Exchange Rate Regimes and External Adjustment: An Empirical Investigation for the U.S.

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Abstract

I document a structural break in the dynamics of the U.S. net external position (nxa) that happened in the third quarter of 1971. The break coincides with the time the U.S. government suspends the convertibility of the dollar into gold and announces no further intervention to support the dollar. The U.S. nxa increases its volatility and changes its mean after the break. This findings shed new light on the relation between the nxa and the RER. Using a novel technique I obtain a present value relation that decomposes the nxa into future portfolio returns (valuation component) and future net exports growth (trade component). The valuation component accounts for 24% of the variance of the U.S. nxa before the break. That figure increases to 60% during the convertibility period.
1 Introduction

The external adjustment of a country’s foreign position is one of the most debated topics in international economics. Recently, a new wave of research has focused on the contribution of valuation effects on the adjustment process. Within this literature, there are several studies that have highlighted the role of exchange rates on this external adjustment process. Tille (2003) analyzes the effect of the currency composition of U.S. assets on the behavior of its external position. Melesi-Ferreti (2004) find a strong cross-sectional correlation between changes in real exchange rates and changes in net foreign assets, in both industrial and developing countries.

In this paper I empirically analyze how different exchange rate regimes affect the dynamics of the U.S. external imbalance and its adjustment process. I document a structural break on the dynamics of the U.S. net external position (hereafter $nxa$) that happens in the third quarter of 1971. The break coincides with the time (August 1971) the U.S. government suspends the convertibility of the dollar into gold and announces no further intervention to support the dollar. During the post convertibility period the volatility of the U.S. $nxa$ is higher and its mean changes from a creditor (positive mean) to a debtor position (negative mean). These findings can also shed new light about the historical decline of the U.S. net external position.

Using a novel technique implemented by Evans and Fuertes (2010) I am able to obtain a present value relation that decomposes the $nxa$ into future portfolio returns (valuation component) and future net exports growth (trade component). I can easily get estimates for the valuation and trade components using linear time series methods and evaluate the present value relation. I identify the break on the dynamics of the U.S. $nxa$ because linear models are misspecified under the presence of non linearities in the data series (like changes in the variance and the mean). I also use non linear time series methods as well as tests for structural breaks at unknown date to bring further evidence on the structural break.

The break affects the implementation of different econometric techniques. For example,
the increase on the volatility of nxa after the break affects any calibration exercise involving second moments. If we want to take theory into data comparing the moments from a calibrated theoretical model with those in the actual data, we have to use the the pre and post convertibility periods separately. Also, as I mentioned before, linear models over periods that span the break are misspecified.

I find that the valuation component accounts for 24% of the variance of the U.S. nxa during the convertibility period. That figure increases to 60% during the post convertibility period. The exchange rate regime matters for the relative importance of valuation and trade effects on the U.S. external adjustment process. The floating exchange rate regime has allowed the valuation channel of external adjustment to increase in importance, leaving the tradional trade channel with a less prominent role.

Other interesting topic in the literature is the relationship between international payments and the real exchange rate (RER): the transfer problem. There is ample evidence on the non neutrality of the exchange rate regime and the volatility of the RER (Liang (1998), Carrera and Vuletin (2003) and Morales and Sosvilla (2010)). Floating exchange rate regimes imply a more volatile RER. Both, the U.S. nxa and the RER increased their volatility during the post convertibility period. This fact sheds new light on the relation between the nxa and the RER. Also, Lane and Melesi-Ferreti (2004) find a strong cross-sectional correlation between changes in real exchange rates and changes in net foreign assets, in both industrial and developing countries. Their results are consistent with the ones I find.

Finally, there are several policy implications related with this work. First, we should think about how desirable is a fixed or a floating exchange rate regime to facilitate the external adjustment of a country. Lane and Melessi-Ferreti (2005) analyze the different nature of valuation effects due to exchange rate movements depending on the currency composition of the net external assets. Countries with most of its liabilities denominated in foreign currency (like the majority of emerging countries) may experience adverse valuation effects due to the depreciation of the exchange rate. Calvo and Reinhardt (2002) talk about the
term “fear of floating” to portrait these adverse valuation effects. Given that a floating exchange rate regime amplifies the valuation channel, it may be better for some countries to choose a fixed exchange rate regime. Industrial countries, on the contrary, experience beneficial valuation effects due to exchange rate depreciations and a floating exchange rate regime should facilitate the external adjustment process. Second, it seems interesting to think about the case of monetary unions. Countries within the union may find it more difficult to adjust its nxa given that the exchange rate is no longer related to the domestic economy but to the monetary union economy as a whole.

The paper proceeds as follows: Section 2 presents the empirical evidence on the structural break. Section 3 analyzes the economic implications of the break, and Section 4 concludes.

