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1. Introduction

A country cannot consume beyond its means indefinitely. Economic theory states that the dynamic evolution of the amount of money that a country spends abroad and the amount that it takes in should be balanced, that is, there should be a long-run relationship between the two. In other words, current account (CA) disequilibria ought to be a short-run phenomenon.

When a country's CA deficit is highly persistent, the government usually implements macroeconomic policies to bring the account back to equilibrium; such deficits must be fixed sooner or later, and the later they are corrected the higher the economic cost of the adjustment. These policies ensure that the country's intertemporal budget constraint is not violated and that the deficits are a short-term phenomenon.

The balance of the CA is usually referred to as the balance of trade, that is, the difference between the value of goods and services exported and those imported; however, the CA also includes net services and net transfers. The importance of these particular sub-accounts is usually minimized and not considered due to the fact they normally represent a small fraction of the total.

The long-run relationship between exports and imports has been studied using a range of cointegration techniques (some of which allow for structural breaks in the cointegrated relationship).

This issue has been widely studied in the literature and, in general, evidence of cointegration is more commonly found for developed economies; for example, Irandoust and Ericsson (2004) find evidence of cointegration between imports and exports for Germany, Sweden, and the US, though not for the UK. Nevertheless, the evidence for the US is mixed: Fountas and Wu (1998) find no long-run relationship between exports and imports even when they employ cointegration and a UR test allowing one break; Husted (1992) finds evidence of cointegration for the US if one break is allowed in 1983. Bahmani-Oskooee and Rhee (1997) also find cointegration in their analysis of the Korean economy.

In contrast, finding that the long-run relationship holds for developing economies is more difficult. Narayan and Narayan (2005) find evidence that exports and imports are cointegrated for only 6 out of 22 least developed countries. Nag and Mukherjee (2012) allow for multiple structural breaks and find no evidence that exports and imports are cointegrated for India. Arize (2002) finds evidence in favor of cointegration for 35 out of 50 countries; nevertheless, he reports that countries in the Middle East and Latin America have cointegrated relationships that appear to be more unstable.

In this paper, we study whether a long-run equilibrium exists between Mexico's total CA receipts (exports, services, and transfers) and total CA payments (imports, services, and transfers). Two factors distinguish this study from other related empirical works: firstly ,we take into account the total receipts and total payments assessed in all the sub-accounts of the CA (i.e., merchandise, services, and unilateral transfers), rather than simply analyzing the relationship between exports and imports plus any interest payments on net debt. We believe this is relevant for our particular case study because some of the sub-accounts that are not considered in other studies are highly relevant in the Mexican case; for example, transfers represented, on average, almost 9% of the nation's exports during the relevant period. Secondly, we study the long-run relationship using either (i) cointegration tests, with and without structural breaks;[1] and, (ii) a unit-root (UR) test that endogenously determines structural breaks, in order to analyze whether the CA balance (receipts minus payments) has a tendency to revert to a constant mean.

Cointegration between total CA receipts and total CA payments, and a UR test on the CA balance are comparable. However, the cointegration approach is more flexible because the cointegrated vector is calculated rather than imposed.[2] However, different results are plausible because the UR test we employ allows for up to three breaks whereas the cointegration procedure just one.

Our results imply that Mexico's trade deficits (surpluses) can be considered a short-run experience, though only if we allow a certain degree of flexibility (i.e., three structural breaks) when modeling the statistical properties of the series. The cointegration tests cannot reject the null of no cointegration, whereas it is possible to reject nonstationarity using the UR test, when allowing for three breaks.

As in studies that analyze developing economies, when studying Mexico, an economy that has undergone many economic events that are important in determining CA behavior, in order to give any stationary test a fair chance one has to allow for the unexpected changes caused by abrupt depreciations of its real exchange rate.

The rest of the article is organized as follows: Section 2 shows the theoretical framework that explains what the relationship should be between a country's exports and imports. Section 3 presents the methodological approaches taken when studying this issue and their corresponding results. Section 4 discusses the main findings and conclusions.

2. Economic Background

The economic intuition behind the expected long-run relationship between a country's income and expenditures can be understood if we consider a small open economy that trades goods and financial assets with the rest of the world.[3] The economy maximizes lifetime utility subject to budget constraints, which implies that it chooses a consumption and a bond-holding vector $\{C_t, B_t\}$, taking as given all the other variables $\{r_t, Q_t\}$.[4] The budget constraint for the initial period is given by:

$$q_1 + r_0 b_0 = c_1 + (b_1 - b_0) \tag{1}$$

[1] Allowing for structural breaks is necessary because many studies have provided evidence of instability. Arize (2002), among others, provides evidence of parameter instability due to unmodelled structural breaks. If the long-run relationship is not stable, but does exist, under the alternative hypothesis we could end up not rejecting the null of no cointegration when there is a break.

