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A Threshold Model of the US Current Account*

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Abstract

What drives US current account imbalances? Is there solid evidence that the behavior of the current account is different during deficits and surpluses or that the size of the imbalance matters? Is there a threshold relationship between the US current account and its main drivers? We estimate a threshold model to answer these questions using the instrumental variable estimation proposed by Caner and Hansen (2004). Rather than concluding that the size or the sign of (previous) external imbalances matters, we find that time is the most important threshold variable. One regime exists before and another one exists after the third quarter of 1997, a period that coincides with the onset of the Asian financial crisis and the Taxpayer Relief Act of 1997. Statistically significant determinants in the second regime are the fiscal surplus, productivity, productivity volatility, oil prices, the real exchange rate, and the real interest rate. Productivity has become a more important driver since 1997.

JEL codes: E32, E65, F32, F41, F62

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1 Introduction

The size of the US external deficit has been an issue of major concern for many years, including before the so-called Great Recession. Concerns about the consequences of a sudden reversal in domestic output, the real exchange rate, and the level of economic activity in the rest of the world were raised by several scholars and analysts.[1] Others did not hesitate to affirm the close link between the current account deficit and the 2007-09 recession or that, at least, they were the result of a common factor (Bernanke, 2009; Caballero *et al.*, 2008; Chinn, 2013; Obstfeld and Rogoff, 2009). In this context, it is worth identifying the factors behind the US external deficit and the way they relate to each other.

Several questions are worth addressing. What are the main drivers of the US current account? Is the behavior of the current account the same during deficits and surpluses or does the size of the (previous) external imbalance matter as some analysts suggest? Is there a threshold relationship between the current account and its drivers? In this paper, we present new evidence on this ongoing debate.

Our work might be viewed as a bridge between empirical work, which uses univariate threshold models to understand the nonlinear behavior of the US current account, and the theoretical literature, which is mainly composed of dynamic stochastic general equilibrium (DSGE) models and proposes a set of exogenous drivers of the current account. On the one hand, some economic researchers and analysts contend that thresholds in the dynamics of the current accounts exist (see, for example, Aizenman and Sun, 2010; Bergsten, 2002; Freund, 2005; Holman, 2001). More formally, Clarida *et al.* (2005) propose a threshold autoregressive model to test the presence of thresholds in the current account of the G7 countries using data between 1979 and 2003. They find two thresholds almost equivalent in absolute value for the US current account scaled by GDP (2.15% and -2.18% of GDP) under a first-order autoregressive process. Using a similar threshold model but with smooth transition, Christopoulos and León-Ledesma (2010) reject the null hypothesis of non-stationarity favoring the sustainability hypothesis under a nonlinear mean reversion process. Moreover, their model outperforms the linear and random walk models in terms of forecast performance.[2] On the other hand, a number of works based on DSGE models suggest that the US current account is driven by fiscal and productivity shocks (Bussière *et al.*, 2010; Glick and Rogoff, 1995; Kollmann, 1998), as well as shocks of productivity volatility (Fogli and Perri, 2006) or oil prices (Bodenstein *et al.*, 2011).

[1] See, for instance, Obstfeld and Rogoff (2005), Roubini and Setser (2004). According to some authors (e.g., Croke *et al.*, 2005), current account reversals may entail some costs in terms of GDP growth.

[2] Another branch of the empirical literature goes beyond the univariate framework and centers its attention on medium-term fluctuations of the current account using cross-country samples (Chinn and Prasad, 2003; Gruber and Kamin, 2007; Lane and Milesi-Ferretti, 2012). The inclusion of demographic regressors, for example, is more appropriate in cross-country regressions rather than time-series models due to their low variability over time.

Even though the nonlinear empirical works might be useful for forecasting purposes, their univariate approach leaves aside the fundamentals behind the current account dynamics. The DSGE literature, in turn, usually focuses on one or two factors –partly due to the curse of dimensionality– and does not address all of the variables we consider in a multivariate empirical framework that can offer more tractability. Thus, our objective consists of estimating a threshold model with multiple regressors to explain the behavior of the US current account during the period between 1973.I and 2012.I and test for the presence of regimes in its dynamics. As threshold candidates, we try a set of variables suggested by commentators and previous empirical works. As regressors, we evaluate a similar set to the one proposed in the DSGE literature mentioned above. To accomplish this task and control for potential endogeneity of the regressors, we use a threshold model developed by Caner and Hansen (2004), in which the slope parameters are estimated by GMM. To our knowledge, this is the first empirical application of the GMM estimation of such a threshold model.

Our contribution relies on the following findings. First, in contrast to the univariate threshold models found in the literature, time is the most important threshold variable. We find a robust time break –not previously documented in the literature– in the relationship between the current account and its main drivers in the third quarter of 1997. This period coincides with the eruption of the Asian financial crisis and the Taxpayer Relief Act of 1997. We view the Asian crisis as the beginning of a sequence of financial crises among emerging market economies and, more importantly, as a structural change in both international investors' portfolios and policies regarding exchange rate regimes and foreign exchange reserves in emerging market economies. Second, as opposed to what other authors contend, there is no strong evidence on the importance of the size and sign of the (lagged) current account; the time line always dominates any potential threshold variable previously used or proposed by the empirical literature. Third, the most significant determinants of the US current account are productivity, the real exchange rate, the fiscal surplus, and the volatility of productivity. Other relative prices such as the oil price and the interest rate became statistically significant in the second regime. In particular, productivity shocks became more important after 1997. To a lesser degree, the Taxpayer Relief Act might have contributed to increasing the sensitivity of consumption and the current account to productivity shocks due to lower capital gains tax rates. All together, these findings might be viewed as evidence that confirms the twin-deficit hypothesis and assigns a role for the worldwide saving glut phenomenon (Bernanke, 2005) and the revived Bretton Woods hypothesis (Dooley *et al.*, 2003).

In the next section, we discuss the empirical strategy, that is, the issues related to the model, the regressors and their expected signs, the potential threshold variables, and the data. In section 3, we report and discuss the main results and robustness checks. Section 4 concludes briefly.

2 Empirical Strategy

2.1 Model

The structural equation we propose is the following:

$$ca_t = \beta_1' z_t 1(q_t \leq \gamma) + \beta_2' z_t 1(q_t > \gamma) + \varepsilon_t \tag{1}$$

where the dependent variable ca_t is the current account surplus, z_t is a set of potentially endogenous regressors, q_t is a known real-valued continuous function of an exogenous variable and stands for the threshold variable, $1(.)$ denotes the indicator function, and ε_t is a martingale difference sequence. The parameters to be estimated are the ones in vectors β_1 and β_2 (which might differ), and the threshold parameter $\gamma \in \Gamma$, where Γ is a strict subset of the support of $q(.)$.

The reduced form is a model of the conditional expectation of z_t given x_t:

$$z_t = g(x_t, \pi) + u_t \tag{2}$$

where x_t is the exogenous k-vector with $k \geq m$, π is a $p \times 1$ vector of unknown parameters, $g(,.)$ is a known function that maps $R^k \times R^p$ to R^m, and u_t is $m \times 1$ such that $E(u_t|x_t) = 0$. The methodology allows the reduced form model to be either a linear regression or a threshold regression model.

2.2 Estimation

We follow the estimation procedure proposed by Caner and Hansen (2004). Here, the estimation of parameters is sequential. First, we estimate π from the reduced form, equation (2), by LS. Second, we estimate the threshold parameter γ using predicted values of the endogenous variables z_t and minimizing the sum of squared errors (SSE). We verify the statistical precision of the threshold variable chosen using the likelihood ratio test (LRT) and estimate the asymptotic confidence interval of γ. Finally, we estimate the slope parameters β_1 and β_2 by GMM on the split samples implied by our estimate of γ.

