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EXCHANGE RATE REGIME AND EXTERNAL ADJUSTMENT: AN EMPIRICAL INVESTIGATION FOR THE U.S. (*)

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Abstract

This paper analyses the relationship between the U.S. net external position and the exchange rate regime. I find a structural break in the U.S. net external position at the end of the Bretton Woods system of fixed exchange rates that changed both the mean and variance of the series. On average, the U.S. changed from a creditor to a debtor position and the variance of the external position increased during the floating period. This increase is to a large extent due to the valuation component of external adjustment, which accounts for 54% of the variance of the U.S. external position during the floating period but only 29% during the fixed exchange rate period. Further analysis shows that the exchange rate regime mainly affects the valuation channel of external adjustment. There is also evidence of another structural break in the U.S. external position around the time of the introduction of the euro. Finally, I document asset pricing implications from the relationship between the exchange rate regime and the external adjustment process, as external imbalances predict future exchange rate developments once the exchange rate regime is taken into account.

Keywords: external adjustment, exchange rate regime, structural breaks, valuation adjustment.

JEL classification: F31, F33.

Resumen

Este trabajo analiza la relación entre la posición externa neta de Estados Unidos y el régimen de tipo de cambio. Se detecta una ruptura estructural en la posición externa neta de Estados Unidos al final del sistema de tipo de cambio fijo de Bretton Woods, que modificó tanto la media como la varianza de la serie. En promedio, Estados Unidos pasó de una posición acreedora a una deudora y la varianza de la posición externa aumentó durante el período de tipo de cambio flexible. Este aumento se debe en gran medida al componente de valoración en el ajuste externo, que representa el 54 % de la varianza de la posición externa de Estados Unidos durante el período de tipo de cambio flexible, pero solo el 29 % durante el período con tipo de cambio fijo. También se demuestra que el régimen de tipo de cambio afecta principalmente al componente de valoración en el ajuste de desequilibrios externos. Existe también evidencia de otra ruptura estructural en la posición externa neta de Estados Unidos en el momento de la introducción del euro. Finalmente, hay implicaciones de valoración de activos procedentes de la relación entre el régimen de tipo de cambio y el proceso de ajuste externo, ya que los desequilibrios externos tienen capacidad explicativa sobre la evolución futura del tipo de cambio una vez se tiene en cuenta el régimen cambiario.

Palabras clave: ajuste externo, régimen de tipo de cambio, rupturas estructurales, ajuste por valoración.

Códigos JEL: F31, F33.

1 Introduction

The role of the nominal exchange rate regime in the process of external adjustment has been a topic of ample research. During the Bretton Woods system of fixed exchange rates, Friedman (1953) warned that flexible exchange rates facilitate the correction of external imbalances by allowing an automatic adjustment in a context of nominal rigidities. Empirical research on this topic has just focused on whether the exchange rate regime affects the flexibility of the current account, narrowing the analysis to the trade component of external adjustment and neglecting the importance of the already documented valuation channel. This work tries to fill this gap by analyzing the consequences of different nominal exchange rate regimes on the external adjustment of the U.S. net foreign asset position.

The trade channel of external adjustment assumes that countries running current accounts deficits would reduce their imbalances by exchange rate depreciation, boosting exports and reducing imports. Several studies have empirically investigated how this trade channel is affected by the exchange rate regime with different results. Chinn and Wei (2013) find no relationship between the flexibility of foreign exchange regimes and the rate of current account reversion. On the other hand, Gosh et al. (2014) argue that previous studies fail to find such a relationship due to the exchange rate regime classification used. They do find a robust relationship between the exchange rate regime and the speed of external adjustment confirming Friedman's hypothesis by using a novel data set of bilateral foreign exchange regimes. Similarly, Eguren-Martin (2016) finds robust evidence that flexible exchange rate arrangements deliver a faster current account adjustment among non-industrial countries.

Friedman's argument as well as the studies supporting his hypothesis focus on the trade balance as the mechanism through which exchange rates operate to reduce external imbalances. For instance, Gosh et al. (2014) use bilateral data on trade balances as their measure of external imbalance and Eguren-Martin (2016) finds that the most robust driver in the correction of current account imbalances is expenditure switching between local and foreign products as relative prices change, particularly via its impact on exports. Against these findings, the literature on the exchange rate disconnect provides increasing evidence of a possible weakened relationship between exchange rates and trade, being the rise of global value chains a common explanation (IMF (2015a), Swarnali et al (2016) and Patrice et al (2015)).

A recent wave of empirical studies has pointed out the importance of valuation effects in the adjustment of external imbalances, being the real exchange rate a mayor player. Gourinchas and Rey (2007) show that the dynamics of the exchange rate play a major role since it has the dual role of changing the differential in rates of return between assets and liabilities denominated in different currencies and also of affecting future net exports. They also point out that because the current account is reported at historical cost it may be a very approximate and potentially misleading reflection of the change of a country's net foreign asset position. Using a data set on U.S. gross external positions and portfolio returns they find that the valuation component has contributed by 27% to the cyclical external adjustment. Further analysis by Evans and Fuertes (2011) and Evans (2012) show that the contribution of the valuation component is larger than that of the trade component when analyzing the adjustment of the whole U.S. net foreign asset position and not only its cyclical part[1]. None of these papers analyze the implications of different exchange rate regimes for the external adjustment process.

The relevance of the valuation component makes necessary to incorporate its contribution when analyzing the relation between the exchange rate regime and the external adjustment. Moreover, the documented weakened relationship between exchange rates and trade may leave valuation effects as the main factor in the external adjustment process. The ignored valuation component may act reinforcing the trade channel of external adjustment or against it, depending on the currency composition of foreign assets and liabilities. For instance, a debtor country with most of its external liabilities denominated in foreign currency could potentially experience valuation effects that more than offset the improvement on its external position coming from an exchange rate depreciation due to the traditional trade channel. This is very unlikely in the case of developed countries, such as the U.S., where most of its debt is denominated in domestic currency, but it could be possible for emerging economies that accumulate a large part of its debt in foreign currency.[2] In any case, ignoring the importance of valuation effects may distort the exchange rate contribution to the external adjustment.

Within this framework, the contribution of this paper is threefold. First, I document a robust relationship between the foreign exchange regime and the external adjustment process, identifying a structural break in the mean and the variance of the U.S. external position at the end of the Bretton Woods system of fixed exchange rates in 1973. The variance of the U.S.

[1]Evans and Fuertes (2011) and Evans (2012) analyze the adjustment of the U.S. external imbalance during the floating exchange rate regime.

[2]Calvo and Reinhart (2002) point out to liability dollarization as one of the reasons for the "fear of floating" in emerging economies.

external position increased and its mean changed from a creditor to a debtor position during the floating exchange rate period that began in 1973. Second, the valuation component increased its contribution to the variance of the U.S. external position from 29% during the fixed exchange rate regime (1952-1972) to 54% over the floating period (1973-2016), with the part of the valuation component related to the real exchange rate accounting for 19% of that variance. Further analysis shows that the exchange rate regime mainly affects the valuation channel of external adjustment. There is also evidence of another structural break in the U.S. net external position around the time of the introduction of the euro. Third, I document asset pricing implications from the relationship between the exchange rate regime and the external adjustment process, as external imbalances predict the foreign exchange once the exchange rate regime is taken into account. Furthermore, the relationship between the external imbalance and future changes of the real exchange rate is affected by the nominal exchange rate regime.

Following Evans and Fuertes (2011) and Evans (2012), I use a simple present value equation that relates current external imbalances with future expected net exports growth and portfolio return differentials.[3] Applying the methodology developed by Campbell and Shiller (1988) to this present value equation, I analyze the non-linearities behind a VAR specification that includes the three main variables of study (the external imbalance, net exports growth and portfolio return differentials), documenting a change on the behavior of the U.S. external position that happened when the Bretton Woods system of fixed exchange rates collapsed in 1973. I also document this change by applying the methods developed by Qu and Perron (2007) to test for structural breaks in mean and variance at unknown dates in a system of equations. I do find a structural break in the VAR specification at the end of Bretton Woods system of fixed exchange rates. The test reveals not only a change in the variance of the series but also a change in the mean, suggesting that the large deterioration of the U.S. net external position could be related, at least to some extent, to the end of the fixed exchange rate regime. I also find evidence of another break that happened right before the introduction of the euro, signaling that this currency union may have affected the U.S. external adjustment path. This finding should not be surprising as the U.S. has an important part of its foreign assets denominated in euros. The test identifies a third break in 1984, the beginning of the period known as the Great Moderation.[4]

[3]This present value equation includes both the cyclical and the secular components of the external imbalance while the equation developed by Gourinchas and Rey (2007) only includes the cyclical component.

[4]See McConnell and Perez-Quiros (2000).

I also apply the method proposed by Inclan and Tiao (1994) to detect changes in the unconditional variance of a series, which provides robustness to the previous result. I find three structural breaks in the variance of the U.S. external position at the same points in time of those previously identified in the VAR specification. For the series of portfolio returns differentials, this test identifies two breaks, one at the end of Bretton Woods and another at the end of the 1990's. For the series of net exports growth there is only one structural break in the variance at the beginning of 1984. This may be consistent with the nominal exchange rate regime mainly operating through the valuation channel. On the contrary, the trade channel seems to be more related to the real economy, with the break in that series happening at the beginning of the Great Moderation. Additionally, I apply tests of structural breaks in mean at unknown dates developed by Bai and Perron (1998) to the U.S. external position, identifying breaks at the same points in time than those documented for the VAR. The series of portfolio return differentials and net exports growth do not present any structural break in mean.