[2] Our approach is analogous to that used in international finance literature. When practitioners empirically examine the validity of Purchasing Power Parity (PPP) in the long run, they do it either by: (i) testing whether the nominal exchange rate and domestic and foreign prices move together in the long run (cointegration); or (ii) testing whether the real exchange rate, RER, (nominal exchange rate adjusted for relative prices) reverts to a stable equilibrium level over time (unit-root test). The latter approach implies that the practitioner imposes the symmetry and proportionality conditions when constructing the RER.

[3] Without loss of generality, we will assume that the economy only trades one good and one financial asset. Our simple analytical framework is based on Husted (1992).

[4] It is not necessary for the interest rate or the endowment stream to be constant over time, though they do have to be known.

where c_1, q_1, $r_0$denote, respectively, consumption in period 1, endowment in period 1, and interest rates on bonds held between periods 0 and 1; $(b_1 - b_0)$ denotes the change in bond holdings between periods 0 and 1. Since equation (1) holds for every period, we can construct a lifetime budget constraint combining all of the one-period budget constraints,

$$\sum_{t=1}^{\infty} \frac{q_t}{(1+r_t)^t} + (1 + r_0)b_0 = \sum_{t=1}^{\infty} \frac{c_t}{(1+r_t)^t} \quad (2)$$

Imposing the no-Ponzi game condition ($\lim_{t\to\infty}(1 + r_t)^{-t} b_t = 0$) we can express equation (2) in terms of the economy's CA: $CA_t = b_t - b_{t-1}$, i.e., a country's initial net foreign asset position must be equal to the sum of its current account deficits.

$$(1 + r_0)b_0 = \sum_{t=1}^{\infty} \frac{-CA_t}{(1+r_t)^t} \quad (3)$$

Equation (3) implies that the country's initial asset position must be equal to the sum of its current account deficits. As argued by Husted (1992), the testable implication for the condition in equation (3) is that:

$$\alpha + X_t + \delta \cdot M_t = \varepsilon_t \quad (4)$$

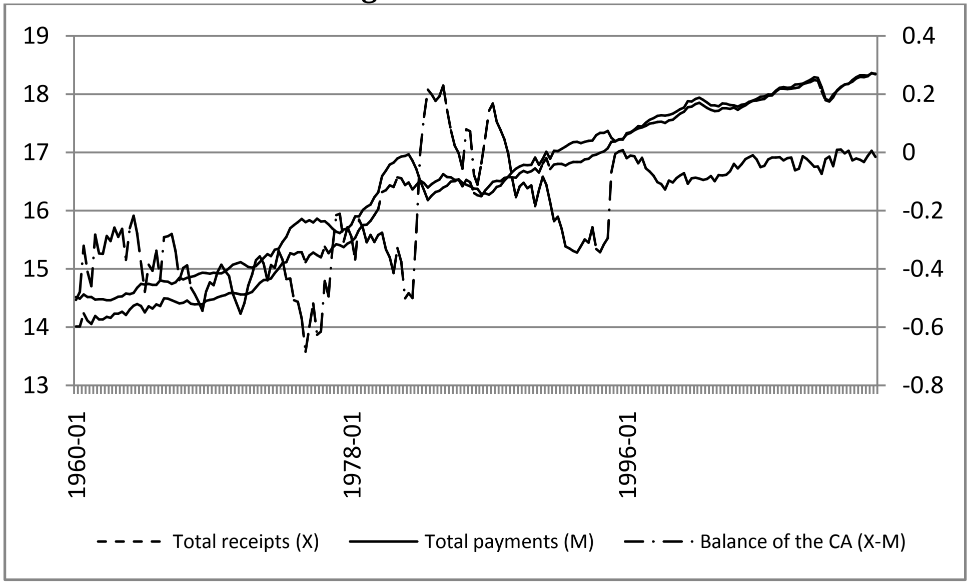
where X_t is the total value of the country's CA receipts (exports, services and transfers) and M_t is the total value of country's CA payments (imports, services and transfers). If the country is satisfying its intertemporal budget constrain, the variables, X_t and M_t, must be cointegrated, with a cointegrating vector (α, δ); therefore, ε_t would be a stationary series.[5]

3. Data and Empirical Results

For the empirical analysis we use quarterly data for the period 1960:01–2012:02 provided by Mexico's Central Bank. The series are seasonally adjusted in constant 2005 dollar prices and expressed in logarithms. The evolution of the Mexican series, X_t, M_t, and $(X_t - M_t)$, is shown in Figure (1).

