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The Extrapolative Component in Exchange Rate Expectations and the Not-So-Puzzling Interest Parity: The Case of Uruguay

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Abstract: This paper analyses the importance attached to the past behaviour of the exchange rate when forming expectations and tests for the uncovered interest parity hypothesis. Using interest rate differentials for Uruguay over 1980-2010, we identify a strong and time-varying extrapolative component in exchange rate expectations. Agents attach more importance to the past behaviour of exchange rates the higher the level of inflation is. Yet agents are able to internalise policy announcements and external events that are likely to affect exchange rate fundamentals. Further, we find deviations from the uncovered interest parity hypothesis. These are lower than those usually reported for developed economies. Also, they tend to be higher for the period of low inflation and freely floating exchange rates. As long as what it takes to predict well is rather simple — i.e. look backwards, follow policy announcements, the interest rate differential performs well. Once the exchange rate determination model becomes more intricate or less familiar to the agents, they tend to fail at predicting exchange rate depreciations. These results point to expectational failures as a likely explanation for the 'uncovered interest parity puzzle'.

JEL Classification: F31, G14

Key Words: Exchange rates, Uncovered interest parity, Expectations, Emerging Economies, Bias, Puzzle

1 Introduction

The uncovered interest rate parity condition (UIP) implies the domestic currency is expected to depreciate when domestic nominal interest rates exceed foreign interest rates. However, empirical evidence since the seminal work of Fama (1984) has often found the opposite: the currency of the country with the relatively higher interest rate tends to appreciate. This is commonly known in the literature as the 'forward premium puzzle', or the uncovered interest parity puzzle. This puzzle has triggered significant research on the mechanisms underlying expectations formation, with the seminal contribution of Frankel and Froot (1987).

Two regularities in the extant literature motivate this paper. First, that most of the tests done on the deviations from the interest parity and on expectations formation mechanisms have been applied to major currencies and developed economies.[1] Second, that most of the tests done on expectations generating mechanisms implicitly assume time stability. An exception in the literature is the work done by Prat and Uctum (2007), who use a switching-regression framework with stochastic choice of regime for a set of European currencies to find that expectation processes change gradually and smoothly over time.

The scant interest in the case of emerging economies, and in the evolution of expectation generating mechanisms is surprising. Exploring determinants of expectations formation and testing for UIP in the context of emerging economies is particularly interesting for these economies which typically display two distinctive features: they evolve from high inflation to low inflation levels, and they undergo changes in exchange rate policies.

Our contribution in this paper is twofold. First, we test and identify a time-variant exchange rate expectations formation mechanism in the context of Uruguay over the period 1980-2010, and second, we test the UIP across different exchange rate regimes. Uruguay provides an interesting and representative case, since it is a small, open and highly dollarized economy in which agents are familiar with the use of financial instruments denominated in both domestic and foreign currency. During this period it went from high to low inflation levels, as well as different exchange rate regimes: a period of short-lived and non-credible stabilization plans with the exchange rate as a nominal anchor (Pre-TZ), a period of credible target zones for the exchange rate (TZ), and a subsequent period in which the Central Bank had no target for the exchange rate, and this was largely determined by market forces (Post-TZ).

We present new evidence suggesting the extrapolative component in expectations formation mechanisms has been substantial on average, and it has changed over time. By "extrapolative component" we mean the portion of yesterday's depreciation that is expected to occur today. Furthermore, we find that apart from an extrapolative component, agents display also adaptive and regressive components in expectation formation, and also internalise the potential effects of policy announcements on the path of exchange rates. In addition, we present evidence of deviations from the UIP, although these are relatively small compared to those typically reported in the literature. The size of the deviations from the UIP is larger when looking at sub-periods than when looking at the whole period, which

[1] The few exceptions that compare the size of the deviations from the parity for developed and developing countries are Bansal and Dahlquist (2000), and Frankel and Poonawala (2010), while Gilmore and Hayashi (2008) focuses on emerging economies only.

points to the importance of the ‘peso problem’ in our data. Across sub-periods, the largest deviations are found during the last period of freely floating exchange rates, in which the economy experienced low inflation.

The remainder of the paper is structured as follows. Section 2 describes the links between depreciation expectations and interest rate differentials. Section 3 introduces the research questions, and defines a number of key concepts to be used in this paper. Section 4 presents the analysis of the determinants of exchange rate expectations. Section 5 explores the tests on the uncovered interest parity. Finally, Section 6 concludes.

2 Depreciation Expectations and Interest Rate Differentials

To explore the exchange rate expectation generating mechanism one should ideally use forecast data gathered in surveys of participants in the foreign exchange market. Unfortunately, these data are not available for Uruguay for the period under consideration. Inevitably, we have to use an indirect measure of expectations equal to the interest rate differentials obtained from the uncovered interest parity hypothesis.[2]

The hypothesis of uncovered interest parity states that as long as portfolio investors are risk-neutral and have the choice of holding bonds denominated in domestic (pesos) or foreign currency (dollars), with same default risk and no differences in transaction costs, then the following condition is verified:

$$(1 + i^k_{t,dc}) = (1 + i^k_{t,fc}) \times (\frac{s^e_{t+k}}{s_t}) \tag{1}$$

where $i^k_{t,dc}$ is the interest on a peso-bond at time t of maturity k-months, i^k_{fc} is the interest on a comparable dollar asset, s is the nominal exchange rate expressed as pesos per dollar, s^e_{t+k} is the expected exchange rate for period $t + k$, t is the time period in months. Then, the expected depreciation rate for the domestic currency will be equal to $(1 + i_{dc})/(1 + i_{fc}) - 1$. If agents are risk-averse, a risk premium is added to the right hand side of equation (1). For the same expected return, the holder of the risky asset will require an extra compensation.

During the period of analysis (1980-2010) agents in Uruguay have been allowed to buy or sell assets denominated in foreign currencies without any restrictions. Moreover, the banking system faced symmetric regulation for their peso and dollar borrowing. In fact, all banks in the market offered deposits both in pesos and in dollars, which meant that when the agent faced the decision of choosing between the two assets, there were no differences in transaction costs or risk of default. Masoller (1997) argues that the use of interest rate differentials as a proxy for depreciation expectations at the beginning of the 1980s may be problematic due to frictions in the banking system (mainly related to a small number of players). However, we argue that the size of the domestic banking system should not necessarily be taken as suggestive of a lack of competition, since the capital account was fully liberalized in 1978, and restrictions to capital mobility were eliminated. Thus, in the current paper we use the interest rate differential as an indicator of expected depreciation of the peso against the dollar.

3 Some Definitions & Research Questions

Given the aforementioned, in what follows, the paper uses interest rate differentials for Uruguay over $1980m2 - 2010m3$ and attempts to answer a number of research questions listed below. For the sake of precision, before outlining the research questions, we make explicit the way in which some key terms will be understood in the analysis that follows.

[2] A survey on exchange rate expectations has only been carried out since 2006 by the Central Bank of Uruguay. Also, given the absence of forward markets in Uruguay for most of the period of analysis, we cannot use data on the forward premium.

Backward-looking or Extrapolative expectations An agent forming expectations in a "backward-looking" or "extrapolative" manner will be understood, here, as one that uses an autoregressive forecast model for exchange rate depreciations. "Backward-looking expectations" and "extrapolative expectations" will be used interchangeably.[3]

Backward-looking or extrapolative component in expectations: This will be understood as the portion of the past depreciation that is extrapolated into the future. That is, the portion of the depreciation that took place in period $t-1$, that agents expect to occur again in period t." Backward-looking component" and "degree of extrapolation" will be used interchangeably.