The paper proceeds as follows: Section II presents the proposed measure of external imbalances. Section III documents the data used and section IV analyzes the behavior of the U.S. net external position under different exchange rate regimes. Section V presents the tests of structural breaks and Section VI analyzes the asset pricing implications. Section VII concludes.

2 Net external position

The current account measures transactions in goods, services, income, and net unilateral current transfers between residents and nonresidents during the year. For the purpose of analyzing the relation between the external adjustment and the exchange rate regime, this measure may present several problems. First, it may not accurately portrait the needs of external adjustment of a country as it does not take into account the stock of total debt. Second, it does not include the effects of changes in asset prices and exchange-rate movements on a country's external imbalance. In the case of the U.S., this is quite obvious if we compare the cumulative value of current account deficits with the International Investment Position as it is shown in Figure 1. The latter is much lower due to the valuation effects related with changes in the price of assets and exchange rate movements. Focusing only on current account imbalances we may conclude that the need for external adjustment in the U.S. is much larger than it really is as valuation effects have mitigated, in part, the deterioration of the U.S. external position. Thus, if we want to investigate the effects of the nominal exchange rate regime on the process of external adjustment it looks reasonable to incorporate a measure based on the Net International Investment Position (NIIP), which is directly affected by exchange rate movements.

Gourinchas and Rey (2007) derive a present value equation that relates the cyclical component of a country's net external position with future net exports growth and portfolio return differentials. Evans and Fuertes (2011) develop a similar present value relation including both the cyclical and secular components of the country's net external position[5]. I follow this approach and use their measure of external imbalance as the variable of interest to analyze the consequences of different nominal exchange rate regimes on the process of external adjustment. Both Gourinchas and Rey (2007) and Evans and Fuertes (2011) find that a relevant part of the changes in the U.S. net external position come from the valuation channel. They also find that the net external position predicts future exchange rate movements over periods beginning in 1973. As I already mentioned, none of these papers study the implications of the exchange rate regime for the external adjustment process.

Evans and Fuertes (2011) derive the present value relation for the net external position using several log-linearizations that include assumptions about the behavior of different financial ratios[6]. I will next summarize the main steps to obtain this present value equation.

They start with the following equation:[7]

$$FA_t - FL_t \equiv X_t - M_t + R_t^{FA} FA_{t-1} - R_t^{FL} FL_{t-1} \tag{1}$$

Where FA_t and FL_t are gross foreign assets and liabilities at the end of period t, X_t and M_t are exports and imports during period t, all measured in terms of the consumption index. R_t^{FA} and R_t^{FL} represent gross real returns on foreign assets and liabilities between the end of periods $t-1$ and t. After several log-linearizations and some algebra they obtain the following relation:

$$nfa_t \approx r_t^{NFA} + \frac{1-\rho}{\rho} nx_{t-1} + \frac{1}{\rho} nfa_{t-1} \tag{2}$$

Where nfa_t is the log of the ratio of foreign assets to liabilities at the beginning of period t. r_t^{NFA} is the log of the return differential of foreign assets and liabilities and nx_t is the

[5]This same method was also applied by Evans (2012).
[6]See Evans and Fuertes (2011) and the Appendix for a complete description of the derivations.
[7]The analysis does not include the secondary income which has been historically low for the U.S.

difference of the log of exports minus imports. ρ is a discount factor. Defining $nxa_t = nfa_t + nx_t$ and $\Delta nx_t = nx_t - nx_{t-1}$ we obtain the following expression:

$$nxa_t \approx r_t^{NFA} + \Delta nx_t + \frac{1}{\rho} nxa_{t-1} \tag{3}$$

Iterating forward equation (3) and taking expectations conditioned on period t information, which includes de value of nxa_t , they obtain:

$$nxa_t \approx -E_t \sum_{i=1}^{\infty} \rho^i (r_{t+i}^{NFA} + \Delta nx_{t+i}) + E_t \lim_{i \to \infty} \rho^i (nxa_{t+i})$$

They impose the no-Ponzi game condition $E_t \lim_{i \to \infty} \rho^i (nxa_{t+i}) = 0$ on the equation above. I will further develop the implications of this condition in the next sections but the intuition is that a country cannot default on its foreign claims. For the case of the U.S. it seems to be a reasonable assumption, especially if we assume that agents follow rational expectations. The next equation shows the present value relation between the variable nxa_t and future expected portfolio return differentials and net exports growth,[8]

$$nxa_t \approx -E_t \sum_{i=1}^{\infty} \rho^i (r_{t+i}^{NFA} + \Delta nx_{t+i}) \tag{4}$$

I will use nxa_t as the variable of interest that measures external imbalances, being the two terms at the right hand side of the equation the valuation component and the trade component respectively. This equation shows how current imbalances will be corrected in the future. Equation (4) implies that the net external position can only vary if it forecasts changes in portfolio returns or if it forecasts changes in net exports growth. If $E_t \sum_{i=1}^{\infty} \rho^i r_{t+i}^{NFA} = 0$, any adjustment of the net external position will come from future changes in net exports growth (trade component). On the other hand, if $E_t \sum_{i=1}^{\infty} \rho^i \Delta nx_{t+i} = 0$, any adjustment will come from future changes in portfolio returns (valuation component).

Regarding the main research question, if the nominal exchange rate regime affects the behavior either of the valuation component or the trade component, then the external adjustment process should be affected.[9] Movements in the real exchange rate affect the valuation component because it modifies the yield of gross foreign assets and liabilities as well as capital

[8]In deriving equation (4) I have performed several first order approximations. To assess the accuracy of those approximations we can compute the error term from equation (3) which also includes any measurement errors from the original data. The error term is small and stationary, with its sample variance representing only 0.12% of the sample variance of nxa_t.

[9]In principle, as long as the nominal exchange rate regime changes the behavior of the real exchange rate, e.g. Morales-Zumaquero and Sosvilla-Rivero (2010), the external adjustment process could change as well.

gains, affecting the portfolio total return differential. The trade component could be also affected as there is a documented relationship between real exchange rate depreciation and improvements in the trade balance [IMF (2015b)].[10]

In order to empirically analyze how the exchange rate regime affects the behavior of the net external position and the external adjustment process, I estimate the valuation and the trade components from equation (4) following methods developed by Campbell and Shiller (1987). This estimation will allow me to check if there is any misspecification in the estimation such as non-linearities or structural breaks, as these two components should account for all the variation in the net external position. It also let us quantifying the contribution of each component to the adjustment of the U.S. net external position. The period of analysis covers both the Bretton Woods fixed exchange rate regime and the years after its collapse, from 1952:I to 2015:III.

3 Data

The empirical analysis uses quarterly data on U.S. gross foreign assets and liabilities positions as well as portfolio returns for the categories of equity, debt, FDI and other assets. It extends the data set from Gourinchas and Rey (2007) till 2015:III.[11] The data on gross positions comes from the NIIP from the Bureau of Economic Analysis (BEA, henceforth). Data on exports and imports comes from the National Income and Product Accounts Tables from the BEA and price index data[12] comes from the BEA as well.

Regarding the data expansion it is relevant to mention that NIIP series obtained from the BEA provides quarterly data on the U.S. NIIP since 2006. This makes the extended data more accurate as the quarterly data on NIIP previous to 2006 had to be estimated from the annual figures using quarterly flows and calculating capital gains. Another improvement comes from the calculations made to obtain portfolio returns. Equity returns are calculated using country weights from the Report on U.S. Portfolio Holdings of Foreign Securities

[10]In particular it is pointed out that a 10 percent real effective depreciation in an economy's currency is associated with a rise in real net exports of, on average, 1.5 percent of GDP, with substantial cross-country variation around this average. Although these effects fully materialize over a number of years, much of the adjustment occurs in the first year. See IMF (2015b). This relationship between exchange rates and trade may have weakened over time (see IMF (2015a)).

[11]See Gourinchas and Rey (2005) for a detailed description of the series.

[12]It is used a personal consumption expenditures price index.

released by the Department of the Treasury. The report is released on an annual basis since 2003 and the weights are updated every year instead of keeping them constant over several years. The returns are calculated as portfolio weighted averages for each individual series and they are computed from market prices.

The accuracy in estimating portfolio returns has been a topic of ample debate in the literature. Table 1 compares the portfolio return differentials from different data sets with those from the data used in this article. Returns are similar among data sets obtained from market prices and revised data. A first wave of studies calculated portfolio returns implied from U.S. NIIP data (see Lane and Milesi-Ferretti (2005); Meissner and Taylor (2006) and Obstfeld and Rogoff (2005)), obtaining large return differentials. Later, Curcuru et al (2008) argued that these implied returns were upward biased due to inconsistencies in the different sources of data for flows and positions. They calculate portfolio returns from market prices, as Gourinchas and Rey (2007) do, obtaining smaller return differentials. Recent research from the BEA, the compilers of the NIIP data, does also find lower estimates of portfolio return differentials than those obtained from the implied returns in the first wave of papers, pointing out that NIIP data should not be used to obtain returns (see Gohrband and Howell (2015)).

