which can be written (using a Beveridge and Nelson decomposition) as

$$b_{t+j} = b_{t-1} + (j+1)\delta + \psi(1)(\varepsilon_t + \varepsilon_{t+1} + \ldots + \varepsilon_{t+j}) + \eta_{t+j} - \eta_{t-1}, \tag{3}$$

where η_t is a stationary process. Then it is clear from Eq. (3) that b_t has a unit root and a trend component. On the other hand ρ_t^{t+j} is explosive since $t\rho_{t+j}=i_{t+jt}\rho_{t+j-1}$ and $i_t>1$ if the economy is not dynamically inefficient. Then it follows that whenever $b_t-b_{t-1}=(i_t-1)b_{t-1}+m_t-x_t$ is $I(0)$, the

transversality conditions holds, i.e., $\lim_{j\to\infty} E(t\rho_{t+j}^{-1} b_{t+j}|I_t - 1) = 0$, since $\{b_{t+j}\}$ is of smaller order than $\{{}_t\rho_{t+j}\}$.

We conjecture that, given that the LRBC is a long-run condition, countries may face debt problems for periods when the long-run sustainability condition holds. Thus, our aim is to explore the situation in which countries might satisfy the LRBC condition, but face big enough short run imbalances which might evolve into future violations of the LRBC, i.e., situations in which the long-run condition is satisfied but the existence of temporary deviations from this condition may provide a red signal that might be informative to assess whether a country is likely to face future debt problems.[1]

Therefore, we propose to identify sub-periods during which the current account seems to be non-stationary and treat these periods as a red signal: The longer the economy stays in these periods, the more likely it is that the LRBC will be violated.[2] The econometric methodology proposed in this paper allows us to distinguish periods that are associated with unsustainable outcomes from those in which the LRBC condition holds. Furthermore, an answer to the dichotomous question of sustainability can be obtained by checking the global stationarity conditions of the estimated model.

2. The econometric model

In the following section we introduce a switching ADF model of the current account, $b_t - b_{t-1}$. We reparameterize the model so that one state of nature can be associated with unsustainability of the LRBC. The estimated probabilities of being in such a regime will then be used to identify periods, which, over time, could trigger the unsustainability of the LRBC.

2.1. A switching augmented Dickey Fuller

Consider the following simple model for the time series $\{(z_t): t = 1, 2, \ldots\}$:

$$\Delta z_t = [\mu_0(1 - s_t) + \mu_1 s_t] + \lambda(1 - s_t) z_{t-1} + \sigma\eta_t, \tag{4}$$

where $-2 < \lambda < 0$, η_t is a white-noise process, and $\{s_t\}$ indicates the state (or regime) that the system is in at date t. $\{s_t\}$ is a homogeneous, irreducible, and aperiodic Markov chain of order 1 with state space $\mathbb{S}=\{0, 1\}$ and transition probabilities $p_{ij} = Pr\{s_t = j | s_{t-1} = i\}$, $i,j \in \mathbb{S}$, which are independent of $\{\eta_t\}$. Hence, the time series $\{z_t\}$ satisfies a model which allows the dynamic behavior of the series to be governed by either a stable first-order stochastic difference equation, when $s_t = 0$, or by a random walk scheme, when $s_t = 1$. More specifically, although the underlying state variable that dictates the changes in regime is unobservable, the likelihood of each of the possible regimes being operable at each sample observation can be inferred on the basis of the estimated filter probabilities $P(s_t = \ell | \boldsymbol{w}_1, \ldots, \boldsymbol{w}_t; \hat{\theta})$, $\ell = 0, 1$, where $\boldsymbol{w}_t' = [\Delta z_t' : z_{t-1}]$ and $\hat{\boldsymbol{\theta}}$ is an estimator of the unknown parameters in Eq. (4). Thus, we can evaluate the

[1] The converse can also be true. Statistical violations of the sustainability condition (for the whole sample) may arise from sporadic deviations of the current account series, from what can be regarded as a stationary path. This would make unit root tests to lose power to reject the null hypothesis that the current account has a unit root (a violation of the LRBC). See for example Perron (1989) and Banerjee et al. (1992).

[2] In terms of our econometric methodology, the more persistent is the regime when the current account is $I(1)$ (and the less persistent the regime when it is $I(0)$), the less likely it is that the LRBC will hold.