2 The structural break in the U.S. nxa

In this section I show different econometric and statistical evidence on the structural break for the dynamics of the U.S. nxa. I first detail how to derive a present value relation for the nxa. Next I show that linear models are misspecified over periods that span the break. Then, propose a simple non linear Markov-Switching model that captures the nature of the two different regimes and finally I carry out tests for structural break with unknown change point.

2.1 A present value expression for nxa

I follow Evans and Fuertes (2010) to derive a present value equation that relates the nxa with future return differentials and future net exports growth. This expression will be useful to identify the break in the behavior of the U.S. nxa.

We start with the following accounting identity:

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

(1)
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 (1) 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 (1).

Manipulating (1) we get the following expression:

\[
FA_t = FA_{t-1} R_{t}^{FA} \left( 1 - \frac{M_t}{R_{t}^{FA} FA_{t-1}} + \chi_t \right)
\]

(2)

where \( \chi_t = \frac{FL_t}{R_{t}^{FA} FA_{t-1}} \left( \frac{X_t - R_{t}^{FL} FL_{t-1}}{R_{t}^{FA} FA_{t-1}} \right) \). Then we log-linearize equation (2), 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 (2) produces:

\[
\Delta f a_t \approx k + r_t^{FA} - \frac{1 - \rho}{\rho} (m_t - r_t^{FA} - f a_{t-1}) + \frac{1}{\rho} \chi_t
\]

(3)

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 \( \chi_t \):

\[
\chi_t = \frac{FL_t}{R_{t}^{FA} FA_{t-1}} \left( \frac{X_t - R_{t}^{FL} FL_{t-1}}{R_{t}^{FA} FA_{t-1}} \right) \Rightarrow \frac{FL_t}{R_{t}^{FA} FA_{t-1}} = \left( \frac{X_t}{R_{t}^{FA} FA_{t-1}} \right) \left( 1 - \frac{X_t}{R_{t}^{FL} FL_{t-1}} \right) + \chi_t
\]

(4)

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:

\[
\Delta f l_t \approx k + r_t^{FL} - \frac{1 - \rho}{\rho} (x_t - r_t^{FL} - f l_{t-1}) + \frac{1}{\rho} \chi_t
\]

(5)

We combine equations (3) and (5) 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
\[ nfa_t \approx r_t^{NFA} + \frac{1}{\rho} n_x t - 1 + \frac{1}{\rho} nfa_{t-1} \]  

(6)

where \( n_x = x_t - m_t \) 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, \( nxa_t = nfa_t + n_x t \) and rearrange the previous equation into the following one:

\[ nxa_t \approx r_t^{NFA} + \Delta n_x t + \frac{1}{\rho} nxa_{t-1} \]  

(7)

where \( \Delta n_x = n_x t - n_x t - 1 \) is the growth in net exports. Using the equation above we can obtain a present value relation for \( nxa \). We iterate forward and take expectations conditioned on period \( t \) information, \( \Omega_t \), which includes the value of \( nxa \). This produces:

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

If we impose the non ponzi game condition \( E_t \lim_{i \to \infty} \rho^i (nxa_{t+i}) = 0 \) on the equation above we obtain:

\[ nxa_t \approx -E_t \sum_{i=1}^{\infty} \rho^i (r_{t+i}^{NFA} + \Delta n_x t + i) \]  

(8)

I will use \( nxa_t \) as the measure of the U.S. net external position. Equation (8) implies that the net external position (net foreign assets plus net exports) can only vary if it forecasts changes in portfolio returns or if it forecasts changes in net exports growth. If \( E_t r_{t+i}^{NFA} = r \), any adjustment of the net external position will come from future changes in net exports growth (trade component). On the other hand, if \( E_t \Delta n_x t + i = n_x \), any adjustment will come from future changes in portfolio returns (valuation component). If a country runs a negative net external position it will experience future increases in net exports growth or future increases in portfolio returns, or both.

In deriving equation (8) we have performed several first order approximations. To assess the accuracy of those approximations we can compute the error term from equation (7),
\[ \xi_{t+1} = nxa_t - \frac{1}{\rho} nxa_{t-1} - r_t^{NFA} - \Delta nx_t. \] This error term also includes any measurement error in the data. Figure 1 shows that the actual \( nxa \) and the implied \( nxa \) are almost the same. The error term is small and stationary. Its sample variance represents 0.12\% of the sample variance of \( nxa \). We can then conclude that the approximation is pretty accurate.

I used a value for \( \rho \) of 0.993\textsuperscript{1}. A more detailed explanation on the steps to obtain the present value expression for \( nxa \) can be found on Evans and Fuertes (2010).