4 Empirical analysis

4.1 External Imbalance and the Exchange Rate Regime

In this section I empirically estimate the two components on the right hand side of equation (4) following standard time series methods developed by Campbell and Shiller (1987). I also compute the percentage of the variance of nxa_t that can be explained from each of these two terms (the valuation and the trade components) and check if under the restrictions imposed by the empirical specification, equation (4) holds. I take expectations on equation (4) conditional on Ω^*, with $\Omega^* = \left\{nxa_{t-i}, \Delta nx_{t-i}, r_{t-i}^{NFA}\right\}_{i\geq 0}$. Notice that Ω^* is a subset of Ω, the period-t information. Then I obtain the following equation:

$$nxa_t \approx -\sum_{i=1}^{\infty} \rho^i E(r_{t+i}^{NFA} + \Delta nx_{t+i}|\Omega_t^*) \tag{5}$$

Notice that Ω^* contains all the information agents are using to calculate $E(r_{t+i}^{NFA} + \Delta nx_{t+i})$. In order to estimate the valuation and trade components I use a VAR formulation. First, I set a VAR(p) representation with $z_t = (r_t^{NFA}, \Delta nx_t, nxa_t)'$. All variables are demeaned.

$$z_t = A(L)z_{t-1} + \epsilon_t$$

where ϵ_t is a vector of zero mean errors. The VAR has the following first order companion representation:

$$Z_t = \bar{A}Z_{t-1} + \bar{\epsilon}_t$$

where $Z_t = (z_t^{'}, ..., z_{t-p+1}^{'})$ and $\bar{\epsilon}_t = (\epsilon_t, 0)$. Next, I define the vectors $e_r, e_{\Delta nx}, e_{nxa}$ such that they select the different elements of Z_t (for example $e_r^{'} Z_t = r_t^{NFA}$). I can express equation (4) in terms of the VAR formulation.

$$e_{nxa}^{'} Z_t = -(e_r^{'} + e_{\Delta nx}^{'}) \sum_{i=1}^{\infty} \rho^i E_t Z_{t+i}$$

Notice that $E_t Z_{t+j} = \bar{A}^j Z_t$, where $\bar{A}^j$ denotes j multiplications of the $\bar{A}$ matrix. Using this last result, I obtain the following expression:

$$\begin{aligned} e_{nxa}^{'} Z_t =& -(e_r^{'} + e_{\Delta nx}^{'}) \sum_{i=1}^{\infty} \rho^i \bar{A}^i Z_t \\ =& -(e_r^{'} + e_{\Delta nx}^{'}) \rho \bar{A}(I - \rho \bar{A})^{-1} Z_t \\ =& nxa_t^r + nxa_t^{\Delta nx} \end{aligned} \tag{6}$$

The valuation and trade components are:

$$nxa_t^r = e_r^{'} \rho \bar{A}(I - \rho \bar{A})^{-1} Z_t = \sum_{i=1}^{\infty} \rho^i \bar{A}^i E(r_{t+i}^{NFA} | \Omega_t^*)$$

$$nxa_t^{\Delta nx} = e_{\Delta nx}^{'} \rho \bar{A}(I - \rho \bar{A})^{-1} Z_t = \sum_{i=1}^{\infty} \rho^i \bar{A}^i E(\Delta nx_{t+i} | \Omega_t^*)$$

When estimating the valuation and trade components I am assuming that the forecast of future changes in fundamentals, $E(r_{t+i}^{NFA} + \Delta nx_{t+i})$, can be computed from the VAR as $(e_r^{'} + e_{\Delta nx}^{'})\bar{A}^i Z_t$. These forecasts only represent the best forecasts of $r_{t+i}^{NFA} + \Delta nx_{t+i}$ that can be computed using linear combinations of the variables in Z_t. If the processes I am forecasting are non linear it may be the case that even if equation (4) holds, its empirical counterpart (5) does not. Also, the predicted values for the valuation and trade components, nxa_t^r and $nxa^{\Delta nx}$, will be sensitive to the choice of variables included in the VAR. Increasing the number of variables in the VAR such that $z_t = (r_t^{NFA}; \Delta nx_t; nxa_t; \omega_t)$ may change the forecast of the valuation and trade components depending on the additional variables we include in ω_t. Importantly, as I mentioned before, this will not happen with $nxa_t^r + nxa^{\Delta nx_t}$ given that $\Omega^* = \left\{nxa_{t-i}, \Delta nx_{t-i}, r_{t-i}^{NFA}\right\}_{i\geq 0}$ contains all the information agents are using to calculate that term. Finally, in order to find out the contribution of the valuation and trade components to the external adjustment, I perform the following variance decomposition:

$$\begin{aligned} 1 =& \frac{Cov(nxa, nxa)}{Var(nxa)} = \frac{Cov(nxa^r, nxa)}{Var(nxa)} + \frac{Cov(nxa^{\Delta nx}, nxa)}{Var(nxa)} \\ =& \beta_r + \beta_{\Delta nx} \end{aligned} \tag{7}$$

The regression coefficients β_r and $\beta_{\Delta nx}$ represent the share on the unconditional variance of nxa explained by the valuation component nxa^r and the trade component $nxa^{\Delta nx}$. I can empirically estimate nxa, the valuation and trade components as well as the regression coefficients β_r and $\beta_{\Delta nx}$ using the VAR estimates. Let $\hat{A}$ denote the estimated companion matrix from the VAR. The predicted value for the nxa_t based on our VAR estimates will be:

$$\begin{aligned} \widehat{nxa}_t &= -(e_r' + e_{\Delta nx}')\rho\hat{A}(I - \rho\hat{A})^{-1} Z_t \\ &= \widehat{nxa_t^r} + \widehat{nxa_t^{\Delta nx}} \end{aligned} \tag{8}$$

From the OLS regressions of $\widehat{nxa_t^r}$ and $\widehat{nxa_t^{\Delta nx}}$ on nxa_t, I can compute the variance contribution of the estimated valuation and trade components. One way to asses the quality of the approximation in equation (4) and the validity of the assumptions behind the empirical equation (5) is to check how much of the variance of nxa_t can be explained by $\widehat{nxa_t^r}$ and $\widehat{nxa_t^{\Delta nx}}$. If the approximation is good and equation (5) holds, the valuation and trade components should account for all the variance of the net external position. I use the variance decomposition from equation (7) to check this out.

I find that the valuation and trade components are able to explain just 68.72% of the variance of the U.S. net external position for the whole sample (1952:I-2015:III). As I pointed out previously, if there are non-linearities such as structural breaks in the variance of the processes governing the behavior of the estimated forecasts, the linear projections will not be able to correctly estimate them. Next, I perform a variance decomposition using different sub-samples. I use the value of ρ that maximizes the total explained variance for each sub-sample with $\rho \in (0, 1)$. Each period begins at a different date and ends on 2015:III.

Figure 2 shows the percentage of the unconditional variance of nxa explained by the trade and valuation components for these different sub-samples.[13]

Figure 2 shows two different periods with a different percentage of explained variance, and a transitional phase that lasts approximately from 1971:IV to 1972:IV. The estimated trade and valuation components are able to account for all the variance of the net external position for periods beginning since 1973. For sub-samples including dates before 1973 these two estimated components do not account for all the variance. The transitional period coincides with the time the fixed exchange rate regime collapsed.[14]

The estimated valuation and trade components are obtained using forecast of future changes in fundamentals, $E(r_{t+i}^{NFA} + \Delta nx_{t+i}|\Omega_t^*)$. These forecasts come from a VAR specification that consist of linear combinations of the variables in z_t. If the processes governing these variables are non linear during the period of study, any linear model is misspecified. The change in the percentage of the explained variance identifies the point that separates two different regimes for the behavior of the U.S. net external position. Thus, it seems that it is the change on the moments of the variables in the VAR what makes linear projections no capable to fully characterize the dynamics of the series over periods that include both foreign exchange regimes.

The fact that the estimated valuation and trade components are not capable to explain all the variance of the U.S. net external position can be attributed to other reasons. First, it may be due to the approximation error that comes from the first order Taylor approximations applied to obtain equation (4). The approximation error may be also due to data inaccuracies or missing data. Figure 3 shows that this error is small and stationary. Also, the behavior of the error term does not change after the break point.[15]

Second, it may be that the non-Ponzi game condition imposed to obtain equation (4) does not hold. This condition implies that the U.S. fully honors its international debt. From a theoretical perspective, the assumption rests on the widely-accepted premise that the perceived likelihood of default for U.S. debt has been negligible over the past 50 years. From a practical point of view, Bohn (2007) proves that intertemporal budget constraints of the kind presented in equation (4) satisfy the transversality condition (non-ponzi game condition)

[13] The date on the horizontal axis refers to the beginning of the sub-sample with all of them ending on 2015:III.

[14] The U.S. government suspended convertibility of the dollar into gold for official transactions in August of 1971 and announced no further intervention to support the currency.

[15] To confirm this fact I run standard tests of structural breaks in mean and volatility developed by Bai and Perron (1998) and Inclan and Tiao (1994) and I do not find any breaks in the error term. Full details of those test are developed in the next sections.

under some mild assumptions on the behavior of the variable representing the stock of debt. For instance, if a debt series is integrated of order m for any finite $m \geq 0$, then debt satisfies the transversality condition and the intertemporal budget constraint holds.