Table 1
Current account ADF and KPSS tests

	Argentina	Brazil	Japan	UK	USA
ADF	− 2.765 (− 2.953)	− 2.351 (− 2.990)	− 1.837 (− 2.884)	− 2.758 (− 2.884)	− 0.697 (− 2.884)
KPSS	0.101 (0.463)	0.283 (0.463)	4.341 (0.463)	0.516 (0.463)	1.551 (0.463)

5% critical values in parenthesis.

extent to which changes in the order of integration have actually occurred and identify the location of such changes in the sample.

In subsequent analysis, the parameters of the Markov switching model in Eq. (4) are estimated by the method of maximum likelihood (ML), assuming that the conditional probability density function of Δz_t given $\{\boldsymbol{w}_{t-1},\ldots,\boldsymbol{w}_1,s_t,s_{t-1},\ldots,s_0\}$ is Gaussian. The conditional likelihood function is evaluated by using an iterative filtering algorithm similar to the one discussed in Hamilton (1994, ch. 22).

The ML estimates are then found by a quasi-Newton optimization algorithm that uses the Broyden–Fletcher–Goldfarb–Shano secant update to the Hessian.

At this point, some remarks on the properties of the time series $\{z_t\}$ are in order. It is clear from the Markov specification in Eq. (4) that $\{z_t\}$ is 'locally' non-stationary in the state characterized by $s_t=1$. However, second-order stationarity of an autoregressive process with Markov regimes does not require the characteristic polynomial of the process to have all its zeros lying on the open unit disk.[3] Hence, despite its occasional non-stationary behavior, $\{z_t\}$ (when $s_t=1$) can be 'globally' stationary, provided that p_{00}, p_{11}, and $\rho=1+\lambda$ satisfy appropriate restrictions. For the time series $\{z_t\}$ that evolves according to Eq. (4), a necessary and sufficient condition for second-order stationarity is that (Francq and Zakoian, 2001)

$$p_{00}\rho^2+p_{11}+(1-p_{00}-p_{11})\rho^2<1,\quad p_{00}\rho^2+p_{11}<2. \tag{5}$$

3. Empirical results

The data set used for our empirical analysis consists of quarterly observations on real current account for Argentina over the period 1992:1–2001:3,[4] Brazil over the period 1995:1–2002:2, and Japan, the UK, and the USA over the period 1970:1–2002:4. Table 1 shows that the ADF tests do not reject the hypothesis that all the time series are integrated of order one at the 5% significance level. On the other hand, the KPSS tests show that for Argentina, Brazil and UK (at the 1% level) the null of stationarity cannot be rejected (using the AIC criterion to select lag lengths). Therefore, using standard unit root tests not only do we find conflicting results for the three countries, but also face clear problems of interpretation of the results for Japan. This is because the non-rejection of the unit root hypothesis (or the rejection of the stationary hypothesis when using the KPSS) seems to be due to apparent increasing current account surpluses, which can hardly be associated with 'debt' sustainability problems. Given the potential power problems of standard root tests (see Maddala and Kim, (1999) for a survey) and the interpretation problems mentioned

[3] As a matter of fact, stationarity within each regime is generally neither necessary nor sufficient for the second-order stationarity of a Markov switching autoregressive process (see Francq and Zakoian, 2001). See also Psaradakis et al. (2004).

[4] The sample has been cut in the quarter prior to the Argentinean default.

Table 2
Current account estimates (standard errors) of Eq. (4)

	Argentina	Brazil	Japan	UK	USA
μ_0	0.0027 (0.0002)	0.0050 (0.0024)	0.0790 (0.0159)	− 0.0976 (0.0419)	− 0.0337 (0.2204)
μ_1	− 0.0059 (0.0012)	− 0.0466 (0.0175)	− 0.1835 (0.0435)	0.0048 (0.0391)	− 0.2800 (0.0929)
λ	− 0.7249 (0.1360)	− 1.0673 (0.3332)	− 0.1206 (0.0268)	− 0.4498 (0.1132)	− 0.1271 (0.0565)
σ^2	0.3174 (0.0236)	0.5515 (0.0754)	0.0946 (0.0060)	0.2259 (0.0158)	0.8466 (0.0861)
p_{00}	0.9025 (0.0815)	0.9291 (0.0711)	0.9804 (0.0110)	0.8388 (0.1367)	0.9487 (0.0425)
p_{11}	0.8886 (0.2101)	0.5879 (0.3374)	0.7948 (0.1101)	0.7893 (0.1312)	0.9641 (0.0217)
x	− 0.1030	− 0.4102	− 0.0465	− 0.1469	− 0.0085
y	− 1.0431	− 1.4079	− 0.4470	− 0.9568	− 0.3130
Log$L$	− 11.560	− 53.504	109.444	− 0.724	− 169.672