Figure 1: \( nxa \), predicted \( nxa \) and error term \( \xi_t \) from equation (7)

\textsuperscript{1}In the next section I comment on the choice of \( \rho \). Anyway, the actual and the implied \( nxa \) are very similar for a wide range of values for \( \rho \), changing very little the shape of Figure 1. For example, using \( \rho = 0.98 \) the error sample variance represents just 0.16\% of the sample variance of \( nxa \) and Figure 1 looks pretty much the same.
2.2 Empirical analysis of the present value equation for $nxa$

The first piece of evidence on the structural break in $nxa$ will come from the empirical analysis of the present value equation. In this section I empirically estimate the two components on the RHS of equation (8) following standard time series methods developed by Campbell and Shiller (1987). Then I compute what percentage of the $nxa$ variance comes from each of these two terms (the valuation and the trade components) and check if under the restrictions imposed by the empirical specification, equation (8) holds.

I use the data set from Gourinchas and Rey (2007) expanded till 2009:IV (their data set ends in 2004:I). It contains data on gross assets and liabilities positions as well as portfolio returns for different kinds of assets: equity, debt, FDI and other assets. There is also data on positions for each of those assets. I computed the assets (liabilities) total portfolio returns using weights calculated from the assets (liabilities) positions. Gourinchas and Rey (2005) include a complete explanation on how to construct the data set.

I take expectations on equation (8) conditional on $\Omega^*$, with $\Omega^* = \{nxa_{t-i}, \Delta nx_{t-i}, r_{t-i}^{NFA}\}_{i \geq 0}$. Notice that $\Omega^*$ is a subset of $\Omega$, the period-t information. Then we can obtain the following equation:

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

Notice that $\Omega^*$ 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 will need to compute $E(r_{t+i}^{NFA} + \Delta nx_{t+i})$ for $i > 0$. I calculate those terms using a VAR formulation. First I set a VAR(p) representation for $z_t = (r_t^{NFA}, \Delta nx_t, nxa_t)'$ (all the variables are demeaned).

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

where $\epsilon_t$ is a vector of mean zero shocks. This VAR has the following first order companion representation:

$$Z_t = \hat{A}Z_{t-1} + \hat{\epsilon}_t$$
where \( Z_t = (z'_t, \ldots, z'_{t-p+1}) \) and \( \bar{\epsilon}_t = (\bar{\epsilon}, 0) \). Next I define the vectors \( e_r, e_{\Delta nx}, e_{nxa} \) such that they select the different elements of \( Z_t \) (for example \( e'_r Z_t = r^NFA_t \)). Finally I can express equation (8) in terms of the VAR formulation:

\[
e'_{nxa}Z_t = -(e'_r + e'_{\Delta nx}) \sum_{i=1}^{\infty} \rho^i E_t Z_{t+i}
\]

Next 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:

\[
e'_{nxa}Z_t = -(e'_r + e'_{\Delta nx}) \rho^i \bar{A} (I - \rho \bar{A})^{-1} Z_t \\
= nxa'_t + nxa^\Delta_{nx}
\]

The valuation and trade components will be:

\[
nxa'_t = -e'_t \rho \bar{A} (I - \rho \bar{A})^{-1} Z_t = -\sum_{i=1}^{\infty} \rho^i E(r^NFA_{t+i} | \Omega'_{t})
\]

\[
nxa^\Delta_{nx} = -e'_{\Delta nx} \rho \bar{A} (I - \rho \bar{A})^{-1} Z_t = -\sum_{i=1}^{\infty} \rho^i E(\Delta nx_{t+i} | \Omega'_{t})
\]

Several points are relevant to analyze the empirical results. First, I assume that the forecast of future changes in fundamentals, \( E(r^NFA_{t+i} + \Delta nx_{t+i} | \Omega'_{t}) \), can be computed from the VAR as \( (e'_r + e'_{\Delta nx}) \bar{A} Z_t \). These forecasts only represent the best forecasts of \( r^NFA_{t+i} + \Delta nx_{t+i} \) that can be computed using linear combinations of the variables in \( Z_t \). If the processes we are forecasting are non linear it may be the case that even though equation (8) holds, its empirical counterpart (9) does not.