2.3 Regressors

We choose the regressors based on the exogenous variables from a standard neoclassical framework. In particular, the m-vector of regressors z_t contains an intercept, the lagged dependent variable, and measures of the fiscal surplus, total factor productivity, TFP volatility, the real exchange rate, the relative price of oil, and the real interest rate. The expected signs are as follows.

Fiscal surplus. We expect a positive relationship. A decrease in total government spending or an increase in total government revenues implies an increase in the overall fiscal surplus that should raise the current account surplus. The theoretical relationship between fiscal and external surpluses is sometimes called the "twin-deficit" hypothesis and is predicted by a variety of models (Chinn and Prasad, 2003).[3]

Total factor productivity. In principle, one could not expect a specific sign for total factor productivity. One reason for this is that this variable could be measuring persistent or temporary shocks. Therefore, the net effect on total saving and investment, and consequently, on current account balances, can only be resolved with empirical evidence. That said, the RBC literature stresses the importance of highly persistent productivity shocks on US business cycle fluctuations. Consistent with that, we expect a negative sign for the slope coefficient of our measure of productivity. Intuitively, a persistent productivity shock increases not only consumption but also, especially, investment such that this effect on absorption compensates the increase in output. As a result, the current account surplus decreases.

TFP volatility. An increase in the volatility of productivity stimulates precautionary savings. The higher uncertainty about productivity discourages investment in physical capital. As a result, we expect a rise in the current account surplus. The first work that links the fall in TFP volatility, usually dated in the early 1980s, to the imbalances of the US current account is perhaps Fogli and Perri (2006).

Relative price of oil. From a simple perspective, a rise in the relative price of oil can be viewed as a negative supply shock that lowers output and, as a consequence, deteriorates the current account. Bodenstein *et al.* (2011) provide a deeper analysis. Under incomplete financial markets, both oil demand and supply shocks that increase the price of oil lead to a deterioration in the oil balance in the oil-importing country. The wealth transfer to the oil exporter generates a non-oil trade surplus in the oil-importing country. Therefore, the final effect on the trade balance is ambiguous.[4]

Real interest rate. We hypothesize a positive sign between this variable and the current account, i.e., a decline of the world real interest might cause a fall of the current account surplus. This is a possible channel of the global saving glut hypothesis formulated by Bernanke (2005). As the author argues, East Asian "*countries increased reserves through the expedient of issuing debt to their citizens, thereby mobilizing domestic saving, and then using the proceeds to buy U.S. Treasury securities and other assets.*" The latter could have pushed down interest rates and discouraged domestic saving in the US with the corresponding decline in the current

[3]This is the major determinant of the US current account deficit according to Chinn (2005). There are, however, dissenting viewpoints such as Backus *et al.* (2009) and Greenspan (2005).

[4]The authors also conclude that the assumption of complete markets leads to strongly counterfactual implications.

account surplus. In a two-country DSGE model, we can think of an increase in consumers' discount rate in the rest of the world that, in turn, encourages their saving and pushes down the world interest rate. The inability to measure this type of preference shock also motivates us to include this variable as a regressor.[5]

Real exchange rate. Although the real exchange rate is not an exogenous variable in standard macroeconomic models, its inclusion in our empirical model might be useful to capture some exogenous shocks, such as modifications in exchange rate policy in a foreign trade partner (e.g., an exogenous devaluation of the Chinese renminbi or other important US trade partner's currency) that are hard to measure in a simple fashion.[6] Given that a reduction in this index indicates a currency depreciation, we expect a negative effect on the current account. In other words, a real depreciation of the US dollar against a basket of its main trade partners' currencies would improve the current account position.[7]

2.4 Potential Threshold Variables

The set of potential threshold variables (q_t in equation (1)) is basically motivated by previous empirical work and intuitive analyses rather than by theoretical models. The set of candidates we propose is the following.

Current account-to-GDP ratio. Following Christopoulos and León-Ledesma (2010) we evaluate whether the (lagged) current account as a percentage of GDP is an informative threshold variable. This would be the case of a self-exciting threshold auto-regression in a framework with multiple regressors. Implicitly, we are assessing whether the size and sign of the (previous) current account imbalance matter as suggested also by Freund (2005) and Freund and Warnock (2005). For example, Freund (2005) analyzes country episodes of drastic external improvements and concludes that a typical current account reversal begins when the current account deficit is approximately 5% of GDP. As a robustness check, we also test the absolute change of the (lagged) current account surplus.

Size of the current account surplus. We test whether the absolute value of the (lagged) current account measure is a valid threshold and, thus, verify whether only the size of the current account imbalance matters as found by Clarida *et al.* (2005). Note that we would be implicitly testing if there are two (symmetric) thresholds. Thus, if the estimated value for this threshold were γ% of GDP, then there would be a regime determined by a symmetric band

[5]Another possibility is that the long-term interest rate can capture the effects of monetary policy. Under the assumption of price rigidities, a cut in the short-term rate can lower the long-term interest rate, stimulate investment and deteriorate the current account. This mechanism, however, has been challenged by Greenspan's long-term interest rate conundrum.

[6]Eventually, fluctuations in the real exchange rate and the real interest rate might capture the influence of unobserved shocks (e.g., preference shifts) or other types of exogenous domestic or foreign shocks that are absent in our analysis because they are not properly measured since 1957 (or even since 1973) or are not measured at a quarterly frequency (like long-run factors such as demographic differentials).

[7]This would hold as long as income effects are not as large as substitution effects.

between $\gamma\%$ and -$\gamma\%$, and two additional regimes, one above the upper limit of the band and another below the lower limit. This hypothesis makes sense because Clarida *et al.* (2005) found two thresholds almost equivalent in absolute value for the US (2.15% and -2.18% of GDP).

Fiscal balance-to-GDP ratio. Arestis *et al.* (2003) find a statistically significant threshold in the US budget deficit. They conclude that government authorities would intervene by cutting deficits only when they have reached a certain threshold. Because fiscal imbalances might be behind current account movements, we also test to see if the (lagged) fiscal balance constitutes a threshold of the current account.

Size of the fiscal surplus. According to a comment made by Cumby (2005), "*another potentially interesting possibility that could conceivably contribute to threshold behavior in current account dynamics is fiscal policy. Casual empiricism suggests that significant political costs are incurred when a substantial fiscal tightening is enacted. This might lead to legislative behavior in which fiscal policy does not adjust until fiscal imbalances are sufficiently extreme.*" Based on this idea, we test to see whether the size of (lagged) fiscal imbalances is a valid threshold to explain the nonlinearities of the US current account.

Time. In contrast to other studies that explore threshold relationships in the US current account, we also test whether the best threshold variable is time. That is, we test for the presence of an unknown time break in the relationship between the regressors and the dependent variable. In this case $q_t = t$, γ represents the unknown time break point to be estimated, and the structural equation is given by

$$ca_t = \beta_1' z_t 1(t \leq \gamma) + \beta_2' z_t 1(t > \gamma) + \varepsilon_t \tag{3}$$

for $t = 0, 1, ..., T$.