Intelligent expectations We will say that agents form "intelligent expectations" when their expectations about the relevant variable (depreciation) are not only shaped by its past behaviour, but by the evolution of relevant indicators that are bound to affect depreciation. This may imply, for instance, the internalization of policy announcement, or the effects of shocks to the exchange rate market.

The research questions to be addressed in this paper are the following:

(RQ1) To what extent do agents extrapolate past trends when forming expectations about nominal depreciations of the exchange rate?

(RQ2) To what extent agents behave differently in tranquil and crisis periods?

(RQ3) To what extent are they "intelligent" in forming expectations, that is, internalizing policy or environmental changes?

(RQ4) Has the extrapolative component changed over time?

(RQ5) Has the interest rate differential been a good predictor of exchange rate movements?

[3] Of course, strictly, the term "backward-looking", when referring to expectations, only suggests that agents look to the past in order to form expectations about the future. But they may look at the evolution of any variable.

4 Expectation Generating Mechanisms: How much do we extrapolate?

In this section we address Research Questions 1, 2, 3 and 4. We test whether agents have formed expectations by extrapolating past trends in Uruguay over the period 1980-2010, and how the degree of extrapolation changed over time. It is argued that agents in currency markets adopt extrapolative or bandwagon forecasting methods, by simply extrapolating the changes in previous periods into future changes in the same direction. Looking at low-inflation, developed economies, the existing literature finds evidence on extrapolative expectations for short horizons only (up to 1 month), while there is a twist in the mechanism when looking at longer horizons, and agents seem to expect a reversion of the previous exchange rate movement (see, for example, Frankel and Froot (1987), MacDonald and Torrance (1988), Cavaglia et al. (1993) and Chinn and Frankel (1994)).

The focus on Uruguay offers an interesting and representative case study of an emerging economy. During the period of analysis the Uruguayan economy experienced periods of high and low inflation. Consumer Price Inflation reached a maximum of 110% in 1990, then decreased to single digits after 1998. In addition, the economy had different exchange rate regimes. From 1980 until 1992 (Pre-TZ), a number of short-lived regimes were in place. In March 1991, the Central Bank introduced a price stabilization plan with the exchange rate as a nominal anchor. The most visible element of this plan was a target zone (TZ) for the nominal exchange rate. It was not until June 1992 that the amplitude and the slope of the TZ was publicly announced. The regime was abandoned in June 2002, in the middle of a deep recession, a banking crisis and after the drastic depreciations in Brazil (1999) and Argentina (2002). In our analysis, we define the TZ regime as starting in 1993 to allow six months of 'learning' after the public announcement of the width and slope of the bands within which the Central Bank was targeting the exchange rate to fluctuate.[4] A third regime (Post-TZ) started after the abandonment of the target zones in 2002. Since 2003, the Central Bank has not had any explicit target for the exchange rate. It would be wrong, however, to define this regime as a freely floating one, since it is possible to identify Central Bank interventions during this period. However, these have not been systematic, and it was argued by the authorities that their rationale was to decrease the volatility, rather than to affect the level of the exchange rate. These changes in the economic environment are likely to have impacted the way agents formed expectations.

To assist clarity, Figure 1 displays a timeline in which the three sub-periods are located as well as the major external events and different policy announcements that may have affected expectations. Figure 2 plots the time pattern of depreciation and interest rate differentials, as a proxy for expected depreciation, and shows the depreciation threshold that will be used for the definition of 'tranquil' periods and 'turbulent' periods. Turbulent periods will be considered to

[4] The TZ regime has been considered as credible during most of its duration. The credibility of the TZ regime at an early stage has been argued first by Bergara and Licandro (1994), and later by Polgar (2002). Masoller (1997) compares the credibility of a stabilization plan in the early 1980s with the TZ regime and concludes that the latter was substantially more credible than the former.

be those immediately after a 'jump' in the exchange rate has happened. This presents *prima facie* evidence of some degree of an extrapolative component in expectations, as these seem to lag depreciation.

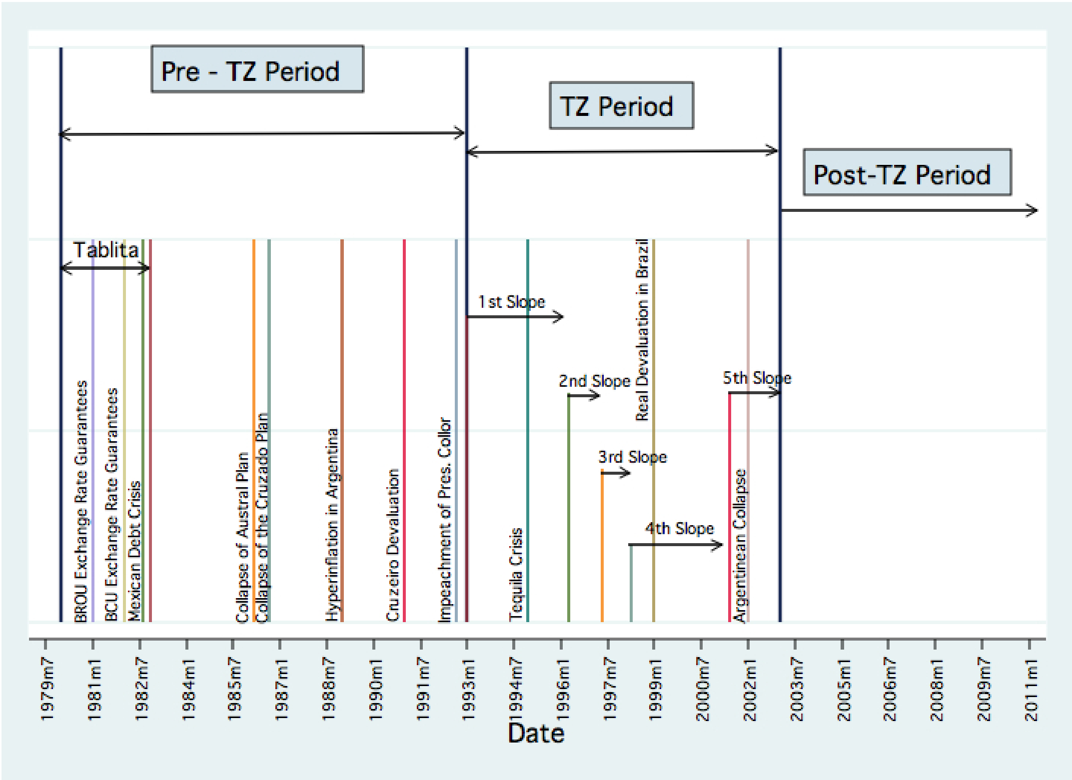

Figure 1: Regimes and Major External Events hitting the Uruguayan Economy

Firstly, we test the contribution of an extrapolative component in expectations as well as the importance of a number of exogenous environmental variables. For these purposes, we estimate a modified version of Frankel and Froot (1987), in which investors' expected depreciation rate for the following six months is a function of the depreciation over the last six months, of extreme movements in the exchange rate, and of policy and other changes in the economic environment as in equation (2).

$$\Delta s^e_{t+6} = \beta_0 + \beta_1 \Delta s_t + \beta_2 Jump_t + \beta_3 Jump_t * \Delta s_t + \mathbf{X_t'}\beta_\mathbf{4} + \epsilon_{t+6} \tag{2}$$

where:

$$Jump_t = \begin{cases} 0 & \text{if } \Delta s_t \leq 50\%, \\ 1 & \text{if } \Delta s_t > 50\%. \end{cases} \tag{3}$$

Δs^e_{t+6} is what agents expect at time t the exchange to depreciate in the following six months and Δs_t is the observed depreciation at time t over the past six months.[5] 'Jump' is included to allow for extreme events to have a direct effect on expectations (through β_2). The interaction of 'Jump' and Δs is included to allow for a differential effect of Δs on expectations after an extreme event has taken place (through β_3).[6] **X** is a matrix of variables capturing events affecting the

[5] We use depreciation and devaluation interchangeably.