Second, the predicted values for the valuation and trade components, \( nxa'_t \) 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 \( z_t = (r^NFA_t, \Delta nx_t, nxa_t, \omega_t)' \) may change the forecast of
the valuation and trade components depending on what variables we include in $\omega_t$. Importantly, as I mentioned before, this will not happen with $nxa_t^r + nxa_t^{\Delta_{nx}}$ given that $\Omega^* = \{nxa_{t-i}, \Delta nx_{t-i}, r_{t-i}^{NFA}\}_{i \geq 0}$ 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 we can perform the following variance decomposition:

$$1 = \frac{\text{Cov}(nxa, nxa)}{\text{Var}(nxa)} = \frac{\text{Cov}(nxa^r, nxa)}{\text{Var}(nxa)} + \frac{\text{Cov}(nxa^{\Delta_{nx}}, nxa)}{\text{Var}(nxa)} = \beta_r + \beta_{\Delta_{nx}}$$

(11)

The regression coefficients $\beta_r$ and $\beta_{\Delta_{nx}}$ represent the share on the unconditional variance of $nxa$ explained by the valuation component $nxa^r$ and the trade component $nxa^{\Delta_{nx}}$.

We can empirically estimate $nxa$, the valuation and trade components as well as the regression coefficients $\beta_r$ 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:

$$\hat{nxa}_t = -(e_t^r + e_t^{\Delta_{nx}})\rho\hat{A}(I - \rho\hat{A})^{-1}Z_t = \hat{nxa}^r_t + \hat{nxa}^{\Delta_{nx}}_t$$

(12)

where $\hat{nxa}^r_t$ and $\hat{nxa}^{\Delta_{nx}}_t$ are the predicted values of the valuation component ($nxa^r_t$) and the trade component ($nxa^{\Delta_{nx}}_t$). Using these estimates the actual U.S. $nxa$ can be decomposed in the following way:

$$nxa_t = \hat{nxa}_t + \hat{\xi} = \hat{nxa}^r_t + \hat{nxa}^{\Delta_{nx}}_t + \hat{\xi}$$

(13)
Following equation (11) we can also obtain:

\[ 1 = \frac{\text{Cov}(\hat{nxa}_t, nxa)}{\text{Var}(nxa)} + \frac{\text{Cov}(\hat{nxa}_t \Delta n, nxa)}{\text{Var}(nxa)} + \frac{\text{Cov}(\xi, nxa)}{\text{Var}(nxa)} \tag{14} \]

From the OLS regressions of \( \hat{nxa}_t \) and \( \hat{nxa}_t \Delta n \) \( nxa_t \), we can compute the variance contribution of the estimated valuation and trade components. These regressions will produce the first two terms on the RHS of the equation above. One way to assess the quality of the approximation and the validity of the assumptions on the empirical equation (9) is to check how much of the variance of \( nxa \) can be explained by \( \hat{nxa}_t \) and \( \hat{nxa}_t \Delta n \). If the approximation is good and equation (9) holds, the valuation and trade components should account for almost all the variance of the net external position \( nxa \). I use the variance decomposition from equation (14) to check that out.

The valuation and trade components are able to explain just 81.72% of the variance of the net external position for the whole sample (1952:I-2009:IV). Because of that I calculated the variance decomposition for different subsamples. I used the value of \( \rho \) that maximized the total explained variance for each subsample with \( \rho \in (0, 1) \). Figure 2 shows the percentage of the unconditional variance of \( nxa \) explained by the trade and the valuation components for different subsamples. The date refers to the beginning of the subsample with all of the subsamples ending on 2009:IV.

From Figure 2 we can see that there is a break in the percentage of explained variance at the end of 1971. After that point the trade and the valuation components account for all the variance of the net external position. For subsamples including dates before the third quarter of 1971 these two components cannot account for all the variance of the U.S. net external position. In August of 1971 the U.S. government suspended convertibility of the dollar into gold for official transactions. At that time the U.S. government also announces no further intervention to support the dollar ending the facto the fixed exchange rate regime period.
Figure 2: Percentage of the \( nxa \) explained by the estimated valuation and trade components for different subsamples. The date refers to the beginning of the subsample with all of the subsamples ending on 2009:IV

The fact that the valuation and trade components together are not able to explain the whole \( nxa \) variance may be due to several reasons. First, we may think that it is due to the approximation error that comes from the first order Taylor approximations we carry out to obtain equation (7). We saw in Figure 1 that this error term is small and stationary. Also, it does not behave differently after the third quarter of 1971 that before that date. We can rule out the approximation error as reason for the break.

Second, we should focus on the assumptions I made in order to obtain equation (9). I imposed a non-Ponzi condition that implies that people expect the U.S. to fully honors its international debt. This assumption rests on the widely-accepted premise that the perceived likelihood of default by the U.S. has been negligible for the past 50 years.

I also assumed that it is posible to fully characterize the behavior of the variables in the vector \( z_t \) from a VAR(\( p \)). I used the Akaike criteria to figure out the optimal number of lags of the VAR for each of the subsamples in Figure 1. I find that the optimal number of
lags is one for all subsamples and the results on Figure 1 are obtained using the VAR(1) specification. I also perform the same analysis allowing for higher order of lags on the VAR and I consistently find the break using these other specifications. The break is not due to a misspecified length on the lags of the VAR.