Third, I assumed that it is possible to fully characterize the behavior of the variables in the vector z_t from a VAR(p). I employed both the Akaike and the Schwarz criteria to obtain the optimal number of lags for each of the sub-samples in Figure 3. The optimal number of lags is one for all sub-samples using any of the two criteria. The results shown on Figure 3 are obtained under the VAR(1) specification. I also perform the same analysis allowing for higher order of lags and I consistently find the same break in the explained variance.

In order to check that the non-linearities behind the VAR are due to the end of the fixed foreign exchange regime, I divide the data into two sub-samples, one that covers the period before the break (fixed exchange rate regime) and another one that covers the period after the break (floating exchange rate regime). I find that the linear projections behind the VAR can fully characterize the dynamics of the data for each of the two sub-periods. The estimated valuation and trade components can fully explain the total variance of the U.S. net external position. Regarding the importance of the valuation and trade components during the two sub-periods, the contribution of the valuation component is larger during the floating period. Table 2 shows the results of the variance decomposition of nxa for different periods. The contribution of the valuation component increases from explaining 28.79% of the variance of the U.S. net external position during the fixed exchange-rate period to 53.55% during the floating period. The estimation of the valuation and trade component may change if there are additional variables that influence the expectations obtained by the VAR estimation. I add other variables to the VAR such as the foreign exchange, long-term interest rates, real GDP and the debt to GDP ratio, consistently finding the same large increase of the variance explained by the valuation component during the floating period that it is observed in the original specification.

This large increase could be driven by other reasons than the change in the foreign exchange regime. For instance, it may be the case that a large part of the valuation component anticipates future changes in the price of assets instead of a depreciation of the real exchange rate. In order to investigate this issue I perform a simple exercise. I re-estimate the VAR including an extra variable that accounts for the contemporaneous relationship between the real exchange rate and the portfolio return differential. This variable includes the part of the portfolio return differential that is related to the real exchange rate. From this estimation, I obtain an *exchange rate component of the valuation channel* that determines the part of the external imbalance that is adjusted due to the valuation component via the real exchange rate.

Figure 4 shows the exchange rate component of the valuation channel along with nxa and the valuation component itself. This exchange rate valuation component is able to explain 19% of the variance of the U.S. net external position during the floating period. This figure diminishes to only 1% over the period of fixed exchange rate. During the floating period the real exchange rate plays a much larger role in adjusting the U.S. external imbalance trough valuation effects. Moreover, a relevant part of the future external adjustment related to the valuation component will happen through real exchange rate depreciation.

Finally, I compute sample statistics of the three variables included in the VAR for the two sub-periods with different exchange rate regime. Table 3 presents the standard deviation and mean of each variable for each period. The net external position shows a larger variance over the floating period, as well as the portfolio return differential. This is not the case for net exports growth. It seems that the larger variance of the next external position observed during the floating period is related to the portfolio return differential and the valuation component. I come back to this issue in the next section. Regarding the mean, the net external position changes from a creditor to a debtor position during the flexible exchange rate regime period; while the mean of the portfolio return differential and net exports growth show similar values for both periods.

5 Further Evidence: Testing for Structural Breaks

In the previous section, I have documented a change in the behavior of U.S. net external position at the end of the Bretton Woods system of fixed exchange rates, by analyzing the non-linearities of the variables included in the VAR. Next, I document this finding applying structural break tests at unknown dates both for multivariate and univariate series. I apply first the test of structural breaks for a system of equations using the VAR developed in the previous section. To provide robustness to the previous results, I next individually analyze the series included in the VAR.

5.1 Test of Structural Breaks in a System of Equations

Qu and Perron (2007) provide a framework to analyze series with multiple structural changes that occur at unknown dates in linear multivariate regression models, such as VARs. The breaks may happen in the parameters of the conditional mean, in the covariance matrix of the errors, or both, and the distribution of the regressors is also allowed to change across regimes. This is important because the tests determine whether or not the breaks in mean and variance happen at the same time. The framework used by these authors is the following:

$$y_t = (I \otimes z_t^{'})S\beta_t + u_t$$

There are n equations and T observations, excluding the initial conditions if lagged dependent variables are used as the regressors. The total number of structural changes in the system is m and the break dates are denoted by the vectors $(T_1, , T_m)$ with the convention of $T_0 = 1$ and $T_{(m+1)} = T$. A subscript j indexes a regime $(j = 1, ..., m + 1)$, a subscript t indexes a temporal observation $(t = 1, ..., T)$, and a subscript i indexes the equation $(i = 1, ..., n)$ to which a scalar dependent variable y_i, is associated. The parameter q is the number of regressors and z, is the set that includes the regressors from all equations $z_t, = (z_{1t}, ..., z_{qt})'$. Finally, u has zero mean and covariance matrix Σ_j for $T_{j-1} + 1 \leq t \leq T_j (j = 1, ..., m + 1)$. When using a VAR model as in this case we have that $z_t = (y_{t-1}, ..., y_{t-q})$, which contains the lagged dependent variables. I use a VAR(1) following the results from the Akaike and the Schwarz criteria that select the optimal number of lags.

In order to construct the test of the null hypothesis of no break versus the alternative hypothesis of some unknown number of breaks between 1 and some upper bound M, I first use the $UDmaxLRT(M)$ and $WDmaxLRT(M)$ double maximum tests to see if at least one break is present. Then, if the test rejects this hypothesis, I consider a $SEQ_T(l+1|l)$ sequential procedure obtained from a global maximization of the likelihood function and based on a test of l versus $l + 1$ changes.[16]. The covariance matrix of the errors is allowed to change and normality is assumed when testing for changes in the covariance matrix. We correct for serial correlation in the residuals and construct the robust covariance matrix by the method of Andrews (1991). No pre-whitening technique is applied. Finally, the distribution of the regressors is allowed to change in order to construct the confidence intervals. The results of the test are presented in Table 4 and indicate the presence of three breaks.

[16] I carried out the procedure with a maximum number of breaks $m = 3$ and a trimming of 0.2, which means that the minimal length required is 50 observations.

The test identifies three breaks in mean and variance: the first one at the early 70s, another one in 1984 and the last one at the end of the 90s. The first break coincides with the one already identified in the previous section. At the beginning of the 70s there were several events that changed the exchange rate regime of the dollar. During August 1971 the U.S. government suspended convertibility of the dollar into gold for official transactions, suspended the use of swaps, and imposed price controls and a 10 percent import surcharge; all countries with major currencies except France started to float, imposed exchange controls, and undertake major interventions to buy dollars. Then, after massive interventions by foreign exchange authorities, the system of fixed exchange rates collapsed into generalized floating in March 1973.[17]

The structural break affects both the mean and the variance, suggesting a relationship between the variance of the net external position and its mean. Sample statistics of the three variables included in the VAR for the periods before and after the collapse of Bretton Woods provide an idea about the change in the behavior of the series after the break (see Table 3). The net external position shows a larger variance during the floating period; the same happens with the series of return differentials. The sample variance of the net external position during the floating period is more than twice that of the the Bretton Woods period. The sample variance of the portfolio return differential during the floating period is more than four times larger than the one during Bretton Woods. On the contrary, the change in net exports growth presents lower volatility after 1973. This is consistent with the results of the test that identify another break in the first quarter of 1984, which is associated to the Great Moderation.[18] Given that the variance of the net external position increases after the collapse of Bretton Woods, it seems that the larger variance in the portfolio returns differential dominates over the lower variance in net exports growth. This is also consistent with the larger importance of the valuation component during the floating period documented in the previous section. Regarding the level of the U.S. net external position, the floating period is characterized for a net debtor position while the fixed exchange rate period shows a positive external position. Finally, the results of the test identify another break at the third quarter of 1997, with a confidence interval at the 10% level that spans from 1997:III to 2002:III. It is difficult to relate this break with any particular event, but given the documented relation between the external imbalance and the exchange rate, the introduction of the euro may have influenced the result. The euro zone is an important trade partner of the U.S. and a

[17] See Garber (1993).

[18] Kim and Nelson (1999) and McConnell and Perez-Quiros (2000) are the first to document a structural break in the variance of U.S. GDP growth in the first quarter of 1984, characterized by a reduction in the variance of output growth. Gadea et al. (2014) show that the Great Moderation still holds for the U.S. GDP with updated data that includes the Great Recession and its subsequent recovery.

large part of the U.S. foreign portfolio includes assets and liabilities denominated in euros. The next section presents more robust evidence about this last break and its relation with the introduction of the euro.

5.2 Robustness Checks: Univariate tests of Structural Breaks

The two previous sections document a structural break in the mean and variance on the VAR that happened at the time of the collapse of the Bretton Woods system. In this section I test for structural breaks in mean and variance on each of the three series included in the VAR, to identify separately which breaks are present in each of them.

Inclan and Tiao (1994) proposed a test for the detection of changes in the unconditional variance of the series which belongs to the CUSUM-type test family and has been extensively used. The test is defined as follows:

$$IT = sup_k \left| \sqrt{T/2} D_k \right| where$$
$$D_k = \frac{C_k}{C_t} - \frac{k}{t} \; with \; D_0 = D_T = 0$$
$$C_k = \sum_{t=1}^{k} \epsilon_t^2$$

This test assumes that the innovations ϵ_t of the stochastic processes y_t are zero-mean normally, i.i.d. random variables and uses an Iterated Cumulative Sum of Squares (ICSS) to detect the number of breaks.