[6] During the period, there have been 15 episodes of depreciations of at least 50% in a 6-month period. The 'extreme' event was arbitrarily defined as a depreciation above 50% in a 6-month period. The threshold was chosen by identifying the atypical episodes in a graph

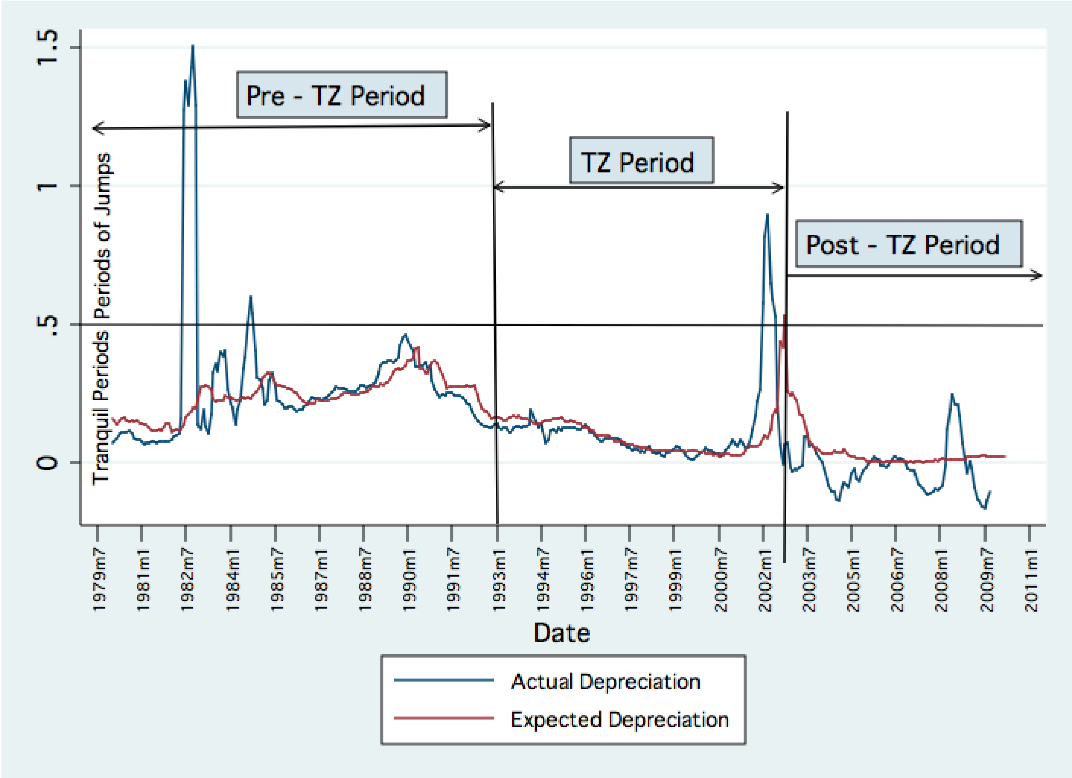

Figure 2: Actual and Expected Exchange Rate Depreciation

economic environment, including government announcements and international and domestic events that may have an impact on depreciation expectations: a trend during the period of the 'Tablita' stabilization plan (which collapsed in December 1982) to allow for agents internalizing the devaluation announcements during that period ('Trend Tablita'), level-dummies controlling for the effects of the sales of foreign exchange guarantees by the "Banco de la Republica" (BROU, $1981m1-1981m10$) and those sold by the Central Bank (BCU, $1982m1-1982m3$), the collapse of the Argentinean 'Tablita' stabilization plan ('Tablita Argentina', $1982m11-1983m6$), the collapse of the Argentinean 'Austral' plan ('Austral Collapse', $1986m3-1986m6$), the collapse of the Brazilian Cruzado plan ('Cruzado Collapse', $1986m9-1987m1$), the hyperinflation and banking crisis in Argentina ('Hyper', $1989m1-1989m12$), the different announced slopes of the target zones ('$i-th$ Slope'), the depreciation of the Brazilian Real (Real, $1999m1-2002m6$), the collapse of the Argentinean currency board (Argentina, $2002m1-2002m6$); impulse dummies controlling for the effects of the Mexican debt crisis ('Mexican Debt Crisis', $1982m8$), the depreciation of the Brazilian Cruzeiro ('Cruzeiro Depreciation', $1991m1$), the Brazilian institutional crisis due to the impeachment of President Collor (Collor, $1992m9$), the Tequila crisis in Mexico (Tequila, $1994m12$), and the rate of change of the foreign exchange reserves of the Central Bank.

Secondly, we explore whether a mixed expectation model fits the data better,

plotting depreciation over time (see Figure 2). For sensitivity purposes, different thresholds were chosen and the results were robust to this choice. A alternative method used to capture possible differential effects of Δs_t on Δs^e_{t+6}, for different levels of Δs_t was a linear spline of Δs_t. The results were very similar to those reported here, but the goodness of fit indicators favoured the model specified in equation (2).

by incorporating variables that would capture adaptive and regressive mechanisms. The rationale for testing a mixed model from an economic point of view, is that forecasters may use several models, or there are heterogeneity of forecasters, with different models. Given that we use a proxy for average expectations, we cannot identify which explanation drives a finding for a mixed model as the two hypotheses are observationally equivalent.[7]

To test for a mixed model, we then estimate equation (4):

$$\begin{aligned}\Delta s^e_{t+6} \;=\;& \beta_0 + \beta_1 \Delta s_t + \beta_2 Jump_t + \beta_3 Jump_t * \Delta s_t + \beta_4 ForeError_t + \beta_5 (s^*_t - s_t)/s_t + \\ & \beta_6 \Delta CPI_t + \mathbf{X_t'}\boldsymbol{\beta_4} + \epsilon_{t+6} \qquad (4)\end{aligned}$$

where:

(1) $ForeError_t$ is the lagged forecast error, given by $(s^e_t - s_t)/s_t$. This would allow for an "adaptive" component in expectations. Here, expectations about the future spot rate, s^e_{t+1}, are formed by placing a weight $(1 - \beta_4)$ on the current spot rate, and (β_4) on the past expected spot (s^e_t). [8] β_4 is usually hypothesized to be between 0 and 1 for expectations to be inelastic. We will refer to this added variable as reflecting the "adaptive" component in expectations.

(2) $(s^*_t - s_t)/s_t$ is a measure of exchange rate disequilibrium. If agents perceive that the exchange rate will eventually adjust to ensure a stable real exchange rate, their depreciation expectations will be influenced by how far that s^*_t that would ensure that real exchange rate stability is from the spot rate s_t. Operationally, we defined the "equilibrium" nominal exchange rate s^*, as s such that $RER = R\bar{E}R$.[9]. β_5 is the speed at which the spot rate is expected to regress to the "equilibrium" value, and is hypothesized to be positive. In that case, agents adjust depreciation expectations upwards when the nominal exchange rate is below the perceived equilibrium value, s^* (and vice versa).[10] We will refer to this added variable as reflecting the "regressive" component on expectations.