[5] This requires that the series X_t and M_t be *I(1)*.

Figure 1. Mexico's CA



The first step in analyzing the long-run relationship between the variables is to determine their order of integration. The results show that the variables X_t and M_t can be considered an *I(1)* variable. The Augmented Dickey-Fuller (ADF) and DF-GLS tests cannot reject the null of UR for the series in levels but do reject it for the series in first differences.

We also consider the possibility of structural shifts in the series of interest. It is well known that the result of a UR test is biased towards the null hypothesis of UR in the presence of structural breaks. To eliminate the possibility of such bias, we employ the tests developed by Kapetanios (2005), Perron (1997), and Zivot and Andrews (1992), all of which determine the breaks endogenously, though only the first allows for more than one break. Furthermore, they include different test models that allow for structural changes at the intercept, on the slope of the deterministic trend, or both. The results of these tests confirm our initial results; the series are *I(1)*. For the sake of brevity, we do not present the results here, though these are available upon request.

3.1 Cointegration tests, with and without structural breaks

To study the long-run relationship between the two series, X_t and M_t, we start by considering the Engle-Granger approach. The null hypothesis of no cointegration implies that the residuals, $\hat{u}_t$, from equation (5) are nonstationary.

$$X_t = \alpha + \beta M_t + u_t \tag{5}$$

The Engle-Granger procedure is, however, not robust when there is a break in the cointegrated relationship (see Noriega and Ventosa-Santaulària, 2011). Therefore, prior to the Engle-Granger test, we apply Hansen's (2002) instability test to study the stability of the relationship. However, Hansen's test is in itself a cointegration test in which the cointegrated relationship is *à la* Engle and Granger, that is, without structural breaks. In this perspective, we would infer that there is sound evidence of cointegration when both tests, Hansen's and the Engle-Granger, find evidence in that sense.

Hansen proposes a test with *I(1)* processes, which, when the null hypothesis of stability is rejected, offers evidence of no cointegration (and instability). In the words of Hansen (2002, p. 52): **"[Hansen's]** *specification tests* [...] *are clearly tests of the model of cointegration proposed by Granger (1981) and developed by Engle and Granger (1987). It is, of course, possible to generalize the definition of cointegration to allow a nonstationary linear relationship between the variables, but this would be a radical departure from the idea Granger originally put forward.*" [Emphasis added].
Hansen proposes three test statistics, L_c, *MeanF,* and *SupF,* designed to have power against different types of instability. However, when applied to test for cointegration, Hansen himself makes the case that the three test statistics can be understood as cointegration tests against various alternatives, all of them sharing the consequence of no-cointegration. Again, in the words of Hansen (2002, p. 52): "*Lc* is a test of the null of cointegration against the alternative of no cointegration.[...] The *SupF* and *MeanF* statistics will be also**[consistent against the alternative of no cointegration]**."[6] [Emphasis added]. Results appear in Table (1):

Table 1.Testing for parameter instability/cointegration using the Hansen(2002) test

Test statistic	*Value*	*p-value*	*Result*
L_C	0.064	>0.20	Null hypothesis of stability cannot be rejected
$MeanF$	1.289	>0.20	
$SupF$	4.067	>0.20	

As can be seen from the results, Hansen's test cannot reject the null hypothesis. This implies that, according to this test, there is both parameter stability and, more importantly, evidence of cointegration. Nevertheless, the Engle-Granger cointegration test contradicts this evidence. We estimate equation (5) and, following the Engle-Granger procedure, perform an Augmented Dickey-Fuller (ADF) test over the estimated residuals. The resulting test statistic, -0.110, does not allow us to reject the null hypothesis of no cointegration when we use the appropriate critical values of the Engle-Granger test.
Although Hansen's test found no evidence to reject the null hypothesis, as in any test, the possibility of a type-I error remains. In this particular case, it is also possible that the nature of the break in the relationship has not been properly controlled for. We therefore test for cointegration allowing for a structural break in the cointegrated relationship.