The motivation to evaluate time as a threshold variable is twofold. Any of the previous candidates might be useful not because their intrinsic behavior implies a nonlinear relationship between the dependent variable and the regressors, but because its seemingly trending behavior dominates during some period of time and masks a time break.[8] In addition, there are other reasons to suspect that there might be a time break between the current account balances and its determinants. Fogli and Perri (2006) argue that the so-called Great Moderation implied a sharp deterioration of the US current account in the early 1980s. Some panel data studies report a drift in the deterministic intercept in current account regressions for many emerging and industrialized countries during the Asian financial crisis (see Gruber and Kamin, 2007; IMF, 2006; Lane and Milesi-Ferretti, 2012). Likewise, Chinn *et al.* (2013) argue that there is evidence of a structural break in the current account behavior of emerging market economies

[8] This is relevant in this case due to a frequent downward-trending behavior of the US current account, for example, during the 1992-2006 period.

and advanced countries in 2006-8, during the onset of the Great Recession.[9] In sum, the start of the Great Moderation (1983-5) and the periods of drastic financial disturbances, such as the Asian Crisis (1997-99) and the Great Recession (2006-8), constitute candidate years that lead us to test time as threshold variable and use specification (3). It is important to emphasize that all of the works cited above impose the corresponding time break rather than estimate it.

2.5 Data

We use quarterly data during the period spanning from 1973.I to 2012.I, covering basically the post-Bretton Woods era. One of the reasons for this is because it makes the study comparable to others in the literature. The starting date is also due to the availability of certain variables on a quarterly basis, in particular the real exchange rate. In contrast to previous studies that use threshold autoregressive models, our sample includes the 2007-09 recession, the so-called Great Recession, and the latest reversal of the US current account just before such a period.[10] We rescale current account balances as a share of potential GDP to minimize cyclical fluctuations in the denominator of the dependent variable. Fig. 1 displays this series during the period of analysis.

In the set of regressors, the fiscal surplus is defined as the cyclical component of the ratio of overall budget balance (total government revenues minus total government expenditures) as a share of GDP. The measure of productivity is a standard Solow residual assuming a classical aggregate production function as in the work of Bussière *et al.* (2010). The volatility of productivity is the standard deviation of the previous variable estimated using a GARCH model as in Fogli and Perri (2006). The relative price of oil is the ratio of the WTI oil price index to the CPI. For the real exchange rate, we use the cyclical component of the real trade-weighted U.S. dollar index. An increase (decrease) of this variable indicates a real appreciation (depreciation) of the US dollar against US trading partners' currencies. The real interest rate is constructed using the 10-year Treasury rate and the ex post CPI inflation rate.[11] All of the variables –except current account and fiscal surplus– are logged. Variables are expressed in percentages and, if necessary, seasonally adjusted. A more detailed description of the data and sources can be found in the Appendix.

[9] The authors use forecasts of the current account and what they call pseudo-confidence intervals. They find a statistically significant structural break in the current account balances of a few industrialized countries except the US.

[10] Clarida *et al.* (2005) uses a sample that ends in 2005, while the sample in Christopoulos and León-Ledesma (2010) ends in 2004.

[11] We do not use the London Interbank Offered Rate because it is available only from 1986. In any case, the correlation between the LIBOR and the 10-year Treasury rate is high (around 0.87).

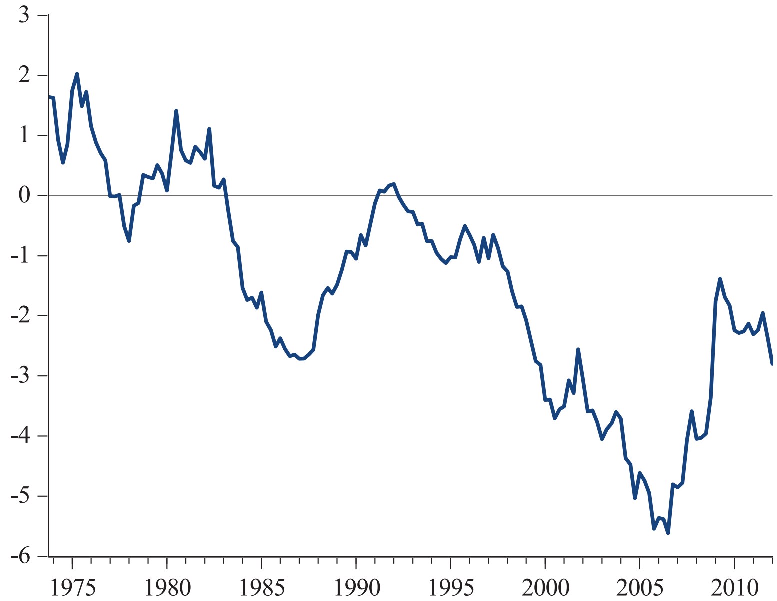

Fig. 1. US Current Account/Potential GDP (1973.I-2012.I).

An assumption of the model is that time series cannot have unit roots or stochastic trends. Thus, we test for the presence of unit roots in the series using the Elliot-Rothenberg-Stock DF-GLS test. We could reject the null hypothesis of a unit root in most of the regressors at a significance level of 1%, TFP volatility at 5%, and the real interest rate at 10% (see Table A1 in the Appendix). For the current account, however, we are not able to reject an apparent unit root during the period of analysis. That said, we decided to continue using our approach because unit-root tests in univariate linear specifications have relatively low power for several reasons. First, it is well known that univariate unit-root tests tend to not reject the unit-root hypothesis because the sample is not sufficiently large. Taylor (2002) rejects the presence of a unit root in the current account of the US and other 14 countries in a long-span study that starts in 1850. Second, there are works that provide evidence against unit roots using panel data studies (see Wu *et al.* 2001). Third, unit-root tests tend to not reject the unit-root hypothesis under the presence of nonlinearities. Using a threshold model, Christopoulos and León-Ledesma (2010) could reject the null of non-stationarity favoring a nonlinear mean reversion process for the US current account during a sample similar to ours.[12]

[12]Moreover, from a theoretical viewpoint, the stationarity of the current account surplus is consistent with the representative consumer's long-run budget constraint (see Trehan and Walsh, 1991).

3 Results

3.1 Choosing the Threshold Variable

Our preferred threshold candidate is time. Table 1 reports the SSE for the set of candidate variables introduced in section 2.4. The choice of the candidate is based on the minimization of the SSE, which is equivalent to choosing the specification with the lowest information criterion (e.g., Akaike, Schwarz, etc.) given that the number of regressors and observations remains unchanged among specifications in a given sample. To verify the sensitivity of our main result to the type of reduced form and sample, the table also displays the SSE for the linear reduced form and threshold reduced form during periods 1973.I-2012.I and 1957.I-2012.I. We can observe that the threshold candidate that minimizes the SSE is the time line.

Based on the results of Table 1, we discard other candidates as valid thresholds. Moreover, in the Appendix we report the threshold estimates of each candidate variable for each sample and the type of reduced-form models (see Table A2). As seen, the only robust candidate variable across samples and type of reduced form is time.[13] All in all, we conclude that there is weak evidence, if any, of a second useful threshold variable in the context of our specification with multiple regressors. This implies that, in contrast to other studies (see references in section 2.4), the size or the sign of the imbalance does not matter once we control for the main drivers of the current account.[14]

[13]The other candidate variables not only fail to minimize the SSE compared to the time line and are highly sensitive to the sample and reduced form, but they also did not provide either precise threshold or slope estimates, or J statistics that could support a valid model in each regime. These latter results are available upon request.

[14]Note that we reject the possibility that the absolute value of the lagged current account is a threshold variable. This finding has two implications. First, the size of external imbalances is not sufficiently useful to explain this type of nonlinearity of the US current account as opposed to what other authors think. Second, we reject the possible existence of two symmetric thresholds (three regimes implied by a symmetric band between γ and $-\gamma$) as explained in section 2.4.

Table 1
Sum of squared residuals for different samples and types of reduced-form models.