(3) ΔCPI_t is CPI inflation over the last six months, pre-determined at period t. Agents may form expectations about real exchange rates, but not be sophisticated enough to respond to the disequilibrium as calculated above. If they face computational costs, they may just look at past inflation and expect that its effects on the RER are partially neutralized by a nominal depreciation. $\beta_6 > 0$ would suggest that agents revise expectations upwards after an increase in inflation.

[7] Most of the literature tends to estimate different models separately. An exception is Prat and Uctum (1996), who find evidence supporting a mixed model, using average expectation data. Another is the work of Benassy-Quere et al. (2003). These authors exploit a panel with disaggregate expectations data and find evidence supporting the hypothesis that forecasters are heterogeneous in the models they use.

[8] It is possible to see that rearranging, $\Delta s^e = \beta_4 ForeError_t$.

[9] $R\bar{E}R$, the average real exchange rate is calculated over the whole period of analysis, 1980-2010.

[10] This follows the logic of Dornbusch (1976) in which variables such as good prices converge to their long-run values over time. Frankel and Froot (1987) use a similar measure of disequilibrium to test for regressive expectations.

Thirdly, given our interest in understanding if the expectation generating mechanism changed over time, we run separate models for each of the three sub-periods mentioned, and examine how heterogeneous coefficients are across periods. Given that there are a number of extreme exchange rate movements, and that these may affect the estimates, we have chosen the beginning and end dates of the three sub-periods such that the extreme episodes are excluded. This means that when we estimate (4) for the period Pre-TZ, we exclude the turbulent first two years. For TZ, we consider the period 1993m1-2002m5, excluding the collapse of the TZ regime, while for Post TZ we estimate over the period $2003m1-2010m3$, thus excluding the turbulent second half of 2002.

Data are obtained from the Central Bank of Uruguay. The series used are 7536 for peso deposits and 7538 for dollar deposits. Exchange rate data correspond to the monthly average of bid prices. Data on foreign exchange reserves is obtained from the IMF IFS database. Some descriptive statistics are presented in Table 4.

4.1 A Note on the Methodology

Here we discuss the methodological problems arising in the estimation of equation (2), along with the strategy pursued in this paper in an attempt to overcome them.

4.1.1 Overlapping Observations: Serially Correlated Errors

Because the forecast horizon corresponding to the interest rate differential is longer than the observational frequency (monthly), a problem of overlapping observations arises, which implies that the forecast error ϵ_{t+k} follows a non-invertible moving average process of order $k-1$.[11]

This can be showed as follows. Imagine a non-overlapping model, in which, say the interest differentials, denoted below as Δs_t^e are those for one-month time deposits, so they capture the expected depreciation over one month only. We specify the following model:

$$\Delta s_t^e = \alpha + \beta \Delta s_{t-k} + u_t \tag{5}$$

where u_t is assumed to be serially uncorrelated, homoscedastic, $E(u_t) = 0$, $V(u_t) = \sigma^2$.

Now, if we look at interest rate differentials of k-month time deposits, then the differential will contain the sum of the depreciation expectations for each of the k periods. Denoting the sums in capital letters, then aggregating we have:

$$\begin{aligned} \Delta S_t^e &= \sum_{j=t}^{t+k-1} \Delta s_j^e \\ \Delta S_t &= \sum_{j=t}^{t+k-1} \Delta S_j \\ e_t &= \sum_{j=t}^{t+k-1} u_j \end{aligned} \tag{6}$$

[11] This was first shown by Hansen and Hodrick (1980).

Which means that, even if the u's are independent and identically distributed, the e's will not be, displaying instead a moving average component of order $k-1$:

$$\begin{aligned} E[e_t] &= E[\sum_{j=0}^{k-1} u_{t+j}] = \sum_{j=0}^{k-1} E[u_{t+j}] = 0 \\ V[e_t] &= k\sigma_u^2 \\ Cov[e_t, e_{t+s}] &= (k-s)\sigma_u^2, \forall k-s>0 \end{aligned} \tag{7}$$

While OLS estimates of the parameters remain consistent with serial correlation, the standard errors are biased downwards. The standard approach in the literature is to use a version of GMM introduced by Hansen (1982) to correct the standard errors. The GMM estimator of the variance-covariance matrix of the OLS estimates of the regression coefficients is:

$$\hat{\Sigma} = (X'X)^{-1}X'\hat{\Omega}X(X'X)^{-1} \tag{8}$$

where $\hat{\Omega}$ is the variance-covariance matrix of the residuals. The element ijth of that matrix is given by:

$$\hat{\lambda}(i,j) = \begin{cases} \hat{u}_i\hat{u}_j & \text{if } |i-j| \leq (k-1), \\ 0 & \text{if} |i-j| > (k-1). \end{cases} \tag{9}$$

where $\hat{\lambda}$ is the estimated autocovariance. It has been shown that the estimates of $\hat{\Omega}$ need not be positive definite when samples are small. A solution to this problem has been suggested by Newey and West (1987), and it has been usually adopted in the literature. This solution consists in weighting $\hat{\lambda_{i,j}}$ in equation(9) as follows:

$$\hat{\lambda}(i,j) = \begin{cases} \hat{u}_i\hat{u}_j\omega_{i,j} & \text{if } |i-j| \leq (k-1), \\ 0 & \text{if} |i-j| > (k-1). \end{cases} \tag{10}$$

where the choice of $\omega_{i,j}$ is given by:

$$\omega_{i,j} = 1 - [|i-j|/(m+1)] \tag{11}$$

where m is chosen so that positive definiteness is ensured. Here we follow the authors' suggestion, and set $m = k = 6$.

4.1.2 Autoregressive Conditional Heteroscedasticity

An additional problem associated to the error term arises if disturbances are conditionally heteroscedastic. This has been frequently found in monthly financial data (and it is almost a regularity in higher frequency data). For example, if large and small errors occur in clusters, then the recent past may provide useful information about the conditional variance of the errors. While OLS are still unbiased in the presence of conditionally heteroscedastic errors, efficiency gains are possible by explicitly modeling the pattern of that heteroscedasticity. Following Engle (1982) and taking our estimable equation (2), that would imply estimating simultaneously a mean and a variance equation, in which the latter has a constant, as well as an autoregressive component as specified below:

$$\begin{aligned} \Delta s_t^e &= \beta_0 + \beta_1\Delta s_t + \beta_2 Jump_t + \beta_3 Jump_t * \Delta s_t + \mathbf{X_t'}\boldsymbol{\beta_4} + \epsilon_t \\ \sigma_t^2 &= \alpha_0 + \alpha_1\epsilon_{t-1}^2 + ... + \alpha_q\epsilon_{t-q}^2 \end{aligned} \tag{12}$$

The variance equation specified as above implies that recent disturbances influence the variance of the current error. In equation (12), the pattern is described as an Autoregressive Conditional Heteroscedasticity (ARCH) process of order p, where p is the number of lags that affect the current variance of the error. The parameters in this model are estimated using Maximum Likelihood techniques (ML).