Finally, I assume that the forecast of future changes in fundamentals, $E(r_{t+1}^{NFA} + \Delta nx_{t+1}|\Omega_t)$, can be computed from the VAR using linear combinations of the variables in $Z_t$. As I mentioned earlier, if the processes governing the variables in $z_t$ are non linear during the period of study, any linear model for those variables is misspecified. The behavior of the U.S. net external position is non linear during the whole sample. The break in the third quarter of 1971 identifies the point that separates two different regimes for the U.S. $nxa$. As I will argue in the next section, the U.S. $nxa$ changed its mean and variance after the break. It is this change on the moments of the U.S. $nxa$ what makes that linear projections cannot characterize the dynamics of the series over periods that span the break. That should not be the case for the two subsamples before and after the break.

Next, I divide our sample into two subsamples, one that covers the period before the break and another that covers the period after the break. I find that equation (9) holds for this two different periods. In other words, the valuation and trade components are be able to account for all the variance of the U.S. $nxa$ in this two different periods. Figure 3 and Figure 4 show the actual and the estimated $nxa$ for the pre and post convertibility period respectively. As we can see the two lines are almost the same for the two figures and the valuation and trade components together are able to explain 100 percent of the U.S. $nxa$ variance. In this case the series does not present non linearities and linear projection can characterize the dynamics of the data. I used the value of $\rho$ that maximized the percentage of explained U.S. $nxa$ variance for each different period.
Figure 3: \( nx_a \) and estimated \( nx_a \) for the convertibility period

Figure 4: \( nx_a \) and estimated \( nx_a \) for the post convertibility period
2.3 A Markov-Switching model for the U.S. nxa

Given the evidence already documented on the break for the U.S. nxa, the next step is to find a non-linear model that could identify the break as well. That would be useful in two different ways. First, it will bring further evidence on the break itself. Second, it will give us information about the differences in the characteristics of the U.S. nxa series during the periods before and after the break.

One widely used tool to confront non-linearities on the data series are Markov-Switching models. For example, Engel and Hamilton (1990) use this kind of models to characterize the behavior of the exchange rate depreciation. Also, Hamilton (1989) and McConnell and Perez-Quiros (2000) use Markov-switching frameworks to study the GDP growth.

Next I present a regime-switching specification that identifies the structural break found in the previous section. The model I am using follows the very simple model from Engel and Hamilton (1990). It assumes the existence of an unobserved variable \( s_t \) that takes on the value of one or two. The idea is that this variable \( s_t \) characterizes the state or regime that the process was at date \( t \). In this particular case I want to identify the break such that \( s_t = 1 \) during the pre-convertibility period and \( s_t = 2 \) for the post-convertibility period.

I further assume that when \( s_t = 1 \) the U.S. nxa follows a \( N(\mu_1, \sigma_1) \) distribution, whereas when \( s_t = 2 \) the U.S. nxa is distributed as a \( N(\mu_2, \sigma_2) \). I finally postulate a Markov chain for the evolution of the unobserved state variable such that:

\[
\begin{align*}
p(s_t = 1|s_{t-1} = 1) &= p_{11} \\
p(s_t = 2|s_{t-1} = 1) &= 1 - p_{11} \\
p(s_t = 1|s_{t-1} = 2) &= 1 - p_{22} \\
p(s_t = 2|s_{t-1} = 2) &= p_{22}
\end{align*}
\]

Figure 5 shows the smoothed probabilities of being at State 2 from the estimated model
together with the series plotted in Figure 2. Consistent with the structural break results presented in the previous section I find a sharp increase in the probability of being in State 2 during the year 1971. The probability of being in state 2 at the second quarter of 1971 is 0.3514, while that probability on the fourth quarter of 1971 is 0.9728. From the first quarter of 1972 till the end of the sample that probability equals one. This is consistent with the break happening on the third quarter of 1971.

![Figure 5: Left axis: percentage of nxa variance explained by the estimated valuation and trade components. Right axis: Probability of State 2 for the estimated Markov-Switching model.](image)

This result together with our previous findings shows further evidence on the structural break of the U.S nxa. Anyway, there is still an open question about the specification of the Markov Switching model. The model I use states that the U.S. nxa is normally distributed with a change on its mean and variance at the same time in the third quarter of 1971. The main puzzle is to reconcile the fact that a series that exhibit so much persistence as the U.S. nxa follows a normal distribution.

Keep in mind that the Markov switching model that I postulate reproduces the most
likely behavior for the U.S. nxa conditional on finding the break. I have run several other specifications and none of them were able to reproduce the structural break. A Markov Switching autoregressive specification cannot account for the break. Also, the original specification does not identify the break either if just the variance or the mean are state dependent but not both of them together. I also use a specification in which the variance and the mean follow independent regimes what implies the existence of four different states. Interestingly the results from the estimates of that specification show that there is just positive probability on two of the four states what indicates that the mean and the variance follow the same regime.