We make use of the Gregory-Hansen (1996) methodology to test the null hypothesis of no cointegration against the alternative of cointegration with a regime change. This test is designed to detect cointegrated relationships when there is a break at the intercept, on the slope, or both. We focus our attention on model 4 (*regime shift model,* see Gregory and Hansen, 1996, p. 103); in this case, the relevant auxiliary regression is

$$X_t = \mu_1 + \mu_2 \varphi_{t\tau} + \alpha_1^\tau M_t + \alpha_2^\tau M_t \varphi_{t\tau} + e_t, \quad (6)$$

[6] The testing procedure is difficult to summarize briefly; readers can verify it in Hansen's (2002) article. The code is available at Hansen's website: http://www.ssc.wisc.edu/~bhansen/progs/progs.htm.

where X_t and M_t are the variables to be cointegrated; μ_1 and μ_2 account for the level and the level shift, whilst α_1^τ is the cointegrating vector before the break and α_2^τ represents the change in such cointegration vector; 0<τ<1 represents the break fraction of the sample. Finally, $\varphi_{t\tau} = \begin{cases} 0 \ if t \leq [T\tau] \\ 0 \ if t > [T\tau] \end{cases}$, where $[T\tau]$ is the integer part. The break date is endogenously estimated. Gregory and Hansen propose three different test statistics; results are shown in Table (2):[7]

Table 2.Testing for a broken-cointegrated relationship using the Gregory-Hansen(1996) test: Model 4*

Test statistic	*Value*	*Result*
DF	-4.847	Null hypothesis of no cointegration cannot be rejected
Z_t	-4.637	
Z_α	-40.144	

*: see Gregory and Hansen (1996, p. 103), eq. (2.3).

None of the test statistics provides enough evidence to reject the null of no cointegration with shift. In sum, there is no sound evidence of cointegration according to these tests.

3.2 UR test that allows for multiple breaks

To continue investigating the trending mechanism of the balance of the CA during a period in which Mexico underwent various crises—which implied severe real depreciations of the peso and drastic adjustments in the current account[8]—we make use of Kapetanios' UR test, which generalizes the Zivot and Andrews test so that a larger number of breaks is possible. As mentioned before, in order to analyze whether or not this series is stationary we have to impose a cointegrated vector (1, -1) to obtain the CA balance. The original Kapetanios test includes three different specifications all embedded in test equation (7).

$$y_t = \mu_0 + \mu_1 t + \alpha y_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta y_{t-i} + \sum_{i=1}^{m} \theta_i DU_{i,t} + \sum_{i=1}^{m} \varphi_i DT_{i,t} + \epsilon_t \quad (7)$$

where y_t is the CA balance, $(X_t - M_t)$, $DU_{i,t}=1(t>T_{b,i})$, and $DT_{i,t}=1(t>T_{b,i})(t-T_{b,i})$, where $T_{b,i}$ denotes the date of the i^{th} structural break ($i=1,2,\dots,m$) and $1(\cdot)$ is the indicator function. The first sum $\left(\sum_{i=1}^{k} \gamma_i \Delta y_{t-i}\right)$ accounts for k lags of the differenced dependent variable to control for possible autocorrelation.[9]

The result of this test shows that the null hypothesis of UR can be rejected, at the 1% level, in favor of the mean stationary with breaks alternative. The test statistic of the autoregressive parameter, $t_{\hat{\alpha}}$, is estimated as equal to -7.4061.

Now that the stationarity of the CA balance series, $(X_t - M_t)$, has been established, we can proceed to use Bai and Perron's (BP) (1998, 2003) methodology. This procedure is designed to detect structural changes in a stationary time series. The test is performed as follows: the full sample is tested for a structural change using a single break *sup-F*. The

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[7] The test code can be found at Hansen's webpage: http://www.ssc.wisc.edu/~bhansen/progs/progs.htm.

[8] The two greatest depreciations were those of 1982 and 1994.

[9] We only test for stationarity using the model that allows for changes in the mean of the process, i.e., the model that sets $\varphi_1 = \varphi_2 = \cdots \varphi_m = 0$. The maximum number of breaks allowed is three, while an upper bound k^{max} is selected for k. If the last lagged difference is significant, k is set equal to k^{max}; if not, k is reduced by one and the process is repeated until the last lagged difference is significant.

sup-F test is based on the difference between the restricted and unrestricted sums of square residuals from the following regressions:

$$y_t = \mu + \delta DU_t + \varepsilon_t \qquad \text{unrestricted regression} \tag{8}$$

$$y_t = \mu + \varepsilon_t \qquad \text{restricted regression} \tag{9}$$

To reject the restricted model and thereby conclude in favor of the model with one break, the overall minimal value of the sum of squared residuals of the unrestricted model must be smaller than the overall minimal value of the sum of squared residuals of the zero break model. Once the initial break is identified and deemed significant, the full sample is divided into two subsamples at the break point. The test is performed for each of the subsamples to identify additional breaks. This procedure is repeated until it is not possible to reject the null hypothesis.