In order to test whether ARCH effects are present, we use a Lagrange Multiplier test (ARCH LM) that consists in estimating equation (2) using OLS, extract the estimated errors, and regress their squared values on lags as below:

$$\hat{e}_t^2 = \hat{\alpha}_0 + \hat{\alpha}_1 \hat{e}_{t-1}^2 + ... + \hat{\alpha}_p \hat{e}_{t-p}^2 + \nu_t \tag{13}$$

and then test the joint significance of $\hat{\alpha}_1 ... \hat{\alpha}_p$. We tested for ARCH effects in all the models estimated in this paper, and given that these suggest unambiguously the presence of conditionally heteroscedastic disturbances (ARCH effects), we used ARCH models.[12]

Unfortunately, the Newey-West procedure does not allow for ARCH effects. Our ad-hoc strategy is to use ARCH models to estimate an augmented version of equation (2) in which lags of the first differences of the dependent and independent variables are included up to an order of $k-1$, in an attempt to control for the moving average process.[13]

4.1.3 Non-Stationarity & Co-integration

Another consideration involves the time-series properties of the variables under consideration. We performed augmented Dickey-Fuller (ADF) tests of unit roots in both actual depreciation rates and interest rate differentials, and results were mixed, depending on the lag length, and on the periods considered (sample size).[14] The inconclusiveness of these unit root tests is not surprising, as it has been widely acknowledged that they have low power in small samples. For these reasons, and in order to exclude the possibility of interpreting results from spurious regressions, we test for cointegration by checking whether residuals from the estimated long-run relationship contain unit roots. Because in the presence of non-stationary regressors, the usual t statistics have non-standard distributions, we use tabulated critical values to perform the cointegration tests. These are reported after each estimation result.

Although the estimator from the long-run relationship is *superconsistent* (it converges to its true value at a faster rate — T — than it would be the case if the series were stationary), this asymptotic characteristic may be of little use when working with finite samples. Banerjee et al. (1993) show that large finite-sample biases can arise in static OLS estimates of co-integrating parameters. A possible method of reducing finite-sample biases, is estimating a single-equation dynamic regression, in the form of an Autoregressive Distributed Lag model (ADL). For purposes of comparison, we run an ADL in which the lag structure to be

[12]The results from the ARCH LM tests are reported after each estimation result.

[13]This idea was kindly suggested by Professor Ron Smith. For verification purposes, we estimated the same models using the Newey-West procedure and found that the results are largely unchanged: while standard errors increase, the main coefficients of interest remain highly significant. Newey-West estimation results for the key coefficients are reported in alongside those obtained using ARCH models.

[14]These are reported in Table 5.

modeled is chosen using a set of information criteria indicators (Akaike (AIC), and Bayesian (BIC)), compute the implied long-run relation and compare it with that obtained when estimating the static relationship.

The mean equation of the ADL to be estimated can be expressed as in (14):

$$A(L)\Delta s_t^e = \beta_0 + B(L)\Delta s_t + \beta_2 Jump_t + \beta_3 Jump_t * \Delta s_t + \mathbf{X_t'}\beta_4 + \epsilon_t \quad (14)$$

where A(L) and B(L) are lag polynomials, whose order is determined by the information criteria mentioned above (both the AIC and BIC suggest 6 lags for the dependent variable and 2 lags for the explanatory variable). The implied long-run relation is given by:

$$\overline{\Delta s_t^e} = \frac{\beta_0}{A(1)} + \frac{B(1)}{A(1)}\overline{\Delta s_t} + \frac{\beta_2}{A(1)}\overline{Jump_t} + \frac{\beta_3}{A(1)}\overline{Jump_t * \Delta s_t} + \overline{\mathbf{X_t'}}\beta_4[A(1)]^{-1} \quad (15)$$

where replacing L by 1 in the lag polynomial gives the sum of the coefficients in the polynomial. The cointegration test in the context of an ADL model consists of testing whether A(1) and B(1) are zero. This is performed and reported in the section that follows.[15]

4.2 Results

Results from estimating equation (2) over the whole period are reported in Column (1) of Table (1). Consider tranquil times first, when the Jump variable and the interaction term take a zero value. Our results suggest that agents extrapolate about 70% of the past exchange rate movement into the future, on average, and *ceteris paribus*. This coefficient is very well determined and suggests a strong extrapolative component in the expectation formation mechanism.

The behaviour is subtler in 'turbulent' times, after agents observe a jump in the exchange rate. The estimated effect of lagged depreciation on expectations should now be calculated as: $\hat{\beta}_1 + \hat{\beta}_3 * Jump_t = 0.222$.[16] After jumps, agents do not extrapolate the whole of the past exchange rate movement, but only a smaller portion. This portion is still sizable, and statistically significant, as we reject the hypothesis of $\beta_1 = -\beta_3$ with 95% confidence. In addition, after jumps, agents revise their depreciation expectations upwards, on average, by about 13%, *ceteris paribus*. The extrapolative component is less pronounced after crisis periods than after tranquil periods, although it is still present. In fact, it explains why agents under-predict large depreciations, but once these have happened, they tend to over-predict them. To visualize this, look at Figure 2. In Table 4 it is possible to appreciate that the sample average of expected depreciation during jumps is 12.7% while the actual equals 92.3%. Instead after the jump has happened, expected depreciation is on average, 30.8%, while the actual is 13.2%.

While our results support the hypothesis of a strong extrapolative component in expectation formation, they also suggest that agents are aware of changes in the economic environment, and internalize their effects on depreciation expectations. The collapses of Argentinean (Austral) and Brazilian (Cruzado) currency stabilization plans induced increases in depreciation expectations in Uruguay by 1.7% and 2.4% respectively while the hyperinflation episode in Argentina induced an increase in depreciation expectations in Uruguay by 2.1%, on average and *ceteris*

[15]See paper 8 in Johnston and DiNardo (1997) for a discussion on ADL models.

[16]A 95% confidence interval for this effect is given by (0.431, 0.013).

Table 1: Expectation Generating Mechanism Regressions

Dep.Var: $i - i^{*}$	(1) Extrap		(2) Mixed		(3) ADL Extrap	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Lagged Dep	0.705***	(0.003)	0.439***	(0.018)	0.017**	(0.007)
Lagged Jump	0.122***	(0.047)	0.204***	(0.024)	0.063***	(0.013)
Inter Lagged Jump*Dep	-0.483***	(0.047)	-0.484***	(0.039)	-0.039**	(0.016)
Lagged Δ CPI			0.317***	(0.016)		
L. Fore Error			0.125***	(0.026)		
L. Diseq E			-0.057***	(0.008)		
Trend Tablita	0.001***	(0.000)	0.001***	(0.000)	0.001***	(0.000)
Slope TZ to come	-0.005	(0.004)	-0.002	(0.003)	-0.002*	(0.001)
Mexican Debt Crisis	-0.000	(0.029)	0.007	(0.036)	-0.003	(54552.198)
Tablita Argentina	-0.069***	(0.012)	0.132***	(0.025)	-0.012**	(0.006)
Austral Collapse	0.017*	(0.010)	0.017***	(0.003)	-0.005**	(0.002)
Cruzado Collapse	0.024***	(0.002)	-0.004	(0.004)	0.006***	(0.002)
Cruzeiro Depreciation	0.021	(0.881)	0.000	(0.039)	-0.001	(0.036)
Forward Contracts BROU	-0.003	(0.004)	0.017***	(0.005)	-0.008**	(0.003)
Forward Contracts BCU	-0.018***	(0.006)	-0.024***	(0.009)	-0.025***	(0.006)
Hyper in Argentina	0.021***	(0.001)	0.011***	(0.002)	0.010***	(0.001)
Collor	0.004	(46399.193)	0.024	(179326.571)	0.008	(15330.109)
1st SlopeTZ	0.005***	(0.001)	0.002	(0.002)	0.003***	(0.001)
2nd SlopeTZ	-0.045***	(0.002)	-0.004	(0.003)	-0.003*	(0.002)
3rd SlopeTZ	-0.055***	(0.002)	-0.011***	(0.003)	-0.001	(0.001)
4th SlopeTZ	-0.049***	(0.002)	-0.004	(0.002)	-0.000	(0.001)
Tequila	-0.008	(0.060)	0.025	(344.482)	0.006	(0.006)
Real	-0.006***	(0.002)	0.001	(0.003)	0.000	(0.001)
Argentina	-0.003	(0.019)	0.026***	(0.005)	0.008***	(0.002)
Var in Forex Reserves	0.008**	(0.004)	-0.026***	(0.007)	-0.009***	(0.003)
Lagged L.Dep.					0.004	(0.007)
L2.L. Dep					-0.008	(0.007)
L.Expected Depreciation					1.035***	(0.069)
L2.Expected Depreciation					-0.037	(0.098)
L3.Expected Depreciation					-0.015	(0.099)
L4.Expected Depreciation					-0.026	(0.079)
L5.Expected Depreciation					-0.025	(0.073)
L6.Expected Depreciation					0.041	(0.038)
Constant	0.065***	(0.001)	0.030***	(0.002)	0.001	(0.001)
ARCH						
Arch	2.061***	(0.218)	1.199***	(0.162)	0.806***	(0.130)
Garch			0.188***	(0.048)	0.447***	(0.060)
Constant	0.000**	(0.000)	0.000**	(0.000)	0.000*	(0.000)
Observations	351		345		351	
AIC	-1586.258		-1744.099		-2387.480	
BIC	-1451.131		-1594.200		-2240.770	
ADF on Res	-6.352		-7.007		-12.977	
ARCH LM	128.084		103.344		70.835	