The U.S. nxa had a break on its dynamics in the third quarter of 1971 that made its mean and variance to change at that time simultaneously. It remains unclear whether the normal distribution is an intuitive process to characterize the U.S. nxa but it comes out to be a good one to characterize the evolution of the U.S. nxa assuming that the break happens.

The fact that there is a different mean and a different variance before and after the break in the U.S. nxa is consistent with the findings on the previous section. Linear projections are not capable to capture these non linearities and that is the reason why the empirical equation (9) does not hold for periods that span the break. Table 1 presents the parameter estimates on the Markov-Switching model.
Table 1: Markov-Switching Model: U.S. nxa- 1952:I - 2009:IV

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<td></td>
<td>(0.004)</td>
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</table>

Note:— The parameter estimates reported in the table refer to the following model for the U.S. nxa: $nxa_t = \epsilon_t, \epsilon_t \sim N(\mu_s, \sigma_s)$. $p_{ij}$ indicates the probability of switching from state $i$ to state $j$.

2.4 The timing of the break

Although from the two series plotted in Figure 2 we can see that the break clearly happens around the third quarter of 1971 I have not performed any test to identify the break point. Next I perform a test of a one time structural change with unknown change point. Conventional test statistics are not applicable in this circumstances because the parameter of the break point appears only under the alternative and not under the null of no break. Andrews and Ploberger (2004) derive asymptotically optimal tests for this kind of problems with an average-exponential form within the likelihood function framework. These test are optimal in the sense that they maximize a weighted average power.

The two statistics proposed by Andrews and Ploberger (2004) are:

$$\text{ave}F_T = \frac{1}{T_2 - T_1 + 1} \sum_{t = T_1}^{T_2} F_T \left( \frac{t}{T} \right)$$

$$\text{exp}F_T = \ln \left( \frac{1}{T_2 - T_1 + 1} \sum_{t = T_1}^{T_2} \exp \left( \frac{1}{2} F_T \left( \frac{t}{T} \right) \right) \right)$$
where $T_1 = T \cdot \pi_0$, $T_2 = T \cdot (1 - \pi_0)$, and $\pi_0 \in (0, 1)^2$. $T$ is the sample size and $F_T$ is any of
the conventional Wald, LM or LR tests for parameter instability when the break point $t$ is
known.

Following the specification used on the Markov-Switching model I apply the likelihood function based Andrews-Ploberger test to a normally distributed process for a structural break
on the entire parameter vector (mean and variance). Specifically I test the null hypothesis
of $H_0 : \alpha = \gamma = 0$ in the model of

$$nxa_t = a + \sigma \cdot \epsilon_t \quad for \quad t \leq T;$$

$$nxa_t = (a + a) + (\sigma + \gamma) \cdot \epsilon_t \quad for \quad t \geq T;$$

$$\epsilon_t \sim N(0, 1);$$

The Andrews-Ploberger test by itself does not produce information on the date that the break
happens, it just tests for the existence of the break. That information can be obtained by
applying the MLE to the model and choosing the break date to coincide with the observation
where the likelihood function is maximized. Bai, Lumsdaine and Stock (1998) prove that
the MLE of the break date in multivariate time series is consistent.

The Andrews-Ploberger test identifies the break in the third quarter of 1971 and the
values of the computed statistics equal to 742.98 for the ave-Wald and 557.06 for the exp-
Wald. Table 2 shows the critical values for the Andrews-Ploberger test with two parameters
and $\pi_0 = 0.15$. The computed statistics are far away from the critical values at any confidence
level, we clearly reject the null of no break on the $nxa$ series. These results complement the
ones obtained in the previous sections and reinforce the evidence on the structural break for
the U.S. $nxa$. It does confirm the existence of a break on the mean and variance of the U.S.
$nxa$ that happened in the third quarter of 1971.

$I set \pi_0 = 0.15 because that is the most commonly used value on empirical applications. The results
from the tests does not depend on the value of \pi_0 though$
Table 2: Critical Values of the Andrews-Ploberger test

<table>
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<th>10%</th>
<th>5%</th>
<th>1%</th>
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<tbody>
<tr>
<td>aveF</td>
<td>3.75</td>
<td>4.61</td>
<td>6.73</td>
</tr>
<tr>
<td>expF</td>
<td>2.59</td>
<td>3.22</td>
<td>4.76</td>
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Note:— The critical values come from Andrews and Ploberger (2004).