	Type of reduced form and sample			
	Linear model		Threshold model	
Candidate variable	1973.1-2012.1	1957.1-2012.1	1973.1-2012.1	1957.1-2012.1
Time	12.98	16.98	12.98	16.98
Current account surplus / GDP	13.73	19.46	13.34	19.46
Absolute value of current account surplus / GDP	13.51	17.94	13.70	17.94
Change in current account surplus / GDP	15.71	17.85	14.34	17.90
Fiscal surplus / GDP	14.83	19.18	14.83	19.18
Absolute value of fiscal surplus / GDP	15.68	19.14	15.68	19.01

Note: Current account surplus/GDP is the second lag of the ratio of US current account surplus to potential nominal GDP. Potential GDP is the trend component of GDP obtained by a HP filter. The absolute value of current account surplus/GDP is the absolute value of the previous variable. Change in current account surplus/GDP denotes the first difference of the current account surplus/GDP. Fiscal surplus/GDP is the lag of the ratio of US overall fiscal surplus to GDP. The absolute value of fiscal surplus/GDP is the absolute value of the previous variable. For further details about the variables and the set of instruments, please see the appendix.

3.2 Estimate of the Threshold Parameter

Fig. 2 displays the likelihood ratio statistic and the corresponding 90% critical value that allow us to infer the statistical significance of the trend line as a threshold for the US current account. The LR statistic (blue solid line) lies beneath the horizontal lines that constitute the critical values assuming homoskedasticity (dotted line) and the critical value corrected for heteroskedasticity (dashed line). The latter yields a heteroskedasticity-corrected confidence interval for the threshold parameter. The threshold estimate, $\widehat{\gamma}$, corresponds to the third quarter of 1997, the lowest point of the relatively sharp V-shaped curve in Fig. 2. This value splits the regression equation in two regimes, before and after 1997.III.

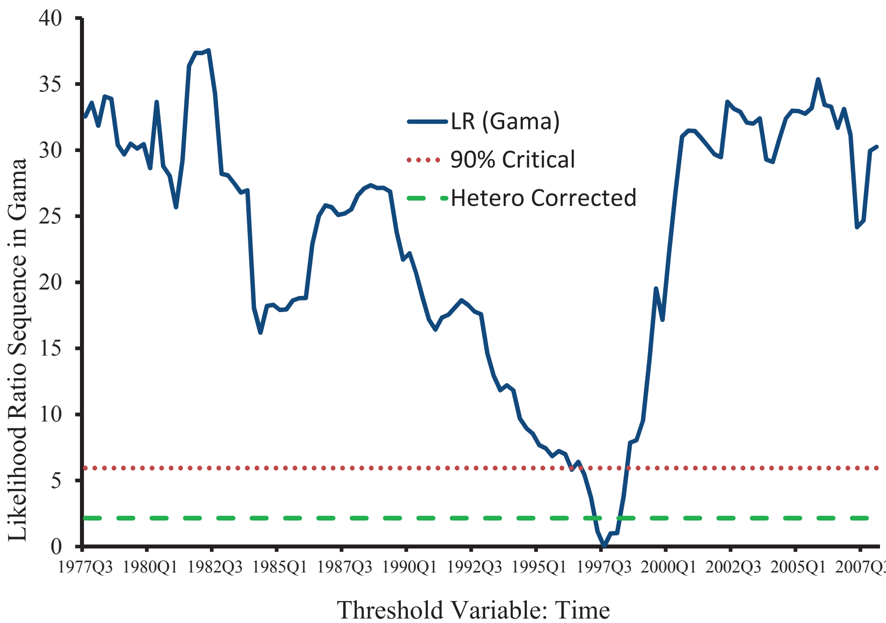

Fig. 2. Confidence Interval for Threshold Estimate.

Table 2 reports some robustness checks. One can argue that the use of relatively small sample (1973.I-2012) is insufficient to detect a robust break or that the trimming of the bottom 15% of the sample required to apply the test can eliminate the possibility of capturing a shift during the 1973 oil shock. The estimates shown in Table 2, however, stubbornly point to 1997.III as the time break even if we use a larger sample such as 1957.I-2012.I and regardless of the type of reduced form we assume. The 90% confidence region is a tight interval between 1996.II and 1998.I. Almost identical intervals are obtained if we use a threshold model as the reduced form.

Table 2
Threshold estimates and confidence intervals.
Dependent Variable: Current account surplus / potential GDP.
Threshold variable: time.

	Type of reduced form and sample			
	Linear model		Threshold model	
	1973.1-2012.1	1957.1-2012.1	1973.1-2012.1	1957.1-2012.1
Threshold estimate	1997.3	1997.3	1997.3	1997.3
90% Confidence Interval				
Uncorrected interval	[1996.2 1998.2]	[1997.1 1998.2]	[1996.2 1998.2]	[1997.2 1998.2]
Heteroskedasticity-corrected interval	[1996.2 1998.1]	[1997.1 1998.2]	[1996.2 1998.2]	[1997.2 1998.2]

Notes: Heteroskedasticity-corrected interval uses a quadratic spectral kernel HAC estimator. The set of instruments used are lags of the regressors (further details in the appendix).

The time break found in 1997.III coincides with two events: (1) the onset of the Asian financial crisis and (2) the Taxpayer Relief Act of 1997. The Asian financial crisis starts with the collapse of the Thai baht in July 1997 and covered, aside from Thailand, several East Asian economies such as Indonesia, South Korea, Hong Kong, Malaysia, Laos and the Philippines. Other economies affected, but to a lesser degree, were Brunei, China, Singapore, Taiwan, and Vietnam. This financial crisis implied a recomposition of portfolios among international investors, including central banks, and the decision of sharp devaluations, the imposition of capital controls,[15] and reserves buildup by monetary authorities (Prasad *et al.*, 2007).[16] In addition, the Asian financial crisis is viewed as the onset of a sequence of international crises among emerging market economies. Other economies that faced similar crises were Russia (1998), Brazil (1998), Argentina (1999-2002), and Turkey (2001). All of them involved sharp devaluations (Chinn, 2013), modification of the exchange rate regime, and the rise of foreign exchange reserves as a hedge against potential speculative attacks or another financial crisis.[17] While the change in exchange rate policies to limit currency appreciations has led to some to talk about a *revived Bretton Woods system* (Dooley *et al.*, 2003), the *war chests* of foreign reserves have, at least in part, led to an increasing purchase of US treasury bonds, which is usually linked to the *global saving glut hypothesis* (Bernanke, 2005).

The second factor that might have contributed to the structural change originated domestically. The Taxpayer Relief Act of 1997, enacted on August 5^{th}, reduced several federal taxes, provided some tax exemptions, and extended tax credits. According to estimates posted by the NBER, the average marginal tax on long-term gains was reduced by almost 7%, from 25.6% to 18.7% in 1997, the largest cut since 1960.[18] This domestic factor is not fully unrelated to the implications of the Asian financial crisis. The tax cuts and exemptions entailed a decline in tax revenues and an increase in the fiscal deficit that could be more easily financed by issuing a larger amount of US treasury bonds purchased, in turn, by investors and governments from emerging market economies. How these events contributed to a structural break between the US current account and its main drivers is an issue addressed in the next section.

[15] According to Chinn and Ito (2008), the "Asian region has had relatively high levels of financial openness since the 1970s, although the rate of financial opening slowed down in the aftermath of the Asian crisis of 1997-98".

[16] Using cross-country micro data, Coulibaly and Millar (2008) conclude that there was a persistent decline in investment rates among Asian firms, which explains the current account surpluses observed after the 2007-2008 financial crisis. The persistence of these surpluses is owing to private restructuring behavior in response to the financial crisis.

[17] According to the classification of Ilzetzki *et al.* (2009), among the countries that adopted a new exchange rate regime between 1997 and 1998 were Indonesia, Laos, Malaysia, South Korea, the Philippines, and Thailand in East Asia; also Albania, Congo, Ecuador, Liberia, Malawi, Slovak republic, Suriname, Tajikistan, Turkey, Turkmenistan, and Zimbabwe in other world regions. Other countries with changes of regimes after 1998 were Argentina (2001), Brazil (1999), Russia (1998-99), and Turkey (2001-02).