The results of the BP test are shown in Table (3). We show the test statistics that demonstrates that the series has three breaks at different dates, $\hat{T}s$, to be considered. Furthermore, we show the different estimated levels for each subsample, $\hat{\delta}s$, identified by the BP methodology.

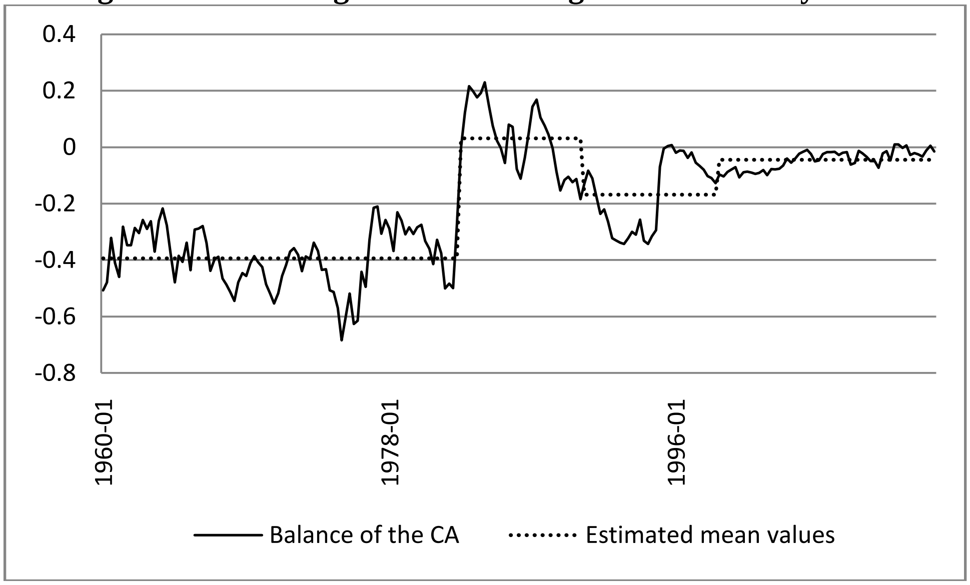
Table 3. Break dates in the CA balance series, BP test results

Sup$F$(1|0)	Sup$F$(2|1)	Sup$F$(3|2)	Sup$F$(4|3)			
22.02***	17.57***	15.49***	3.23			
$\mu + \hat{\delta}_1$		$\mu + \hat{\delta}_2$		$\mu + \hat{\delta}_3$		$\mu + \hat{\delta}_4$
-0.3939		0.0307		-0.1682		-0.0447
(0.00)		(0.08)		(0.00)		(0.00)
	$\hat{T}_1$		$\hat{T}_2$		$\hat{T}_3$	
	1982:01		1990:01		1998:03	

The symbol *** denotes statistical significance at the 1% level. P-values are in parentheses.

Figure (2) shows the same results graphically: the CA balance (solid line), and the estimated mean value of the CA balance (dotted line) over the four subperiods estimated using the BP methodology.

Figure 2. Estimating structural changes in a stationary series



The estimated breaks roughly coincide with a devaluation or a large, sudden depreciation of the real exchange rate often associated with government budget difficulties, such as those of 1982 and late 1994. After these dates, the mean value of the CA jumped upwards (i.e., improved) from -0.3939 to 0.0307 and from -0.1682 to -0.0447, respectively. In contrast, the mean value of the CA jumped downwards (i.e., deteriorated) from 0.0307 to -0.1682 at the beginning of 1990, right in the middle of the period during which the Mexican government did not let the peso depreciate against the dollar, at the cost of great losses of international reserves. During this period the Mexican currency greatly appreciated in real terms.

4. Concluding Remarks

This investigation studies the long-run relationship between Mexican CA revenues and expenditures using cointegration and unit-root tests. The results show that it is not possible to affirm that these two series are cointegrated when only one break is allowed for. However, even if we restrict the parameters of the long-run relationship, but allow for more structural breaks, we are able to find that the CA balance is stationary around a changing mean.

These results are in line with those of related studies. Developing economies tend to be more unstable, therefore when performing this type of analysis, a more flexible structure (structural breaks) for the CA balance is required in order for evidence of stationarity to be found.

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