Standard errors in parentheses. CV for ADF on Res with 2 non-stationary vars. 3.78 at 1%, 3.25, at 5%, 2.98 at 10%
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

paribus. The hypothesis of agents internalizing the announcements on the slopes of the TZ is upheld by the data, as the coefficients are jointly significant. The hypothesis of $\beta_{Slopei} = \beta_{Slopej}$, $i, j \in (1, 4)$ and $i \neq j$, is rejected for the pairs (1, 2), (1, 3), (1, 4) and (2, 3) with 95% confidence. It is worth noting that the changes in the magnitude of the point estimates reflect the direction of the announced changes in depreciation rates. The sales of cheap forward contracts by the Central Bank exerted a negative and statistically significant effect on expectations, reducing them by 1.8%. On the other hand, the estimated coefficients on Mexican Debt Crisis, the sales of cheap forward contracts by the BROU, the sharp depreciation of the Cruzeiro, the institutional crisis in Brazil in 1991, the Tequila crisis, and more surprisingly, the Argentinean crisis of 2001 are not well-determined.[17]

In Column (3) of Table (1) we report the results of estimating an ADL model, as described in equation (14). The ADL model was estimated in an attempt to understand whether the results are affected by explicitly modeling the dynamics. The implied long-run relation between lagged depreciation and expectations can be obtained by calculating $B(1)/A(1)$, which yields $0.014/0.027 = 0.52$ — which is in line with the one obtained from the static model (reported in Column 1). We test for $A(1)$ and $B(1) = 0$, and reject the null hypothesis at 1% significance, which gives further evidence of cointegration.[18]

Column (2) of Table (1) reports the results of estimating equation (4), in which adaptive and regressive expectation formation mechanisms are also allowed. The effect of lagged depreciation on expectations during tranquil times is now reduced by about 35%. After jumps, while the effect of lagged depreciation is not statistically significantly different from zero, agents seem to revise their depreciation expectations upwards, on average, by about 23%, *ceteris paribus*. When looking at the coefficients on the environmental variables, now the collapse of the Argentinean Tablita in 1982, the collapse of the Argentinean currency board in 2001, and the changes in foreign exchange reserves carry the expected signs and are statistically significant (positive, positive and negative respectively).

The sign on the estimated coefficient on the adaptive component is positive, implying that the weight placed on the previous prediction is positive, although much lower than that placed on the current spot rate ($\hat{\beta}_4 = 0.125$). The negative sign of the estimated coefficient on the regressive component is puzzling as it implies that agents actually expect the exchange rate to diverge away from the "equilibrium" value. One could argue that the choice of a 'wrong equilibrium' value may determine this finding, although the strong statistical significance of the (negative) coefficient is discomforting. An alternative explanation is related to the finiteness of the sample size. Agents may expect a convergence to an equilibrium value in the long run, but may have reasons to expect a divergence over shorter time periods. The estimated coefficient on past CPI inflation suggests that agents revise expectations upwards by slightly less than a third of what they observed inflation to be in the previous period, on average and *ceteris paribus*.

The diagnostic tests on these estimated models suggest, firstly, that the mixed model performs better than the extrapolative model, using the AIC and BIC information criteria. Secondly, that the stationarity of the estimated residuals cannot be rejected, which provides evidence of cointegration between the interest rate differentials and the depreciation rates. Thirdly, that there is strong evidence of GARCH effects in the errors. For this reason, the reported estimates were constructed on the basis of GARCH models. Given that GARCH models do not allow for a treatment of the non-invertible moving average process present in the errors due to the overlapping nature of the observations, we re-estimated the

[17] The coefficients for the depreciation trend during the Tablita stabilization plan, the one on the collapse of the Argentinean 'Tablita', the one on the Real Devaluation, and the one on the rate of change of foreign exchange reserves are well determined but do not yield the expected sign.

[18] The test of $A(1) = 0$ is equivalent to testing the sum of the lagged coefficients on the dependent variable being equal to unity. The prob-value for this test is 0.000. The prob-value for the test $B(1) = 0$ is 0.000. We do not report the transformations for all of the covariates, for the sake of brevity of exposition.

models using GMM, with the Newey-West adjustment, as described in Section 4.1, and report the results in Table 6. Those results are in line with these reported here. [19]

It could be argued that because we rely on the interest rate differential as a measure of depreciation expectations, the observed increase in the interest differential after extreme exchange rate movements is not fully explained by changes in depreciation expectations, but also by an increase in the risk-premium required by the holders of the peso asset. But even if it is a combination of expected depreciation and risk that is revised upwards after a drastic depreciation, that behaviour would still be indicative of a backward-looking, extrapolative component in the expectation formation mechanism about the variance and about the mean of the exchange rate.

Our findings of extrapolative expectations over long horizons may be related to a perception of uncertainty with respect to the exchange rate exhibited during much of the 1980s and early 1990s. It has been pointed out by DeGrauwe (1990) that when the environment is uncertain, rules based on an autoregressive model become important. This is, probably, because that is all the forecaster has available. One relevant question is how stable the extent to which agents extrapolate has been over the period considered. This is a relevant question, given that over the period considered, different regimes have been in place and constitutes the focus of attention of next section.

4.3 A time-varying extrapolating factor

In this subsection we address RQ3 & RQ4. Firstly, we explore whether the extent to which agents extrapolate changed across the three different periods considered in this paper: Pre-TZ, TZ and Post-TZ. Secondly, and motivated by the heterogeneity we find in the extrapolative component estimated when looking at the sub periods separately, our contribution consists of identifying a time-pattern in the degree of extrapolation in expectation formation mechanisms.

To proceed, we estimate equation (4) for the periods Pre-TZ, TZ and Post-TZ separately. Results are reported in Columns 1-3 of Table 2. A number of conclusions can be reached by looking at these results.

First, both the Akaike Information Criterium (AIC) and the Bayesian Information Criterium (BIC) indicate that estimating the model separately for these three sub-periods fits the data better than pooling.

Second, the estimated effect of the extrapolative component in the expectation formation mechanism is always well determined, and it decreases as we move from the Pre-TZ period to the TZ.