[18] The estimates are based on Feenberg and Coutts (1993) and can be downloaded from http://users.nber.org/ taxsim/. In particular, according to Public Law 105-34, the top tax rate on long-term gains was cut from 28% to 20%, while the 15% bracket was lowered to 10%.

3.3 Estimates of the Slopes

Table 3 reports the baseline estimates of the slopes, vectors β_1 and β_2, for the baseline threshold model (see columns 2 and 3). Just to have an idea of the improvement that our threshold model provides compared to a linear specification, we also report estimates for a linear model, assuming no threshold, in the first column of Table 3.[19] HAC standard errors are reported in parentheses. The analysis of the economic relevance of the regressors will basically rely on the results over the second regime (post-1997) because it is currently the most relevant.

We use lags of the regressors as instruments for our model (further details are described in the Appendix). Table 3 displays the J-statistics and corresponding p-values. Based on them, we cannot reject the null hypothesis that the over-identifying restrictions are satisfied in each regime.

As the table shows, we obtain the expected signs for all of the coefficients.[20] There are some differences between regimes and findings that are worth highlighting. First, the point estimate of the autoregressive coefficient has fallen between the first regime and the second by 0.06. This lower persistence can be exemplified by the current account reversal just before the onset of the Great Recession.

Second, the magnitude of the parameters related to the oil price and the interest rate are low and statistically insignificant during the pre-1997 regime. They become statistically significant and more economically relevant after 1997, although shocks to the interest rate do not contribute significantly to fluctuations in the current account surplus, at least as much as other regressors of the model. For example, given the coefficient value of 0.079, a one-standard-deviation shock in the interest rate (1.43%; see Table A3 in the Appendix), ceteris paribus, would be associated with a rise in the current account of only 0.11% of long-run GDP. From an economic viewpoint, the saving glut effect through the interest rate is relatively less important. Similarly, a one-standard-deviation shock in oil prices above its trend (20.6%) would be related to a current account decline of 0.11 percentage points of long-run GDP.[21]

Third, fiscal balances also matter for the dynamics of the current account. In other words, there is evidence in favor of the twin deficit hypothesis. The coefficient of the fiscal surplus is positive and statistically significant in both regimes. An increase in the fiscal surplus-to-GDP ratio of one standard deviation (1.6%) above its trend is associated with a rise of the current account-to-GDP ratio in 0.14 percentage points of long-run GDP in the second regime. It is

[19] As should be clear soon, the linear model ignores a significant time break point, misleadingly telling us that some drivers of the current account do not matter, and does not allow us to identify the most important structural changes in the relationship between the current account and its drivers. Moreover, under normality, a traditional F test concludes that the threshold model is preferred to the linear model ($F_{stat} = 5.76 > 2.02 = F_{cv}$).

[20] The only exception is the parameter of the interest rate in the first regime, but it is not statistically significant.

[21] The fact that oil shocks are important only in the second regime somehow supports the argument of Bems *et al.* (2007) that the recycling of petrodollars as a factor behind the growing global imbalances became relevant by the end of the 1990s.

worth mentioning that our coefficient estimates (0.11 and 0.09) lie within the low range of values obtained in the literature.[22]

Another interesting result is the statistical significance of TFP volatility in both regimes. This finding is qualitatively consistent with that of Fogli and Perri (2006). A rise in one standard deviation (0.06) above its mean would be associated with a current account improvement around a tenth of a point in GDP trend during the most recent regime.

Fifth, productivity and real exchange rate shocks show more important potential effects on the current account. Productivity shocks have become more important since 1997. The coefficient estimate has more than doubled, changing from -0.17 to -0.38. Given our parameter estimate in the second regime (-0.38), a one-standard-deviation productivity shock (0.8%) above its trend is related to a reduction of the current account surplus of almost one third of a point in long-run GDP.[23] On the other hand, given our coefficient estimate related to the real exchange rate (-0.06), an exogenous change that causes a real depreciation of 3% (a standard deviation) will be accompanied by an increase in the current-account-to-GDP ratio of 0.2 percentage points.

Note that the magnitude and statistical significance of the slope estimates in the threshold model differ from those of the linear model estimates (Table 3, column 1). Interestingly, the results from the linear model basically imply that only three out of six regressors are statistically significant: the fiscal surplus, productivity, as in the work of Bussière *et al.* (2010), and, marginally, oil price shocks. Our threshold specification, however, also yields statistical significance for TFP volatility and the real exchange rate in both regimes, and the interest rate in the second regime. From a statistical point of view, the use of a linear specification that ignores the break might lead to an underestimation of the role of some important drivers of the US current account.

Regarding structural changes, we can observe that the slopes of productivity, the real exchange rate, the interest rate, and the intercept are the ones that showed the most significant changes from one regime to the other. This is because there is no overlap between confidence intervals (see Table A4 in the Appendix).

Why did parameters change in 1997 and how can we interpret such a structural change? We mentioned that the time break coincides with the onset of the Asian financial crisis. One possibility is that international investors moved their funds from East Asia to the US and invested in more capital-intensive sectors such as the information industry.[24] The best example of this

[22]In a medium-term panel study, Chinn and Prasad (2003) report estimates in the 0.15-0.38 range for 88 industrial and developing economies; Erceg *et al.* (2005) find a value of 0.2 for the US; Chinn and Ito (2007) obtain estimates between 0.1 and 0.5 for a panel of industrialized countries; Gruber and Kamin (2007) find a value slightly above 0.11 in a sample of 61 countries; Bussière *et al.* (2010) obtain 0.14 in a panel estimation for a sample of OECD economies.

[23]Bussière *et al.* (2010) report estimates between -0.11 (G7 sample) and -0.14 (OECD sample), while Glick and Rogoff (1995) found a value of -0.14 (US).

[24]According to Acemoglu and Guerreri (2006), the information sector has a capital share of 0.53 (the average capital intensity is around 0.4).

investment shift could have been the dot-com bubble observed between 1997 and 2000. The capital intensification of the economy could have made productivity shocks a more important driver of investment and, as a result, the current account.[25]

To a lesser degree, another possibility is that the Taxpayer Relief Act of 1997 raised the sensitivity of consumption and, consequently, the sensitivity of the current account to productivity shocks. Consider, for simplicity, an economy in which consumers earn capital gains that are taxed at the rate τ. Tax revenues are used to finance, for example, the provision of some non-tradable good (e.g., public services). The intertemporal budget constraint would relate the consumption stream to the disposable income stream. In this simplified world, a productivity shock that raises dividends and, in turn, the price of equity can cause higher capital gains. As a result, consumption would increase by a proportion that depends on, among other parameters, $1-\tau$. Then, if such a tax rate is reduced, the sensitivity of consumption to productivity shocks would increase.

The shift of the coefficient related to the real exchange rate is harder to interpret due to the endogenous nature of this variable in a theoretical setting. It is possible that this might be capturing the structural change in the link between productivity and the current account.

A change in the intercept in current account regressions is reported in some medium-term panel data studies, especially for East Asian economies. For example, Gruber and Kamin (2007) find that an intercept dummy that controls for the Asian financial crisis is statistically significant in explaining medium-term fluctuations in the current accounts of 61 countries. The IMF (2006) uses a similar dummy variable for a sample of 54 countries. Lane and Milesi-Ferretti (2012) use it for those Asian economies at the center of the Asian financial crisis during the 1997-2000 period for a set of 65 advanced economies and emerging markets. Chinn *et al.* (2013) suggest that there is some sign of a structural break in the 1996-2000 period for a group of industrialized countries. None of these works, however, report a break in the relationship between the US current account and any of its determinants.[26] The shift of the intercept in our estimated model might be due to exogenous changes in certain long-run features of the US economy and the rest of the world. Foreign monetary policies such as those mentioned above as well as demographic differentials[27] might be among the candidates. The Taxpayer Relief Act might have worked as a pull factor for those US investors who move their portfolio away from East Asian assets toward US assets that would require lower capital gains taxes.