3 Economic Implications

In this sections I analyze the economic implications of the structural break on the U.S. \( nxa \). First I study the consequences that the change in the exchange rate regime had on the external adjustment process. Specifically I analyze how the relative importance of the valuation channel of external adjustment changes under these two different regimes.

Finally I analyze the results from the Markov-Switching estimation. Those results shed new light on the relationship between the U.S. \( nxa \) and the real exchange rate.

3.1 Valuation Effects and the exchange rate regime

A recent wave of research has focused on the contribution of valuation effects to the external financial adjustment. Changes in currency and asset prices can produce large wealth transfers across countries. Those wealth transfers can reduce the external imbalances and facilitate the sustainability of the countries’ foreign debt.

Tille (2003) studies the impact of exchange rate movements on the U.S. foreign debt and points out that the impact of a rising dollar can account for part of the deterioration in the U.S. \( nxa \). Gourinchas and Rey (2007) (hereafter G&R) study the contribution of the valuation and trade components to the external adjustment of the cyclical component of the U.S. \( nxa \). They derive a similar present value equation that the one I use but in contrast to G&R, this equation models variations in the entire U.S. external position, not
just its cyclical part. Finally, in a recent study, Evans and Fuertes (2010) analyze the
dynamics of the U.S. net external position and its future adjustment paths for the post
Bretton Woods era. They quantify the importance of valuation effects during that period
and the implications of exchange rate movements for the future adjustment of the U.S. \( nxa \).

None of the previous literature has analyzed how different exchange rate regimes may
affect the importance and behavior of valuation effects. Table 3 shows the percentage of
the U.S. \( nxa \) variance explained by the valuation and trade components for two different
subsamples: the period before the structural break (1952:I - 1971:II) and the period after
the break (1971:IV-2009:IV). I also report the results for the whole sample. The value of the
discount factor \( \rho \in (0, 1) \) is computed for each different period such that the total explained
\( nxa \) variance is maximized.

Table 3: Unconditional Variance Decomposition of \( nxa \)

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<tr>
<td>( \beta_r )</td>
<td>44.20</td>
<td>24.10</td>
<td>59.18</td>
</tr>
<tr>
<td>( \beta_{\Delta nx} )</td>
<td>37.42</td>
<td>75.61</td>
<td>40.62</td>
</tr>
<tr>
<td>( \beta_r + \beta_{\Delta nx} )</td>
<td>81.62</td>
<td>99.71</td>
<td>99.80</td>
</tr>
</tbody>
</table>

Note: \( \beta_r \) and \( \beta_{\Delta nx} \) represent the percentage of the unconditional variance of \( nxa \) explained by
the estimated valuation component \( \hat{nxa}^r \) and the estimated trade component \( nxa_{\Delta nx} \).

There is a remarkable increase on the percentage of the U.S. \( nxa \) variance explained
by the valuation component during the post-convertibility period. The floating exchange
rate amplifies the valuation channel of external adjustment. The nature of the adjustment
process is not neutral to the exchange rate scheme.

Some people have argued that the collapse of Bretton Woods and the fixed exchange
regime responds to an external adjustment problem. The U.S. \( nxa \) could not adjust under
the fixed exchange regimen and the change to a floating rate let the U.S. \( nxa \) to come back
to a consistent adjustment path. It is this amplified valuation channel the one that let the
U.S. nxa to come on a consistent path.

From a policy oriented point of view, these results open the debate on which kind of exchange rate regime should be better. The valuation effect of exchange rate movements behaves differently depending on the currency composition of net assets. As Melessi-Ferreti (2005) point out, industrialized countries like the U.S. hold most of its foreign assets in foreign currency and most of its foreign debt in domestic currency. A depreciation of the exchange rate leads to capital gains and facilitates the adjustment of the nxa. On the contrary, if most of the foreign debt is denominated in foreign currency as in the majority of the emerging economies, a exchange rate depreciation may lead to capital loses making more difficult the adjustment. Calvo and Reinhardt (2002) talk about the term “fear of floating” due to these adverse valuation effects.

A floating exchange rate regime increases and amplifies the valuation effects of a exchange rate movement. Depending on whether those valuation effects are desirable, the floating exchange rate regime may ease or difficult the external adjustment process. An interesting case to study is the one of monetary unions. In that framework the countries within the union abandon their own currency but they are still responsible on their own to honor their international obligations. A net debtor country within the union may find it more difficult to adjust its nxa given that the exchange rate is no longer related to the domestic economy but the monetary union economy as a whole. Adverse valuation effects of exchange rate movements due to joining a monetary union may arise depending on different factors: the net asset position of the country, the currency composition of that net assets position as well as the size of the economy of the country with respect to the total monetary union area. The recent debt crises on some countries of the European Monetary Union may be an example of these adverse valuation effects of exchange rate movements. The creation of a monetary union may be analyzed as a inverse experiment to the one presented in this paper: the change from a fixed exchange rate regime to a floating one.
3.2 Markov-Switching model estimates

Next I analyze the results from the estimation of the Markov-Switching model. Table 1 presents the parameter estimates on the Markov-Switching model. The estimated variance of the process is 0.025 for the convertibility period. During the post convertibility period the estimated variance is 0.123, what implies that the estimated variance during the period after the break is almost 5 times larger that the one during the period previous to the break. The estimates for the mean reveal a change from a creditor to a debtor position.