Third, the economic environment variables take the expected sign and are of reasonable magnitudes in most cases, although they tend to be less well-determined, probably due to a smaller sample size used to estimate the models separately for each period. The coefficient on the change in foreign exchange reserves changes sign from the Pre-TZ to the Post-TZ period. This may be related

[19] The size of the coefficients on the ARCH and GARCH terms suggests non-stationarity in the variance, as they add to more than one. This suggests that the system is not stable in the way it absorbs shocks to volatility, which is problematic. We have tried different lag structures in the variance equation, as well as estimated the model using different distributional assumptions for the error term (normal, gaussian and t), but the high coefficients persisted.

to the fact that during the Pre-TZ, Central Bank intervention in the foreign exchange market was relatively common (not only through actual foreign exchange transactions, but also through announcements). Reductions in reserves could have been perceived as an alert that the Central Bank's ability to prevent the currency from depreciating was affected, hence the negative estimate. Instead, the Post-TZ period in which intervention is much less frequent, unsystematic, and the policymakers' concerns are related to the appreciation of the domestic currency, and not the converse, increases in the stock of foreign exchange reserves could be perceived as a signal that the Central Bank is committed to prevent the the currency from appreciating any further.[20] The puzzling result is related to the coefficient on the Real devaluation, which is statistically insignificant. This variable may be capturing the fact that soon after the devaluation of the Real, the Central Bank (BCU) reduced the amplitude of the TZ in an attempt to show commitment to the regime. This could have convinced agents that the BCU was serious about its commitment to the exchange rate regime, which explains the negative coefficient.

When investigating the sign and size of the estimated coefficients on the regressive component of the model, an interesting pattern emerges. While the estimated coefficient is negative for the TZ period, it is positive for the Post-TZ period. It is reasonable to think that only if exchange rates are allowed to some extent to float, one could expect that it converges towards an equilibrium value. If the exchange rate is instead manipulated with other objectives, agents may reasonably expect it to diverge from that equilibrium value. Our results are in line with this interpretation, as the estimated coefficient for the regressive component over the Post-TZ period — when the nominal exchange rate was allowed to float relatively freely — is positive and significant, suggesting that agents expect about 6.5% of the disequilibrium to be corrected per period, on average and *ceteris paribus*.

The estimated coefficient on the adaptive component is not well-determined for the Pre-TZ and Post-TZ periods, although it is statistically significant and negative during the TZ period.

In terms of the diagnostics, the ADF tests on residuals suggest no unit roots are present — although for Pre-TZ the rejection is only at the margin. The tests on ARCH effects on the residuals now suggest no ARCH effects for the periods TZ and Post-TZ. This is reasonable. Over shorter periods, it is more likely that the assumption of a constant variance is upheld by the data. Particularly, given that episode of substantial volatility (the collapse of the target zone regime in 2002) is left out of the sample, for the reasons argued in Section 4. We still report the estimates from ARCH models, and replicate the analysis using GMM, reporting the results in Table 7.[21]

The results reported above suggest that imposing a constant effect of past

[20] For example, on the 10th June 2010, the Ministry of Finance announced that they were going to start intervening in the foreign exchange market to counteract forces towards an appreciation of the currency. The announcement was followed by a the largest daily increase in the exchange rate that had happened in the year. The additions to the stock of foreign reserves of the Central Bank could be seen as a factor that enhances the credibility of the announcement, inducing expectations of further depreciation. This episode is out of our sample, but it is helpful to illustrate our point.

[21] Here again, the estimated coefficients on the ARCH processes in the variance equation are larger than one.

depreciation on expected depreciation as in equation (4) is restrictive. For this case study analysed here, given the number of policy changes, allowing for time variation in the expectation generating mechanism is in order. Surprisingly, the hypothesis of the same expectation generating mechanism prevailing at any time of the sample period has generally been implicit in the literature.[22] Even if there is no explicit change in exchange rate policy, it would be reasonable to think that the true model of exchange rates evolves over time (see, for example, Kaminsky (1993)) and so, one should expect some evolution of the expectation formation mechanisms. To our knowledge, the one exception to be found in the literature is attributable to Prat and Uctum (2007). These authors use a switching-regression framework with stochastic choice of regime, and look at six European currencies, to determine if expectation processes change gradually and smoothly over time. However, little attention seems to be paid to the underlying causes of the switching process.

We allow the degree of extrapolation to vary non-linearly over time by interacting lagged depreciation with a linear, and a quadratic time trend.[23] For these purposes we estimate the following equation:

$$\begin{aligned}\Delta s^e_{t+k} = \quad & \beta_0 + \beta_1 \Delta s_t + \beta_2 Jump_t + \beta_3 Jump_t * \Delta s_t + \beta_4 \Delta s_t * Trend + \beta_5 \Delta s_t * Trend^2 \\ & + \beta_6 ForeError_t + \beta_7 (s^*_t - s_t)/s_t + \mathbf{X_t'} \beta_{\mathbf{8}} + \epsilon_{t+k} \qquad (16)\end{aligned}$$

Then, in order to be able to appreciate the evolution of the extrapolative component without imposing any type of functional form to it, we perform rolling regressions, with a window of 120 observations (10 years), starting at the beginning of our sample period (January 1980). This implies running 247 regressions. We then extract the estimated coefficients of interest as well as their standard errors and plot their evolution over time (and their confidence intervals). This will allow us to assess the validity of the approximation with a quadratic functional form for the evolution of the extrapolative component.[24]

Column (4) of Table (2) reports the results of estimating equation (16) over the whole period. Both the AIC and the BIC reveal substantial improvements in the fit of this model compared to that postulated by equation (4). The marginal effect of lagged depreciation on expectations during periods of tranquility is given by $\beta_1 + \beta_4 * Trend + \beta_5 * Trend^2$. The effect takes an inverted-U shape during this period, starting from 0.5, and tending to zero at the end of the period. The analysis suggest that the maximum is found in the period that goes from $1990m3 - 1993m2$. This is consistent with the beginning of the TZ regime (which started in March 1991 and was publicly announced in June 1992). The point estimate at the midpoint of the period is 0.58. In line with our previous results, our estimates suggest that after extreme exchange rate movements, agents revise expectations upwards by 24%, on average and *ceteris paribus*, while the effect of lagged depreciation gets close to zero.[25] Although not formally explored here, this inverted-U shape pattern in the extrapolative component may be indicative of a

[22]See MacDonald (2000) and Jongen et al. (2008) for reviews on the subject.

[23]We also experimented with a cubic time trend, but both the AIC and the BIC suggested that the quadratic performed better.

[24]Results reported for the rolling regressions correspond to GMM models and not ARCH. This is because convergence could not be achieved for the majority of the 247 regression models run.

[25]At the midpoint of the period, the hypothesis of $(\beta_1 + \beta_4 * Trend + \beta_5 * Trend^2) = -\beta_3$ is actually rejected with 95% confidence. While $(\beta_1 + \beta_4 * Trend + \beta_5 * Trend^2) = 0.58$, $\beta_3 = 0.496$