The results of the tests support those obtained from the Qu-Perron (2007) test in section 5.1 and provide further insights about the external adjustment process.[19] Table 5 shows the results of the test for each of the three variables: net external position (nxa), portfolio return differentials (r^{NFA}) and net exports growth (Δnx). The test finds three structural breaks in variance for the series of the net external position at the same points in time detected by the Qu-Perron (2007) test. It documents a first break at 1971:III, right at the

[19]Sanso et al (2004) show that the test proposed by Inclan and Tiao (1994) may produce wrong results for leptokurtic and heteroskedastic series. To overcome this drawback, they propose two corrections, which explicitly take the fourth order moment porperties of the disturbances and the conditional heteroskedasticity into account. I implement their proposed modification when analyzing the series of net exports growth because it is leptokurtic.

same time the U.S. government suspends convertibility of the dollar into gold for official transactions. It documents the second break at 1984:II, right at the beginning of the Great Moderation. Finally, another break is documented at 1998:II, the one that could be related to the introduction of the euro. Additionally, running the test for the other two variables provides information on whether the breaks are driven either by changes in the portfolio returns differential or by changes in net exports growth. The test for the series of portfolio return differentials documents two breaks, one at 1970:III, which corresponds to the end of the fixed exchange rate regime and another one at 1999:II possibly related with the introduction of the euro. The variance of the series of portfolio return differentials do not structurally change due to the Great Moderation, a process that is linked to the real economy. On the contrary, the portfolio return differential seems to be mainly influenced by the nominal exchange rate regime. For the series of net exports growth the test identifies only one break at 1984:II, at the beginning of the Great Moderation.

It seems that the behavior of the U.S. net external position has been influenced by the nominal exchange rate regime through the portfolio return differentials (valuation component) and also by the growth of net exports (trade component). Both the net external position and the portfolio return differentials show larger variance during the period after the collapse of the fixed exchange rate regime. This is consistent with previous studies documenting a more volatile real exchange rate under floating nominal regimes (Morales-Zurraquemo and Sosvilla-Rivero (2010)). The influence of net exports growth goes in the opposite direction as there is a reduction in the volatility of the series. The fact that the volatility of the net external position increases, denotes that the valuation component is more important in determining the behavior of the net external position during the floating period as it is shown in the previous section. To sum up, the test performed using the methodology proposed by Qu-Perron (2007) documents structural breaks on the VAR specification in mean and variance. Using the methods developed by Inclan and Tiao (1994), I document structural breaks in variance at the same dates for each of the three series included in the VAR.

Finally, I also analyze whether each of the series have structural breaks in mean by applying the tests developed by Bai-Perron (1998). Table 6 shows the results of the test. It documents four structural breaks in mean for the net external position, three of the them coinciding with the ones documented both by applying the Qu-Perron (2007) and Inclan-Tiao (1994) methodologies. These results confirm that the structural breaks previously documented imply a change not only in the variance of the external imbalance but also in the mean. The structural breaks in mean show that the exchange rate regime affects the level of the U.S. external position, being a potential driver of increases or decreases. The other two series (net exports growth and portfolio returns) do not present any structural breaks in mean.

6 Asset Pricing Implications

Given the results in previous sections, it is expected that the U.S. external imbalance has some explanatory power over the evolution of the foreign exchange. This relationship has already been documented by Gourinchas and Rey (2007) and Evans and Fuertes (2011). I check whether the exchange rate regime influences the external adjustment process by regressing the changes in the real exchange rate on the net external position, a dummy variable identifying the exchange rate regime and an interaction term between the external position and the dummy. This interaction term will be the main variable of interest given that a statistical significant coefficient will imply a different relation between the foreign exchange and the net external position depending on the nominal foreign exchange regime. I compute the OLS estimates of

$$\frac{1}{k}\Delta^k e_{t+k} = \alpha + \beta_1 nxa_t + \beta_2 FXd_t + \beta_3 nxa_t * FXd_t + \nu_{t+k} \tag{9}$$

for different horizons $k = \{1, 4, 8\}$. $\Delta^k e_{t+k}$ is the real dollar depreciation rate and FXd_t is the dummy variable that identifies the foreign exchange regime (equals one during the fixed exchange rate period). For comparison purposes, I also compute the regression without the foreign exchange regime dummy and the interaction term.

Table 7 shows the results of the regressions with robust standard errors in parenthesis. The left hand side shows the results of the regression without the foreign exchange regime dummy and the interaction term. The right hand side shows the result from the regression of equation (9). The top panel shows the results of the regressions using the U.S. trade weighted foreign exchange depreciation as the dependent variable. The U.S. external imbalance does not have any predictive power over the future foreign exchange depreciation at any horizon in the left hand side regression. On the contrary, when including in the regression the exchange rate regime dummy and the interaction term, the coefficients turn statistically significant. The relationship between the external imbalance and future changes in the real exchange rates differs depending on the period. During the Bretton Woods system of fixed exchange rates, changes in the external imbalance triggered larger movements of the real exchange rate than during the floating period. The sign of the coefficients is positive as expected: a deterioration on the external imbalance implies a future depreciation of the dollar. Also, the R^2 increases substantially in the right hand side regressions, reaching 15.7% over an horaizon of 8 quarters compared to only 0.1% for the regression that does not take into account the foreign exchange regime.

To check the robustness of the previous results I run the same regressions for different currencies. The second panel of Table 7 presents the results for the foreign exchange of the dollar against the British pound (GBP/USD) . The regressions with the GBP/USD produce the largest R^2, reaching 50% over an horizon of 8 quarters when the dummy and the interaction term are included. In this case during the fixed exchange rate period a deterioration in the U.S. external imbalance implies future appreciation of the dollar. During the floating period the coefficient has the expected positive sign. The other two panels of Table 7 show the results for the Japanese yen (JPY/USD) and the Deutschmark (DEM/USD). For the yen, the U.S. external imbalance has very low predictability power and for the Deutschmark the results are similar to those obtained with the trade weighted exchange rate. The results presented in the last two panels confirm that the relation between the foreign exchange and the external imbalance changed after the collapse of the foreign exchange regime.

7 Conclusion

Research analyzing the implications of different exchange rate regimes to the process of external adjustment has focused on the current account as the main variable of interest, neglecting the importance of the valuation channel and considering the trade channel as the only mechanism to correct imbalances. A recent wave of empirical studies has pointed out the importance of valuation effects in the adjustment of external imbalances, being the real exchange rate a mayor player. The ignored valuation component may act reinforcing the trade channel of external adjustment or against it, depending on the currency composition of foreign assets and liabilities. Following a present value equation that relates current imbalances with future net exports growth and future portfolio return differentials I analyze the non-linearities behind a VAR specification that includes these three variables of study (the external imbalance, net exports growth and portfolio return differentials) and document a change on the behavior of the U.S. external position that happened when the Bretton Woods system of fixed exchange rates collapsed.

I further document this change by applying the methods developed by Qu and Perron (2007) to test for structural breaks in mean and variance at unknown dates in a system of equations. The test reveals not only a change in the volatility of the series but also a change in mean, suggesting that the large deterioration of the U.S. net external position could be related, at last to some extent, to the change in the nominal exchange rate regime. I also find evidence of another break that happened right before the introduction of the euro, signaling that the currency union may have affected the U.S. external adjustment path. The exchange rate regime mainly affects the valuation component of external adjustment, being the trade component more related to the real economy. For the series of net export growth I find a structural break at the beginning of the period known as the Great Moderation.

Finally, I analyze the asset pricing implications of the relationship between the exchange rate regime and the external adjustment process. I find that external imbalances have predictive power over future exchange rate depreciation once we take into account the exchange rate regime. The magnitude of future exchange rate depreciation induced by changes in the external imbalance also changes depending on the exchange rate regime.

The breaks documented in the U.S. external imbalance have important consequences for different theoretical and empirical techniques like calibration exercises and estimation of vector autoregression models over periods that span the break. Linear models for the U.S. net external position are misspecified over periods including both the fixed and the floating exchange rate regime.

The results of the paper continue the debate for policy analysis on the benefits of a fixed or a floating exchange rate regime to correct external imbalances. A fixed exchange rate regime could be preferred in case of adverse valuation effects (emerging economies with most of its liabilities denominated in foreign currency). If valuation effects facilitate the external adjustment, a floating regime could be better. In addition, there are also implications on how the external adjustment process is affected for a country that joins a monetary union. The structural break detected in the VAR and the portfolio return differential at the end of the 90s may signal the effects of the European Monetary Union on the U.S. external adjustment. Countries belonging to a monetary union may change their external adjustment process once they adopt the common currency. This may also have external solvency implications as it is highlighted by Camarero et al (2015).

References

[1] Bai, J. and Perron, P. (1998). Estimating and Testing Linear Models with Multiple Structural Changes, Econometrica, 66(1), 47-78.

[2] Bohn, H. (2007): Are stationarity and cointegration restrictions really necessary for the intertemporal budget constraint?, Journal of Monetary Economics 54, 18371847.