The change on the exchange rate regime made the U.S. *nxa* to jump into a new state in which the U.S. turns to be a net debtor and the volatility of its *nxa* increases substantially. The increase in the volatility of the *nxa* during the post-convertibility period indicates the tight relationship between the exchange rate regime and the U.S. *nxa*.

Other interesting topic in the literature is the relationship between international payments and the real exchange rate (RER): the transfer problem. There is ample evidence on the non neutrality of the exchange rate regime and the volatility of the RER (Liang (1998), Carrera and Vuletin (2003) and Morales and Sosvilla (2010)). Floating exchange rate regimes imply a more volatile RER. Both, the U.S. *nxa* and the RER increased their volatility during the post convertibility period. This fact sheds new light on the relation between the *nxa* and the RER. Lane and Melesi-Ferreti (2004) find a strong cross-sectional correlation between changes in real exchange rates and changes in net foreign assets, in both industrial and developing countries. Their results are consistent with the ones I find.

Finally, we should also analyze the estimates for the parameter $\mu$. Those estimates are basically equal to the averages for the U.S. *nxa* during the two different periods. What really matters is the fact that there was a change in the mean at the break point. This change may explain in part the persistent decline in the U.S. *nxa*. It also opens an alternative view on the continuous U.S. current account deficits. The end of the fixed exchange rate regime has let the U.S. to became a net debtor and run consecutive current account deficits. From the U.S. *nxa* series it is difficult to visualize the break on its mean. Further analysis
on the components of nxa may clarify this point. There is data available on the different components of the U.S. nfa: debt, equity, FDI and other assets. Figure 6 shows the ratios \( \frac{\text{assets}}{\text{liabilities}} \) for the debt category and the other categories together (debt, equity, FDI and other assets). We can clearly see the change in the mean of the series for the debt ratio after the end of 1971. On the other hand, the series for the ratio of other categories has been adjusting smoothly.

Figure 6: Asset to liabilities ratios for debt assets and non debt assets (equity, FDI and other assets)

The sharp decrease in the debt ratio responds to speculative attacks on foreign currencies that happened before the end of the convertibility of the dollar into gold. Once the convertibility was abandon, the debt ratio stabilized. It is hard to believe that an episode like that one may happen again under the floating exchange rate regime. During the last financial crises we see an important deterioration on the assets to liabilities ratios accompanied by a posterior increase. Interestingly the RER had a very similar behavior with a sharp depreciation during the decrease in the ratios and an appreciation after that. The valuation effects of
exchange rate movements may have been crucial in the external adjustment process during the last financial turmoil.

4 Conclusion

This paper identifies a structural break in the dynamics of the U.S. nxa that happened in the third quarter of 1971 when the U.S. government suspends the convertibility of the dollar into gold and announces no further intervention to support the dollar. The U.S. nxa increases its volatility and changes its mean (from a net creditor to a net debtor position) after the break. The change from a fixed exchange rate to a floating one produced a different behavior of the U.S. nxa.

I also find that the valuation channel of external adjustment accounts for 24% of the variance of the U.S. net external position during the convertibility period. That figure increases to 60% during the post convertibility period. The floating exchange rate regime amplifies the valuation channel of external adjustment, leaving the traditional trade channel with a less important role in the U.S. external adjustment process.

The break 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. nxa are misspecified over periods that span the break.

This paper also opens the debate for policy analysis on the benefits of a fixed or a floating exchange rate regime to facilitate the correction of external imbalances. A fixed exchange regime may be preferred if there are expected to be adverse valuation effects (that may be the case for emerging economies with most of its liabilities denominated in foreign currency). If valuation effects facilitate the external adjustment, a floating regime should be better. In addition, there are also implications on how the external adjustment process will be affected for a country that joins a monetary union. The different behavior of a new common exchange
rate may affect the valuation channel and the whole adjustment process.

There are several open topics for further research. On the theoretical side, we need to set a theoretical model that can account for the empirical regularities found in the paper. On the empirical front, the next step should be to generalize this analysis to other countries. That could help to understand the external adjustment process for emerging economies as well as from the ones within the European Monetary Union.
References