[25]Assuming a Cobb-Douglas production function, other things equal, the higher the capital share, the more sensitive investment is to productivity shocks. For example, one can show that, *ceteris paribus*, the elasticity is $\Delta lnk_{t+1}/\Delta ln(TFP_t) = 1/(1-\alpha)$, where k denotes the capital stock. This elasticity depends positively on the capital share, α.

[26]An exception may be Makin and Narayan (2008). They study the relationship between the real interest rate and the current account between 1985 and 2004. Assuming 1997 as a breakpoint year and using a Chow test, they are unable to reject the null hypothesis of no structural change at the 7% level of significance.

[27]For instance, Ferrero (2010) contends that demographic factors account for about 65% of the deterministic component of the US trade balance.

Table 3
Baseline GMM Estimates.
Dependent Variable: Current account surplus / potential GDP.

	Linear model (no threshold)		Threshold model			
			Regime I		Regime II	
Regressor	1973.1-2012.1		1973.1-1997.3		1997.4-2012.1	
Lagged dependent variable	**0.989**	***	**0.947**	***	**0.884**	***
	(0.012)		(0.031)		(0.021)	
Fiscal surplus	**0.070**	***	**0.112**	***	**0.089**	***
	(0.024)		(0.032)		(0.023)	
Productivity	**-0.304**	***	**-0.174**	***	**-0.378**	***
	(0.033)		(0.036)		(0.048)	
TFP volatility	0.337		**2.807**	***	**1.507**	***
	(0.547)		(0.582)		(0.474)	
Relative price of oil	**-0.004**	*	-0.001		**-0.005**	***
	(0.002)		(0.003)		(0.002)	
Real exchange rate	-0.008		**-0.028**	***	**-0.064**	***
	(0.009)		(0.007)		(0.014)	
Real interest rate	0.006		-0.001		**0.079**	***
	(0.016)		(0.015)		(0.022)	
Constant	-0.011		0.009		**-0.585**	***
	(0.044)		(0.039)		(0.110)	
Statistics						
(Joint) R-squared	0.964		…	0.969	…	
(Joint) Adjusted R-squared	0.962		…	0.965	…	
J-statistic	0.076		0.109		0.198	
P-value	0.765		0.839		0.777	
No. of observations	154		96		58	

Notes: HAC standard errors are reported in parentheses. An * denotes p-value lower than 10% (also boldfaced), ** p-value lower than 5%, *** p-value lower than 1%. For definitions of the variables, please see the appendix. HAC covariance weighting matrix uses prewhitening, a Barlett kernel and fixed bandwidth. The set of instruments used are lags of the regressors (further details in the appendix).

3.4 Additional Robustness Checks

In addition to the robustness checks for our threshold estimate reported in sections 3.1 and 3.2, we also perform a number of sensitivity exercises to assess the robustness of our coefficient estimates in each regime. In general, the exercises shown in Table 4 suggest that the main results do not change qualitatively in several dimensions. The main findings are not sensitive to:

Table 4
Robustness Checks.

	Dependent Variable: Current account surplus / potential GDP								Dependent Variable: Current account surplus / GDP	
	[1]		[2]		[3]		[4]		[5]	
	Regime I	Regime II	Regime I	Regime II	Regime I	Regime II	Regime I	Regime II	Regime I	Regime II
Regressor	1973.1-1997.3	1997.4-2012.1	1973.1-1997.3	1997.4-2012.1	1973.1-1997.3	1997.4-2012.1	1973.1-1997.3	1997.4-2012.1	1973.1-1997.3	1997.4-2012.1
Lagged dependent variable	**0.952** ***	**0.904** ***	**0.962** ***	**0.924** ***	**0.950** ***	**0.918** ***	**0.942** ***	**0.887** ***	**0.952** ***	**0.880** ***
	(0.036)	(0.021)	(0.036)	(0.020)	(0.034)	(0.020)	(0.033)	(0.022)	(0.032)	(0.022)
Fiscal surplus	**0.142** ***	**0.077** ***	**0.139** ***	**0.045** **	**0.128** ***	**0.064** ***	**0.095** ***	**0.090** ***	**0.115** ***	**0.095** ***
	(0.042)	(0.026)	(0.042)	(0.022)	(0.040)	(0.021)	(0.032)	(0.022)	(0.032)	(0.023)
Productivity	**-0.169** ***	**-0.206** **	**-0.176** ***	**-0.340** ***	**-0.180** ***	**-0.413** ***	**-0.171** ***	**-0.384** ***	**-0.175** ***	**-0.375** ***
	(0.036)	(0.083)	(0.035)	(0.080)	(0.035)	(0.049)	(0.036)	(0.049)	(0.036)	(0.051)
TFP volatility	**2.640** ***	**1.780** ***	**3.049** ***	**0.791** *	**2.862** ***	**0.918** **	**2.737** ***	**1.534** ***	**2.877** ***	**1.529** ***
	(0.684)	(0.526)	(0.684)	(0.440)	(0.655)	(0.415)	(0.610)	(0.484)	(0.581)	(0.501)
Relative price of oil										
Oil price/CPI	0.000	**-0.005** *	-0.001	-0.003	0.000	**-0.004** **			-0.001	**-0.006** ***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)			(0.003)	(0.002)
Oil price/Export prices							-0.003	**-0.006** ***		
							(0.003)	(0.002)		
Real exchange rate	**-0.021** ***	**-0.044** **	**-0.025** ***	**-0.075** ***	**-0.025** ***	**-0.076** ***	**-0.027** ***	**-0.071** ***	**-0.029** ***	**-0.068** ***
	(0.008)	(0.017)	(0.008)	(0.018)	(0.008)	(0.014)	(0.008)	(0.014)	(0.007)	(0.014)
Real interest rate	-0.005	**0.062** ***	0.000	**0.060** ***	-0.005	**0.056** ***	0.000	**0.077** ***	0.002	**0.080** ***
	(0.016)	(0.020)	(0.017)	(0.020)	(0.016)	(0.020)	(0.017)	(0.022)	(0.016)	(0.023)
Constant	0.027	**-0.531** ***	0.023	**-0.419** ***	0.030	**-0.428** ***	-0.001	**-0.566** ***	0.002	**-0.596** ***
	(0.040)	(0.095)	(0.042)	(0.105)	(0.040)	(0.105)	(0.043)	(0.111)	(0.040)	(0.112)
Statistics										
Joint R-squared	0.969		0.966		0.967		0.969		0.968	
J-statistic	0.086	0.158	0.099	0.169	0.104	0.188	0.113	0.202	0.111	0.200
P-value	0.692	0.608	0.730	0.709	0.865	0.816	0.818	0.762	0.833	0.773
No. of observations	96	58	96	58	96	58	96	58	96	58

Notes: HAC standard errors are reported in parentheses. An * denotes p-value lower than 10% (also boldfaced), ** p-value lower than 5%, *** p-value lower than 1%. For the definitions of the variables, please see the appendix. HAC covariance weighting matrix uses prewhitening, a Barlett kernel and fixed bandwidth. The set of instruments used are lags of the regressors (further details in the appendix).