[3] Calvo, G. and Reinhart, C. (2002). Fear of Floating, The Quarterly Journal of Economics 12 (3), 383-398.

[4] Camarero, M., Carrion-i-Silvestre and Tamarit, C. (2015). Testing for external sustainability under a monetary integration process. Does the Lawson doctrine apply to Europe? Economic Modelling, 44, 343-349.

[5] Campbell, J. and Shiller, R. (1987). Cointegration and Tests of Present Value Models, Journal of Political Economy, 95, 1062-88.

[6] Chinn, M.D., Wei, S.J., (2013). A faith-based initiative meets the evidence: does a flexible exchange rate regime really facilitate current account adjustment? Rev. Econ. Stat. 95 (1), 168184.

[7] Curcuru., S.E., Thomas., C.E. and Warnock., F.A. (2013): On returns differentials, Journal of International Money and Finance 36:125.

[8] Eguren-Martin, F. (2016). Exchange rate regimes and current account adjustment: An empirical investigation, Journal of International Money and Finance 65, 6993.

[9] Evans, M. and Fuertes, A. (2011). Understanding the Dynamics of the US External Position. Working Paper.

[10] Evans, M. (2012). International Capital Flows and Debt Dynamics, IMF Working Paper 12/175.

[11] Friedman, M. (1953). The case for flexible exchange rates. In: Friedman, M. (Ed.), Essays in Positive Economics. The University of Chicago Press, Chicago, pp. 157203.

[12] Gadea, M.D., Gomez-Loscos, A. and Perez-Quiros, G. (2014). The Two Greatest. Great Recession vs. Great Moderation. CEPR Discussion Paper Series, 10092.

[13] Garber, P.M. (1993). The Collapse of the Bretton Woods Fixed Exchange Rate System. Chapter in NBER book: A Retrospective on the Breton Woods System: Lessons for International Monetary Reform, 461-494.

[14] Ghosh, R.A., Qureshi, M.S., Tsangarides, C.G. (2014). Friedman Redux: External Adjustment and Exchange Rate Flexibility, IMF Working Paper 14/146.

[15] Gohrband, C. and Howell, K. (2015): U.S. international financial flows and the U.S. net investment position: new perspectives arising from new international standards. In: Hulten, C., Palumbo, M., Reinsdorf, M. (Eds.), Wealth, Financial Intermediation and the Real Economy (NBER), Studies in Income and Wealth, volume 73, 231-270.

[16] Goldfajn, I, and Valds, R.O. (1999). The Aftermath of Appreciations, The Quarterly Journal of Economics, 114(1): 229-262.

[17] Gourinchas, O. and Rey, H. (2005) From world banker to world venture capitalist: US external adjustment and the exorbitant privilege, NBER Working Paper 11563.

[18] Gourinchas, O. and Rey, H. (2007). International Financial Adjustment. Journal of Political Economy, 115(4), 665-703.

[19] Inclan, C. and Tiao, G.C. (1994). Use of Cumulative Sum of Squares for Retrospective Detection of Changes of Variance, Journal of the American Statistical Association, 89, 913-923.

[20] IMF (2015a). World Economic Outlook: Exchange Rates and Trade: Disconnect?, International Monetary Fund, October 2015.

[21] IMF (2015b). World Economic Outlook: Adjusting to lower commodity prices, International Monetary Fund, October 2015.

[22] Lane, Philip R. and Milesi-Ferretti, G.M. (2004). The Transfer Problem Revisited: Net Foreign Assets and Real Exchange Rates, Review of Economics and Statistics, 86, 841-857.

[23] McConnell, M.M and Perez-Quiros, G. (2000). Fluctuations in the United States:What has Changed since the Early 1980s, The American Economic Review, 90: 1464-1476.

[24] Meissner, C. and Taylor, A. (2006). Losing Our Marbles in the New Century? The Great Rebalancing in Historical Perspective. NBER Working Paper No. 12580.

[25] Morales-Zumaquero A. and Sosvilla-Rivero, S. (2010). Structural breaks in volatility: Evidence for the OECD and non-OECD real exchange rates. Journal of International Money and Finance, 29, 139168.

[26] Obstfeld, M. and Rogoff, K. (2005). Global current account imbalances and exchange rate adjustments. Brookings Papers on Economic Activity 1, 67123.

[27] Patrice, O., Rusticelli, E. and Schwellnus, C. (2015). The Changing Role of the Exchange Rate for Macroeconomic Adjustment. OECD Economics Department Working Paper 1190.

[28] Sanso, A., Arago, V. and Carrion-i-Silvestre, J.L. (2004). Testing for changes in the unconditional variance of financial time series. Revista de Economia Financiera, 4, 32-53.

[29] Swarnali, A., Appendino, M. and Ruta, M. (2016). Global Value Chains and the Exchange Rate Elasticity of Exports. BE Journal of Macroeconomics, forthcoming.

[30] Qu, Z. and Perron, P. (2007). Estimating and Testing Structural Changes in Multivariate Regressions. Econometrica, 75(2), 459-502.

Figures

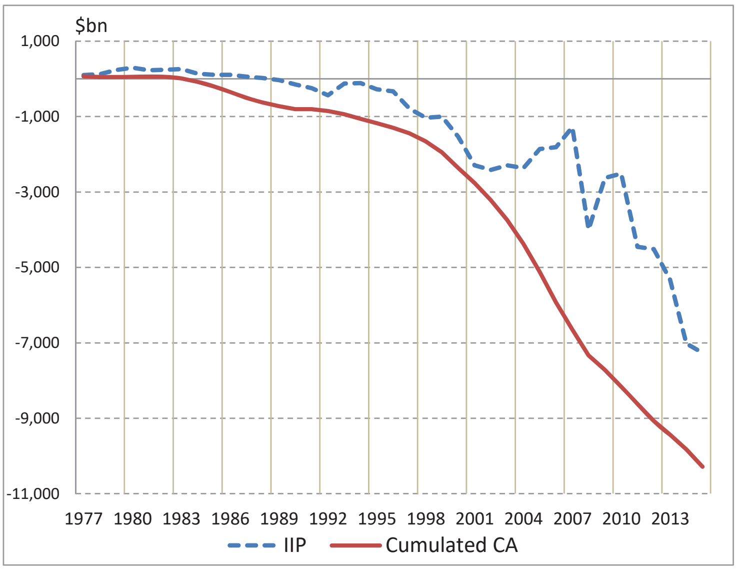

Figure 1: U.S. Net International Iinvestment Position vs. Cummulated Current Account