$x = p_{00}\rho^2 + p_{11} + (1 - p_{00} - p_{11})\rho^2 - 1$, $y = p_{00}\rho^2 + p_{11} - 2$ and $\rho = 1 + \lambda$. Tests of the null $x = 0$ and $y = 0$ against the alternative of global stationarity ($x < 0$, $y < 0$) are not carried out since the distribution is non-standard under the null.

above, we argue that the LRBC sustainability analysis would benefit from the approach discussed in the previous section.

Having established the 'global' characteristics of the series, we now focus on their 'local' behavior by estimating the nonlinear models discussed in Section 2. In Table 2 we report maximum likelihood (ML) estimates (based on the Gaussian likelihood) and associated asymptotic standard errors of the parameters of the Markov switching ADF Eq. (4) for the current account series.

The estimated adjustment coefficients are of the correct signs and show significant evidence of shifts between regimes.[5] The inferred probabilities, $P(s_t = 1|\boldsymbol{w}_1,\ldots,\boldsymbol{w}_t;\hat{\boldsymbol{\theta}})$, that the Eq. (4) is in the unsustainable regime at each date are shown in Fig. 1, together with a time plot of the time series under analysis.

Starting with Argentina, we find that the unstable regime is associated with the periods 1993:3–1994:1 and the end of 1996 (and the whole 1997). The first period is associated with the Argentinean boom (when the economy was growing faster than their trading partners), while the second period is associated with the tequila and Asian crises (and according to Calvo, 1998 to a sudden stop of capital inflows). We find that the expected time of remaining in the unsustainable regime is 8.8 quarters while the estimated expected time of remaining in the sustainable regime is around 10.2 quarters. Given that the economy remained long periods in the unstable regime, the likelihood that the LRBC would be satisfied is small (even though the economy seems stationary at the end of the sample). Argentina defaulted its debt at the end of 2001.

The filter probabilities for the Brazilian current account show that the unstable regime is associated with the year 1996, which coincides with the Asian crises and with growing fiscal deficits (the fiscal adjustment in October 1997 seems to have contributed to stabilize the current account). The expected time of remaining in the unsustainable regime is 2.5 quarters, while the estimated expected time of remaining in the sustainable regime is around 14.1 quarters. Given that the last part of the sample is identified with a stationary period and that the economy seems to have stayed a comparatively short period in the unstable regime, we expect the LRBC to hold.

Moving to Japan, the unstable regime is associated with much of the years 1973 and 1979. The former period is characterized by the first oil crisis while the latter unstable period coincides with the second oil

[5] Note that all the results satisfy the global stationarity condition outlined in Eq. (5).