- Small changes in the set of instrumental variables. It is known that GMM estimations are sensitive to the choice of instrumental variables. We verify whether our baseline specification is sensitive to some changes in the instruments set and find that the main results remain unaltered as Table 4 shows in columns 1 through 3.

- The use of the oil prices-to-export prices ratio as an alternative to the real oil price that uses CPI as deflator. This could also be understood as a proxy of terms of trade. As Table 4 shows in column 4, our estimates do not vary drastically.

- The use of a different scale variable for the current account imbalance. Some analysts prefer to use current account as a percentage of nominal GDP. Our results do not change significantly when using such a measure (see Table 4, column 5).

It is worth mentioning that in all of the exercises described above, the time line is still a significant threshold and the preferred threshold among the candidates shown in section 2.4, and its threshold estimate is, once again, the third quarter of 1997.

Finally, we verify whether there is a single break and not more than one. Table 5 shows two panels with results of break tests by Andrews (1993) and Bai and Perron (1998). In each of these, we verify whether there is a structural break in the parameters that relate the current account to productivity, the real exchange rate, the interest rate, and the constant. Thus, this test is also performed to confirm the conclusions based on Table A4 in the Appendix. The upper panel shows test statistics for three different null hypotheses. A couple of comments are worth mentioning. First, the Andrews test allows us to reject the hypothesis that there is no breakpoint between 1973.1 and 2012.1. The most likely breakpoint location the test reports is in the third quarter of 1997. Second, when we split the sample into sub-periods 1973.1-1997.3 and 1997.4-2012.1, we cannot reject the null of the absence of a breakpoint with probability values higher than the standard levels within such sub-samples.

Regarding the Bai-Perron test, the lower panel of Table 5 reports the statistics for testing the nulls of (i) no breakpoint with the alternative of a single breakpoint, and (ii) a single breakpoint with the alternative of two breakpoints. The results point to the rejection of the first null hypothesis only. Moreover, the break date found is 1997.III again, which confirms our previous results.

TABLE 5
Breakpoint tests

I. Andrews test	F-statistic	P-value	Break date
Null hypothesis: no breakpoints between			
1973.1 and 2012.1	5.59	0.004	1997.3
1973.1 and 1997.3	2.17	0.524	1980.2
1997.3 and 2012.1	3.42	0.123	2002.2

II. Bai-Perron test	F-statistic	Critical value at 1%	Break date(s)
Null hypothesis: number of breaks is			
0 (alternative hypothesis: 1 break)	23.45	16.19	1997.3
1 (alternative hypothesis: 2 breaks)	15.81	18.11	

Notes: The probabilities for the Andrews (1993) test are calculated using Hansen's (1997) method. The statistics reported correspond to the maximum LR F-statistic for the Andrews test and the scaled F-statistic for the Bai-Perron (1998) test. The critical value for the Bai-Perron test is chosen at the 1% significance level. The hypotheses refer to a structural break in the parameters that relate the current account to productivity, the real exchange rate, the real interest rate and the constant within 15% trimmed sample.

4 Concluding Remarks

In this paper, we (i) uncover a structural break in the relationship between the US current account and its main drivers, (ii) confirm some findings reported separately in previous works of the DSGE literature, and in turn, (iii) present estimations that also challenge some past results. This is possible through the use of a relatively new technique that allows us to control for endogenous regressors in a threshold specification.

We find a robust breakpoint in the third quarter of 1997, and we argue the fact that the Asian financial crisis erupted in the same period might be more than a coincidence. The Taxpayer Relief Act of 1997 could have also contributed to such a structural change. Conversely, it is hard to accept that other variables such as the size or the sign of the previous current account imbalance could be informative threshold variables. We also found that the most significant determinants of the US current account are productivity, the real exchange rate, the fiscal surplus, and the volatility of productivity. Relative prices such as the oil price and the interest rate become statistically relevant factors after 1997, although their economic importance is less significant than productivity and real exchange rate fluctuations.

We interpret the 1997 structural break as a fact consistent with the worldwide saving glut phenomenon and the revived Bretton Woods hypothesis. Previous empirical works with panel data regressions have found that intercept dummy variables used to control for the Asian crisis were statistically significant in explaining medium-term fluctuations in countries' current accounts. These studies, however, assume that the break time is known and that the break is only on the intercept for a group of East Asian economies. To our knowledge, this is the first time that a structural break of this nature and with unknown time is tested for the US current account. Not only did the intercept suffer a change from 1997 onward, so too did some slopes related to the main drivers of the current account. The break is particularly more significant with respect to the coefficients of productivity, the real exchange rate, and the interest rate. We interpret this as a change in the behavior of international investors and emerging countries' fiscal and monetary authorities. International investors change their portfolios toward direct and financial investment in the US. Simultaneously, central banks change their exchange rate and foreign exchange reserve policies with a particular preference for undervalued currencies and safe US assets. The higher demand for such assets was accompanied by lower interest rates. The latter mechanism is captured by the model estimated in section 3. The slope of the real interest rate shows a larger magnitude after 1997.III. However, shocks of productivity and those behind the real exchange rate are relatively more important. The reduction of tax rates through the Taxpayer Relief Act and the change in exchange rate policies mentioned above could have also affected the sensitivity of the current account to fluctuations in productivity and the exchange rate. Another possible interpretation is that US and non-US investors moved their funds from East Asian economies to the US and invested in more capital-intensive sectors such as the information industry. The dot-com bubble observed during the 1997-2000 period is perhaps just a well-known example of this behavior. This phenomenon could have made productivity shocks more relevant in affecting investment and, thus, the current account.

The use of a linear specification that ignores the structural change we find might lead to underestimation of the role of some important drivers of the US current account as discussed in section 3.3. This message is potentially useful for practitioners who seek to improve the fit of their models to actual data and those who need to forecast the current account deficit. Our results also entail a challenge for DSGE modelers. Theoretical models would also need to consider a structural break in 1997 and include not one or two exogenous drivers but a more complete list with shocks of productivity, fiscal balance, TFP volatility, oil prices, among others. The modeling of such a structural break requires, of course, an adequate choice of the deep parameters that can be behind it. Such a task could be a next step in the research agenda on US external imbalances.

Appendix

A Data sources and definitions

Current account surplus-to-GDP ratio (ca): defined as (Exports -Imports + Net Primary Income from Abroad)/potential GDP, expressed in percentages. Both numerator and denominator variables are expressed in current US dollars. Potential GDP is the trend component of nominal GDP obtained by a Hodrick-Prescott (HP) filter. Source: Bureau of Economic Analysis (BEA).

Fiscal surplus-to-GDP ratio: HP detrended ratio of the overall fiscal surplus (government total receipts minus government total expenditures including interest payments) to GDP, expressed in percentages. Both numerator and denominator variables are expressed in current US dollars before detrending. Source: BEA.

Total factor productivity: HP detrended logged Solow residual, expressed in percent change. The Solow residual as a proxy of total factor productivity (TFP) is defined as $TFP_t = Y_t/(K_t^{\alpha} N_t^{1-\alpha})$, where Y denotes real GDP (source: BEA), K is the stock of capital, N stands for total hours worked, and $0 < \alpha < 1$ is the capital share. The capital stock is constructed using the perpetual inventory method using investment (gross fixed capital formation plus change in inventories; BEA) adjusted by the GDP price deflator (BEA), a depreciation rate $\delta = 0.025$ per quarter, and an initial level of $K_0 = I_0/(\delta + g_I)$, where I_0 denotes real investment in period 0 (assumed to be equal to the actual level observed in 1957.I), and g_I is the growth rate of real investment obtained from estimating $log(I_t) = g_0 + g_I t + \epsilon_t$ for $t = 1957.I, ..., 1966.IV$. We assume that $\alpha = 0.36$. Total hours worked are the product of weekly hours per quarter and number of persons at work (BEA). We also tried other combinations with parameters $\delta = 0.015$ and $\alpha = 0.3$, having TFP series whose percent changes had very high correlations with the percent changes of our main choice.