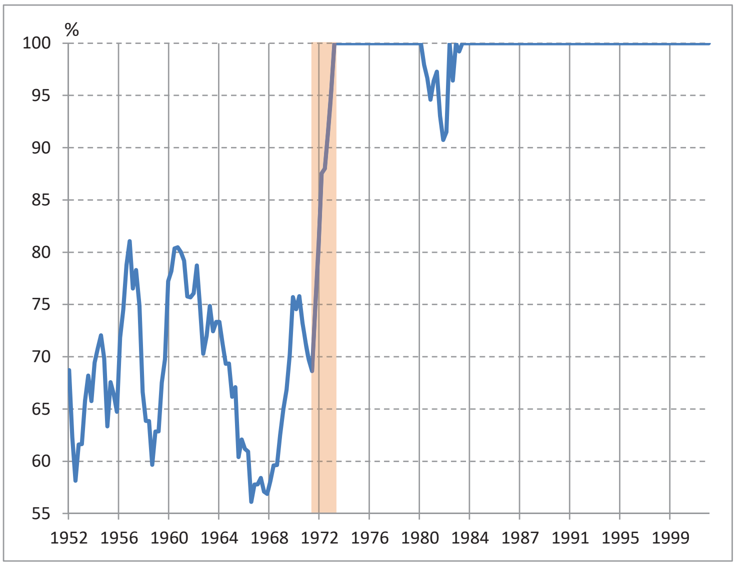

Figure 2: Explained Variance of U.S. Net External Position

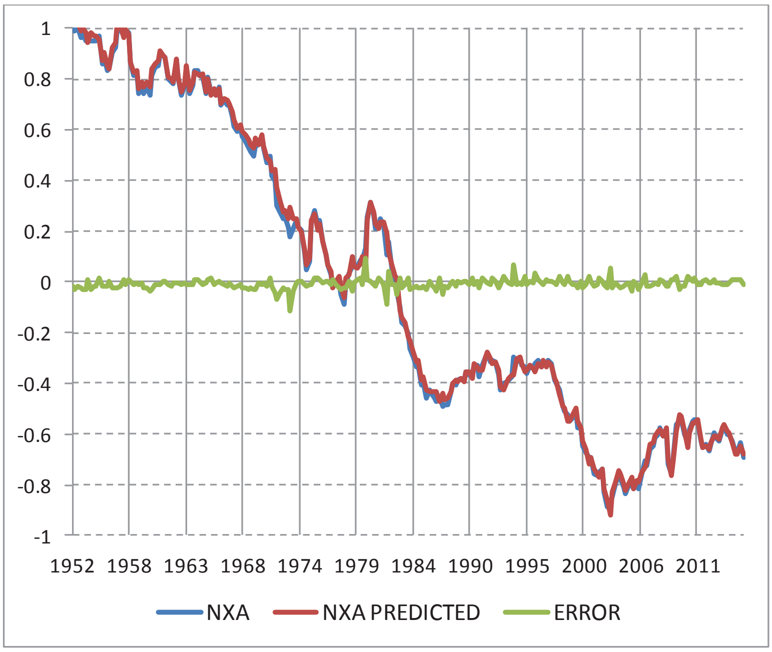

Figure 3: Approximation Error

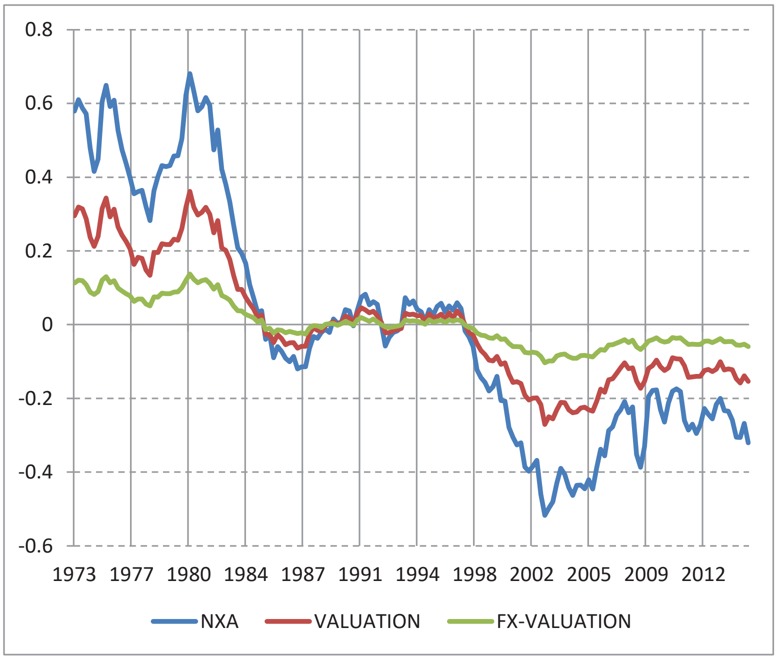

Figure 4: Exchange Rate-Valuation Component

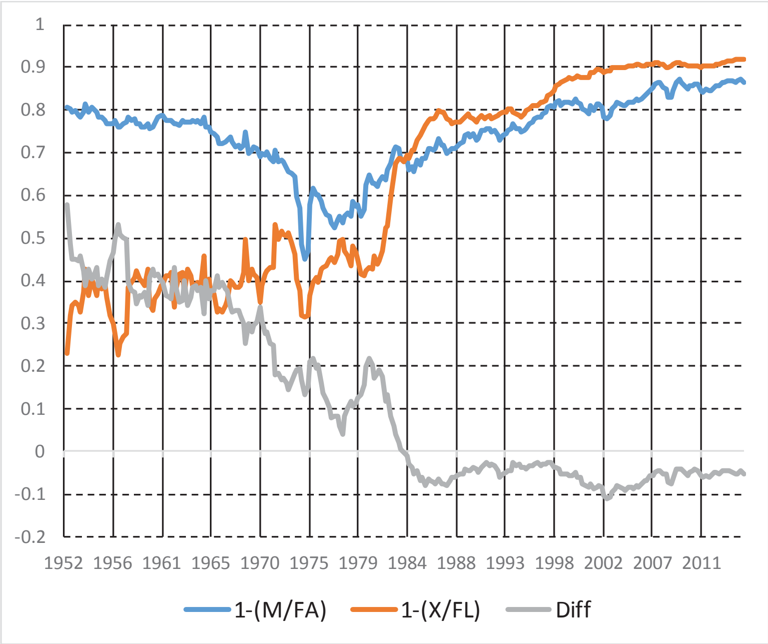

Figure 5: Exports to foreign liabilities and imports to foreign assets ratios.

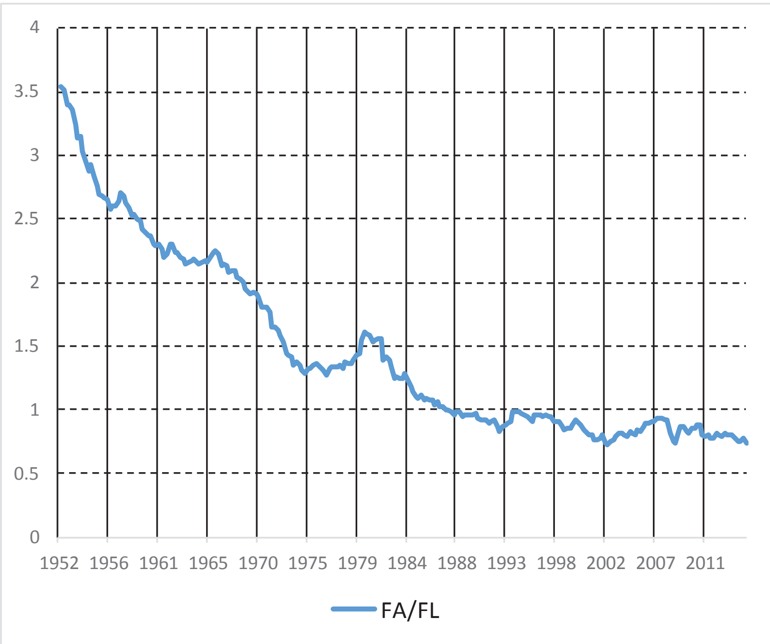

Figure 6: Ratio of foreign assets to foreign liabilities.

Tables

TABLE 1 RETURN DIFFERENTIALS COMPARISON (%)

SOURCE	PERIOD	DIFFERENCE	CLAIMS	LIABILITIES	TYPE OF DATA
		0.14	**7.47**	**7.33**	
Gourinchas and Rey (2007a)	1973-2004	3.30	6.80	3.50	Implied Returns
		-0.78	**6.24**	**7.02**	
Lane and Melesi-Ferreti (2005)	1995-2004	2.70	7.20	4.50	Implied Returns
		-0.59	**7.34**	**7.92**	
Obstfeld and Rogoff (2005)	1983-2003	3.1	-	-	Implied Returns
		0.19	**7.25**	**7.06**	
Curcuru et al (2008)	1994-2005	0.72	8.32	7.6	Market Data
		6.97	**11.01**	**4.04**	
Forbes (2010)	2002-2006	6.90	11.2	4.3	Market Data
		0.59	**7.37**	**6.78**	
Gourinchas et al (2010)	1973-2009	1.60	5.00	3.40	Implied, Excludes OC
		1.84	**4.91**	**3.07**	
Curcuru et al (2013)	2001-2011	2.80	6.70	3.90	Implied, Revised Data
		-0.22	**6.22**	**6.43**	
Gohrband and Howell (2015)	1990-2005	1.50	7.60	6.10	Implied, Revised Data

Note: Returns from my data set are reported in bold. The data refers to annual returns.

TABLE 2: UNCONDITIONAL VARIANCE DECOMPOSITION OF US NET EXTERNAL POSITION

	1952:I-2015:III Whole Sample	1952:I-1971:II (Pre-Break)	1973:I-2015:IV (Post-Break)
β_r	31.46	24.63	51.75
$\beta_{\Delta nx}$	37.27	75.34	48.22
Total	68.73	99.98	99.97

Note: β_r ($\beta_{\Delta nx}$) represents the share of the unconditional variance of nxa explained by the valuation (trade) component.

TABLE 3: SAMPLE STATISTICS FOR DIFFERENT EXCHANGE RATE REGIMES

	FIXED FX- 1952:1972			FLOATING FX -1973:2015		
	nxa	r^{NFA}	Δnx	nxa	r^{NFA}	Δnx
STD. DEVIATION	0.196	0.013	0.046	0.321	0.027	0.030
MEAN	0.754	0.000	-0.001	-0.366	0.000	0.001

Notes: The table shows sample statistics of the three variables in the VAR. nxa represents the net external position; r^{NFA} the portfolio return differential and Δnx the growth in net exports.

TABLE 4: ANALYSIS OF STRUCTURAL BREAKS (QU-PERRON TEST)

	Sequential test (l+1/l)		
Wd_{max}	l=1	l=2	Number of Breaks
169.134***	72.176***	43.675***	3

	Date	CI (95%)	
Break I	1971:I	1970:III	1971:II
Break II	1984:I	1983:II	1984:III
Break III	1997:III	1997:I	2002:III

Notes: Maximun number of breaks M = 3 and trimming = 0.2; The covariance matrix of the error is allowed to change and normality is assumed when testing for changes in the covariance matrix; Serial correlation in the residuals and robust covariance matrix is constructed by the method of Andrews (1991) ; No pre whitening technique is applied; The distribution of the regressors is allowedto change in order to construct the confidence intervals.
*, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

TABLE 5: ANALYSIS OF STRUCTURAL BREAKS IN VOLATILITY (INCLAN-TIAO METHODOLOGY)

Series	Number of Breaks	Breaks
nxa	3	1971:III 1984:III 1998:II
r^{NFA}	2	1970:III 1999:II
Δnx	1	1984:I

Notes: Sanso en al. (2004) show that the Inclan and Tiao test may produce wrong results for leptokurtic and heteroskedastic series. I implement their proposed modification of the test for Δnx as it is leptokurtic. nxa represents the net external position, r^{NFA} the portfolio return differential and Δnx the growth of net exports.