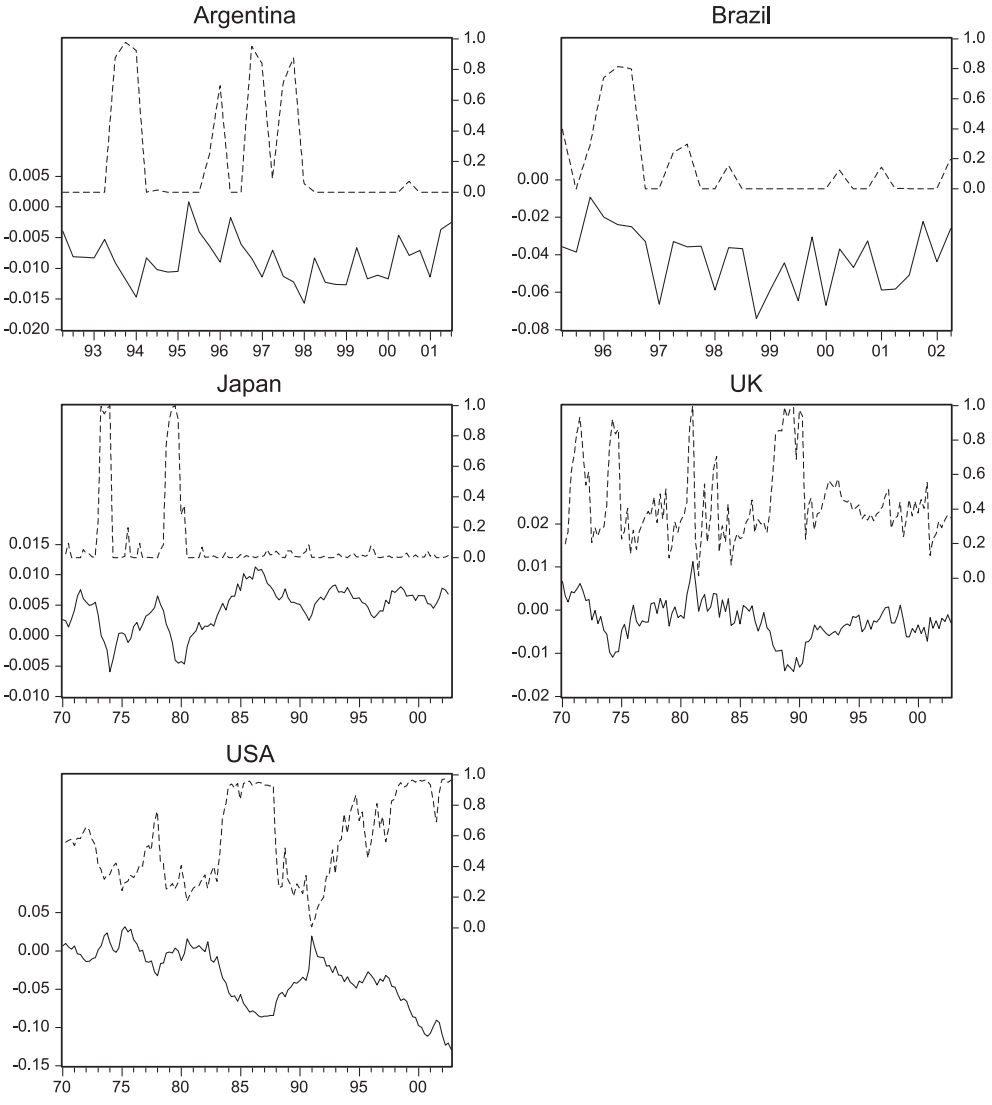

Fig. 1. Current account (solid lines) and filter probabilities (dashed lines).

price shock. After those periods, the current account seems to behave as an $I(0)$ variable, which seems to imply that the LRBC should hold. Also notice that, the expected time that the economy remains in a stable regime is 50 quarters while the expected time it remains in the unstable regime is 4 quarters.

Turning to the UK, the unstable regime is associated with the periods 1973–1974, and 1987–1989. In the first period the UK pursued a highly expansionary budget policy and was also hit by the first oil crisis. The second period is associated with the Lawson boom during which the UK was growing faster than most of its trading partners. We find that the expected time of remaining in the unsustainable regime is 4.5 quarters while the estimated expected time of remaining in the sustainable regime is around 6 quarters. At the end of the sample, the current account seems to be stationary, and this seems to imply that the LRBC condition appears to hold.

Finally, the filter probabilities for the USA current account associates the unstable regime with two periods 1983–1987 and 1993–2002. The former period of instability was mainly caused by unstable trade deficits, which were probably caused by the strength of the dollar. In the period 1993–2002, the strong US economic growth relative to foreign trading partners might have been a key factor in the growth of US current account deficits. Our results show that the expected time to remain in a sustainable regime is around 21 quarters while the expected time to remain in an unsustainable regime is 29 quarters. Unlike the other countries under scrutiny, the observations at the end of the sample are characterized as an unsustainable period and it should definitely be interpreted as a red signal, i.e., there should be a change in the pattern of the trade balance (and therefore in the current account) or otherwise the LRBC would not be satisfied.

4. Summary

In this paper, we have proposed an alternative way to assess the question of sustainability of a country's debt. We use a Markov switching ADF model to identify periods under which the current account accumulates in a non-stationary manner. The potential applicability of the proposed procedure has been illustrated using Argentinean, Brazilian, Japanese, UK and USA data. We have found conflicting evidence using standard ADF and KPSS tests. The evidence presented in this paper suggests that the LRBC is satisfied for Brazil, Japan, and UK, while the results for Argentina and USA are more contentious.

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