TFP volatility: demeaned GARCH-estimated standard deviation of total factor productivity, expressed in percentage. Let a_t and σ_{at} denote detrended logged TFP and its variance. Following Fogli and Perri (2006), the model estimated consists of the following two equations:

$$a_t = a_0 + \rho_a a_{t-1} + \nu_t$$

$$\sigma_{at}^2 = \sigma_0 + \nu_{t-1}^2 + \rho_\sigma \sigma_{at-1}^2$$

where $0 < \rho_a < 1$, $0 < \rho_\sigma < 1$, ν_t is i.i.d. stochastic processes. We construct TFP volatility as the implied standard deviation: $\hat{\sigma}_{at}$, for all $t = 2, ..., T$. Using the Andrews (1993) unknown breakpoint test, we find a time break in the volatility mean on 1983.IV. Thus, we demean the standard deviation using its means for each period as follows: $\hat{\sigma}^d_{at} = \hat{\sigma}_{at} - 0.7495$, for the 1957.II-1983.III period, and $\hat{\sigma}^d_{at} = \hat{\sigma}_{at} - 0.5548$, for the 1983.IV-2012.I period. We follow this procedure because, as opposed to the raw series, the demeaned series does not show non-stationarity under standard unit-root tests (see table with ERS DF-GLS test below).

Relative price of oil: HP detrended log of the ratio of the WTI oil price index to the Consumer Price Index, expressed in percentage. Sources: Federal Reserve Economic Data for the WTI oil price, International Financial Statistics (IFS) of the International Monetary Fund (IMF) for the export price index. For the robustness checks, we also used the export price index as a denominator in column 4, Table 4.

Real exchange rate: HP detrended log of the real trade weighted U.S. dollar index, expressed in percentage. The index is the price-adjusted weighted average of the foreign exchange value of the U.S. dollar against the currencies of a broad group of major U.S. trading partners (Euro Area, Canada, Japan, Mexico, China, United Kingdom, Taiwan, Korea, Singapore, Hong Kong, Malaysia, Brazil, Switzerland, Thailand, Philippines, Australia, Indonesia, India, Israel, Saudi Arabia, Russia, Sweden, Argentina, Venezuela, Chile and Colombia). An increase of this variable indicates a real appreciation of the US dollar. Source: Federal Reserve Economic Data.

Real interest rate: defined as $100 \times log((1+i)/(1+\pi))$, where i is the 10-Year Treasury Constant Maturity Rate, and π denotes the ex-post CPI inflation rate. Source: Federal Reserve Economic Data.

When necessary, the variables described above were seasonally adjusted.

B Elliot-Rothenberg-Stock DF-GLS test

The table below reports the statistics of the Elliot-Rothenberg-Stock DF-GLS test. The null hypothesis of a unit root is mostly rejected at a significance level of 1%, at 5% in the case of the TFP volatility, and at 10% in the case of the real interest rate.

Table A1
Elliott-Rothenberg-Stock DF-GLS test.

Regressor	Test statistic	
Current account surplus	-0.270	
Fiscal surplus	-3.708	***
Productivity	-4.398	***
Volatility of productivity	-2.075	**
Relative price of oil	-7.534	***
Real exchange rate	-3.435	***
Real interest rate	-1.804	*

Note: An * denotes rejection of the null of unit root at 10%, ** rejection of the null at 5%, *** rejection of the null at 1%. For definitions of the variables, please see the appendix.

C Threshold estimates

The threshold estimates obtained for each candidate variable, for different samples and types of reduced-form models, are shown below.

Table A2
Threshold estimates obtained for each candidate variable, different samples and types of reduced-form models.

	Linear reduced-form model		Threshold reduced-form model	
Candidate variable	1973.1-2012.1	1957.1-2012.1	1973.1-2012.1	1957.1-2012.1
Time	1997.3	1997.3	1997.3	1997.3
Current account surplus / GDP	-1.54	0.37	-1.66	0.37
Absolute value of current account surplus / GDP	1.49	1.56	1.54	1.56
Change in current account surplus / GDP	0.40	-0.09	-0.02	-0.09
Fiscal surplus / GDP	0.78	0.73	0.78	0.73
Absolute value of fiscal surplus / GDP	0.78	0.73	0.78	0.73

D Descriptive statistics

The table below shows descriptive statistics of the regressors per regime.

Table A3
Descriptive statistics.

	Fiscal surplus	Productivity	TFP volatility	Relative oil price	Real exchange rate	Real interest rate
Sample: 1973.1-1997.3						
Mean	-0.08	-0.06	-0.01	2.30	-0.26	2.96
Median	-0.05	0.06	-0.01	4.09	-0.36	3.42
Maximum	1.88	1.64	0.12	45.60	12.89	8.51
Minimum	-4.81	-2.31	-0.10	-42.29	-7.80	-3.99
Std. Dev.	1.04	0.86	0.05	17.15	3.85	2.92
Sample: 1997.4-2012.1						
Mean	0.09	0.03	0.01	-1.29	0.38	1.87
Median	0.36	0.17	-0.01	-0.72	0.18	1.90
Maximum	2.99	1.22	0.18	48.93	7.23	5.09
Minimum	-4.29	-3.06	-0.07	-58.69	-7.10	-1.35
Std. Dev.	1.74	0.80	0.06	20.60	3.06	1.43

E Confidence Intervals for the Baseline Specification

The table below reports 90% confidence intervals for the baseline estimates shown in Table 3. An asterisk indicates that the intervals do not overlap between regimes.

Table A4
90% Confidence Intervals.

	Regime I		Regime II		
	1973.1-1997.3		1997.4-2012.1		
Regressor	Lower limit	Upper limit	Lower limit	Upper limit	
Lagged dependent variable	[0.897	0.998]	[0.849	0.919]	
Fiscal surplus	[0.059	0.165]	[0.052	0.127]	
Productivity	[-0.233	-0.115]	[-0.457	-0.299]	*
TFP volatility	[1.850	3.765]	[0.728	2.287]	
Relative price of oil	[-0.005	0.003]	[-0.008	-0.002]	
Real exchange rate	[-0.040	-0.017]	[-0.087	-0.041]	*
Real interest rate	[-0.026	0.025]	[0.043	0.115]	*
Constant	[-0.056	0.074]	[-0.766	-0.404]	*

Note: An asterisk (*) denotes no overlap between confidence intervals.

F Sets of Instrumental Variables

Baseline IV set: current account (second to third lag), fiscal surplus (first to fourth lag), TFP (first to fourth lag), TFP volatility (first to fourth lag), oil price (first to third lag), real exchange rate (first to second lag), real interest rate (first to third lag). IV1: current account (third lag), fiscal surplus (first lag), TFP (first to fourth lag), TFP volatility (first to third lag), oil price (first to third lag), real exchange rate (first to second lag), real interest rate (first to third lag).

IV2: current account (second lag), fiscal surplus (first to third lag), TFP (first to fourth lag), TFP volatility (first to third lag), oil price (first to third lag), real exchange rate (first to second lag), real interest rate (first to third lag). IV3: current account (second to fourth lag), fiscal surplus (first to third lag), TFP (first to fourth lag), TFP volatility (first to third lag), oil price (first to third lag), real exchange rate (first to third lag), real interest rate (first to third lag). All sets include a constant and time trend. The baseline IV set is used in Tables 1 through 3 and columns 4 and 5 in Table 4. Sets IV1 through IV3 are used in columns 1-3 in Table 4.

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