TABLE 6: ANALYSIS OF STRUCTURAL BREAKS IN MEAN (BAI-PERRON TEST)

	nxa	r^{NFA}	Δnx
supF_(k)			
k=1	963.33***	2.97	2.32
k=2	1632.09***	3.26	2.47
k=3	2069.01***	3.25	2.34
k=4	2117.38***	2.63	2.63
supF_(l+1/l)			
l=0	923.87***	1.38	5.55
l=1	660.67***		
l=2	352.59***		
l=3	75.13***		
UD_{max}	2117.39***	3.26	2.63
WD_{max}	3640.7***	4.68	4.75
Break Dates	1961:IV	-	-
	1971:III		
	1983:III		
	1998:IV		

Notes: The table shows the result of test for changes in the mean of the three variables in the VAR. nxa represents the net external position; r^{NFA} the portfolio return differential and Δnx the growth in net exports. Serial correlation and heterogeneity in the errors are allowed. The consistent covariance matrix is constructed using the Adrews (1991) method.

TABLE 7: FORECASTING EXCHANGE RATES WITH NET EXTERNAL POSITION. EXCHANGE RATE REGIME EFFECT

	$\frac{1}{k}\Delta^k \epsilon_{t+k} = \alpha + \beta_1 nxa_t + \upsilon_{t+k}$ (1)			$\frac{1}{k}\Delta^k \epsilon_{t+k} = \alpha + \beta_1 nxa_t + \beta_2 FXd_t + \beta_3 (nxa_t * FXd_t) + \upsilon_{t+k}$ (2)		
	Trade Weighted			**Trade Weighted**		
HORIZON	1	4	8	1	4	8
β_1	-0.0003	0.0007	0.0008	0.0070	0.0095***	0.0096***
	(0.0036)	(0.0019)	(0.0015)	(0.0073)	(0.0034)	(0.0026)
β_3				0.0349	0.0285***	0.0234***
				(0.0217)	(0.0069)	(0.0052)
R^2	0.0000	0.0005	0.0010	0.0254	0.0930	0.1571
	GBP/USD			**GBP/USD**		
HORIZON	1	4	8	1	4	8
β_1	0.0150***	0.0167***	0.0169***	0.0500***	0.0534***	0.0511***
	(0.0043)	(0.0029)	(0.0024)	(0.0105)	(0.0053)	(0.0038)
β_3				-0.0565**	-0.0767***	-0.0781***
				(0.0237)	(0.0088)	(0.0060)
R^2	0.0328	0.1107	0.1826	0.1045	0.3325	0.5021
	JPY/USD			**JPY/USD**		
HORIZON	1	4	8	1	4	8
β_1	-0.0055	-0.0061***	-0.0069***	-0.0020	-0.0024	-0.004
	(0.0040)	(0.0023)	(0.0018)	(0.0109)	(0.0065)	(0.0048)
β_3				0.0590***	0.0449***	0.0374***
				(0.0213)	(0.0100)	(0.0080)
R^2	0.0046	0.0153	0.0338	0.0267	0.0543	0.0789
	DEM/USD			**DEM/USD**		
HORIZON	1	4	8	1	4	8
β_1	-0.0005	0.0003	0.0004	0.0143	0.0196***	0.0196***
	(0.0043)	(0.0024)	(0.0017)	(0.0132)	(0.0064)	(0.0046)
β_3				0.0367	0.0301**	0.0221***
				(0.0235)	(0.0123)	(0.0072)
R^2	0.0000	0.0000	0.0001	0.0275	0.1054	0.1651

Notes: Left (right) hand panel shows the results of the regression in equation 1 (2). $\Delta^k \epsilon_{t+k}$ is the depreciation rate of the dollar for different horizons k={1, 4, 8}. FXd_t is a dummy variable equal to 1 if there is a fixed exchange rate regime. nxa_t is the net external position. Standard errors in parenthesis.
*, ** and *** denote significance at the 10, 5 and 1% levels, respectively.

Appendix

The following appendix develops the algebra steps and assumptions behind equations (1)-(2) in section 2. We start as in section 2 with the following accounting identity:

$$FA_t - FL_t \equiv X_t - M_t + R_t^{FA} FA_{t-1} - R_t^{FL} FL_{t-1} \tag{10}$$

where FA_t and FL_t are U.S. gross foreign assets and liabilities at the end of period t, X_t and M_t are U.S. exports and imports during period t, all measured in terms of the U.S. consumption index. R_t^{FA} and R_t^{FL} represent the gross real return on U.S. foreign assets and liabilities between the end of periods $t-1$ and t. Equation (9) is non-linear and that complicates any further analysis. In order to study the implications of the budget constraint we develop some form of linearization for equation (9).

Manipulating (9) we get the following expression:

$$FA_t = FA_{t-1} R_t^{FA} \left(1 - \frac{M_t}{R_t^{FA} FA_{t-1}} + \chi_t\right) \tag{11}$$

where $\chi_t = \frac{FL_t}{R_t^{FA} FA_{t-1}} + \frac{X_t - R_t^{FL} FL_{t-1}}{R_t^{FA} FA_{t-1}}$. Then we log-linearize equation (10), taking a first-order Taylor approximation around the point where $\chi = 0$ and $1 - \frac{M_t}{R_t^{FA} FA_{t-1}} = \rho \in (0,1)$. The log-linearization of (10) produces:

$$\Delta fa_t \approx k + r_t^{FA} - \frac{1-\rho}{\rho}(m_t - r_t^{FA} - fa_{t-1}) + \frac{1}{\rho}\chi_t \tag{12}$$

where lower case letters denote natural logs of the corresponding upper case variables and $k = ln(\rho) + \frac{1-\rho}{\rho}(1-\rho)$. Now, manipulating the expression for χ_t:

$$\chi_t = \frac{FL_t}{R_t^{FA} FA_{t-1}} + \frac{X_t - R_t^{FL} FL_{t-1}}{R_t^{FA} FA_{t-1}} \quad \Rightarrow \quad \frac{FL_t}{R_t^{FA} FA_{t-1}} = \left(\left(1 - \frac{X_t}{R_t^{FL} FL_{t-1}}\right) \frac{R_t^{FL} FL_{t-1}}{R_t^{FA} FA_{t-1}} + \chi_t\right) \tag{13}$$

Next, we log-linearize the equation above taking another first-order Taylor approximation around the point where $1 - \frac{X_t}{R_t^{FL} FL_{t-1}} = \rho$, $\chi = 0$ and $\frac{R_t^{FL} FL_{t-1}}{R_t^{FA} FA_{t-1}} = 1$. This log-linearization produces:

$$\Delta fl_t \approx k + r_t^{FL} - \frac{1-\rho}{\rho}(x_t - r_t^{FL} - fl_{t-1}) + \frac{1}{\rho}\chi_t \tag{14}$$

We combine equations (11) and (13) and define $NFA_t = \frac{R_t^{FA} FA_{t-1}}{R_t^{FL} FL_{t-1}}$ as the ratio of U.S. foreign assets to liabilities at the beginning of period t. As a result we can obtain the following equation:

$$nfa_t \approx r_t^{NFA} + \frac{1-\rho}{\rho} nx_{t-1} + \frac{1}{\rho} nfa_{t-1} \tag{15}$$

where $nx_t = x_t - m_t$ represents net exports and r_t^{NFA} is the return differential between foreign assets and liabilities. As a final step we define a new variable, $nxa_t = nfa_t + nx_t$ and rearrange the previous equation into the following one:

$$nxa_t \approx r_t^{NFA} + \Delta nx_t + \frac{1}{\rho} nxa_{t-1} \tag{16}$$

This last equation is the same one define as equation (2) in section (2).Empirical analysis of equation (15) shows that the error term is small and stationary but the assumptions related with the first-order Taylor approximations require further analysis. The main purpose of this appendix is to understand the implications of the different assumptions used to perform the first-order Taylor approximations. Basically, We assume that the following ratios are stationary: $1 - \frac{M_t}{R_t^{FA} FA_{t-1}} = \rho$; $1 - \frac{X_t}{R_t^{FL} FL_{t-1}} = \rho$,and $\frac{R_t^{FL} FL_{t-1}}{R_t^{FA} FA_{t-1}} = 1$.

The first two ratios imply that the $1 - \frac{M_t}{R_t^{FA} FA_{t-1}} = 1 - \frac{X_t}{R_t^{FL} FL_{t-1}} = \rho$. Figure (5) shows the ratios computed with U.S. data. Although they have behaved differently over the sample, both ratios seem to converge to a value which is consistent with the empirical value of ρ obtained to maximize the variance of the U.S. external position explained by the valuation and trade components.

Figure (6) shows the other ratio, $\frac{R_t^{FL} FL_{t-1}}{R_t^{FA} FA_{t-1}} = 1$. Again, although the behavior of the series has been different over time it seems to converge to a value close to 1. In the end, the point used to make the first-order Taylor approximation resembles an economy where the stock of foreign assets and liabilities is much larger than the flow of exports and imports; and the volume of foreign assets and liabilities are similar. Empirical ratios from Figures (5) and (6) show that these conditions are not inconsistent with current U.S. data.

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