Table 2: Time-Varying Extrapolating Factor Regressions

Dep.Var: $i - i^{*}$	(1) Pre TZ		(2) TZ		(3) Post-TZ		(4) Whole Per. TV	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Lagged Dep	0.354***	(0.041)	0.177***	(0.041)	0.077***	(0.015)	-1.496***	(0.119)
Lagged Jump	0.117	(0.100)					0.232***	(0.022)
Inter Lagged Jump*Dep	-0.360**	(0.180)					-0.496***	(0.033)
T.V. Extrapol							0.011***	(0.001)
T.V. Extrapol Sq.							-0.000***	(0.000)
Lagged Δ CPI	0.208***	(0.023)	0.158***	(0.027)	0.313***	(0.024)	0.265***	(0.015)
L. Fore Error	-0.062	(0.051)	-0.132**	(0.062)	0.001	(0.013)	-0.016	(0.018)
L.diseq E	0.017	(0.025)	-0.023***	(0.009)	0.065***	(0.006)	-0.035***	(0.008)
Trend Tablita							0.002***	(0.000)
Mexican Debt Crisis							0.003	(0.041)
Forward Contracts BROU							0.005	(0.005)
Forward Contracts BCU							-0.012	(0.008)
Tablita Argentina	0.029	(0.140)					0.095***	(0.015)
Austral Collapse	0.023***	(0.006)					0.040**	(0.019)
Cruzado Collapse	-0.003	(0.004)					0.013***	(0.003)
Cruzeiro Depreciation	0.011	(0.197)					-0.011	(0.032)
Hyper in Argentina	0.015***	(0.003)					0.001	(0.002)
Collor	0.018**	(0.008)					0.019	(5096.624)
Var in Forex Reserves	-0.032***	(0.007)	-0.002	(0.008)	0.020***	(0.006)	-0.013**	(0.006)
Slope TZ to come	-0.002	(0.005)					0.006**	(0.002)
1st SlopeTZ			0.064***	(0.005)			0.004**	(0.002)
2nd SlopeTZ			0.018***	(0.004)			-0.002	(0.003)
3rd SlopeTZ			0.002	(0.003)			-0.008**	(0.003)
4th SlopeTZ			-0.001	(0.003)			0.002	(0.002)
Tequila			0.002	(0.003)			0.021	(4345.545)
Real			0.002	(0.001)			0.004	(0.002)
Argentina			0.052***	(0.005)			0.036***	(0.004)
Constant	0.102***	(0.011)	0.038***	(0.005)	-0.004***	(0.001)	0.016***	(0.002)
ARCH								
L.arch	1.740***	(0.530)	1.097***	(0.378)	1.883***	(0.521)	1.410***	(0.184)
L.garch			0.310**	(0.140)			0.052	(0.038)
Constant	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000***	(0.000)
Observations	119		113		81		345	
AIC	-583.628		-799.586		-577.240		-1854.576	
BIC	-508.592		-728.674		-534.140		-1696.990	
ADF on Res	-2.844		-3.550		-6.042		-6.332	
ARCH LM	25.544		6.091		4.495		-116.722	

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

U shape pattern in the evolution of Central Bank credibility during the Pre-TZ and TZ periods. The coefficients on the economic environment variables exhibit, generally, the expected signs. The size of the estimated coefficients on the slope announcements during the TZ period are as expected, although now only the 1st and 3rd slope are statistically significant. The estimated coefficient on the regressive component suggests that agents expect the exchange rate to diverge away from the equilibrium value, although very slowly (about 1.3% deviation per period). Instead, past inflation of 1% induce an increase in depreciation expectations of about 0.26%, on average. The estimated coefficient on the adaptive component is not statistically significant.

To examine the validity of the quadratic form for the variation over time of the extrapolative component in expectations, in Figure 3 we plot together interval estimate for the time varying effect of lagged depreciation on expectations, together with the evolution of the coefficients on lagged depreciation, obtained from the 247 regressions, when the estimation window of 120 observations was allowed to roll. A number of conclusions can be drawn from this comparison. Firstly, that the interval for the quadratic time varying extrapolative component contains almost all of the relevant coefficients from the rolling regressions, and that the inverted-U shape pattern seems to be common. Secondly, the evolution of the coefficients from the rolling regressions seem to suggest that during the TZ period, the drop in the weight placed on lagged depreciation to form expectations about the future is more pronounced than that estimated when the quadratic functional form is assumed. The reason behind this drop may be related to the fact that the target zone regime became credible soon after it was implemented. The quadratic form does not allow a rapid decrease in that component. Thirdly, the estimated coefficients from the rolling regressions are quite volatile, particularly those calculated from samples that include the turbulent period of 2002. Given the small window considered, the extreme movements in both the dependent and explanatory variables may be very influential in the determination of the estimate. Overall, however, the quadratic time varying factor seems to be a reasonable approximation of how the weight placed on the past depreciation changed over time.

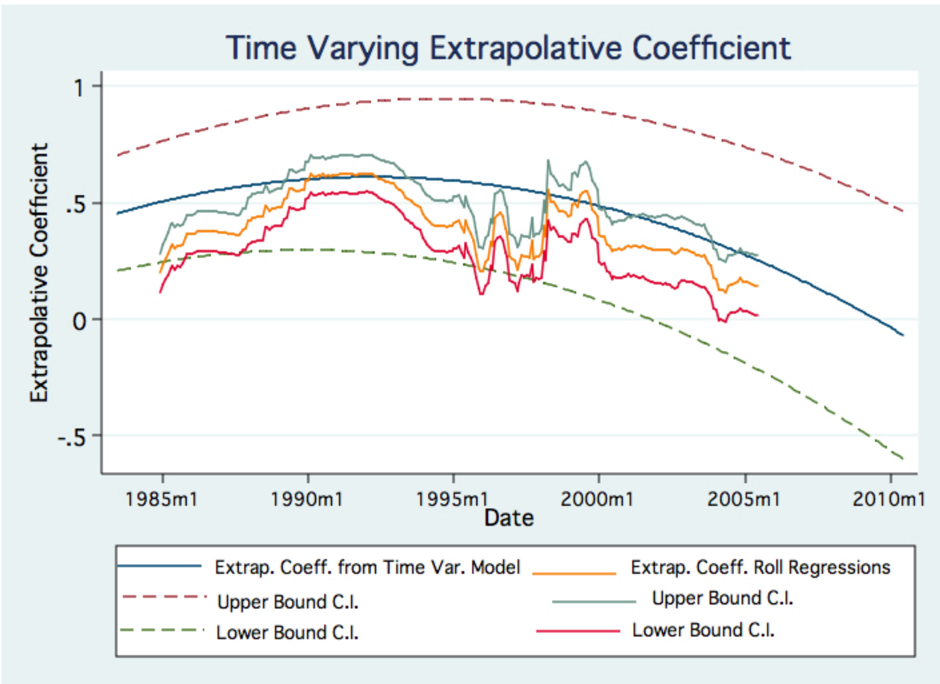

Figure 3: Time Varying Extrapolation Factor for All Period

5 Predictive Power of the Interest Rate Differentials

Having explored what determines the expectation generating mechanism and its evolution, we now turn our attention to RQ5 and investigate how well the interest rate differential performs as a predictor of the future change in the spot exchange rate.

5.1 Estimation Strategy

The 'traditional vehicle' to test unbiasedness of the interest rate differential that is found in the literature is to run some version of the Fama (1984) regression[26], as follows:

$$\Delta s_{t+6} = \gamma_0 + \gamma_1 (i^k_{dc} - i^k_{fc}) + \epsilon_{t+6} \tag{17}$$

where Δs_{t+6} is the ex post future depreciation, defined as $(s_{t+6} - s_t)/s_t$ and $(i^6_{dc} - i^k_{fc})$ is the interest rate differential corresponding to a six-month deposit in domestic and foreign currency respectively, actually defined as: $[(1 + i^6_{dc})/(1 + i^6_{fc}) - 1]$. The null hypothesis to be tested is $\beta = 1$, which implies no systematic time-varying component of the forecast errors: $E(\Delta s_{t+k} - (i^k_{dc} - i^k_{fc})) = \alpha$. This hypothesis is a joint hypothesis of rational expectations plus no time-varying risk premium.[27]

We estimate a model for the period $1980 - 2010$, and then for the sub-periods corresponding to Pre-TZ, TZ and Post-TZ, as done above. The results are presented in Table 8. The scatter plots for the whole period, and for each of the sub-periods are depicted in Figure 4.

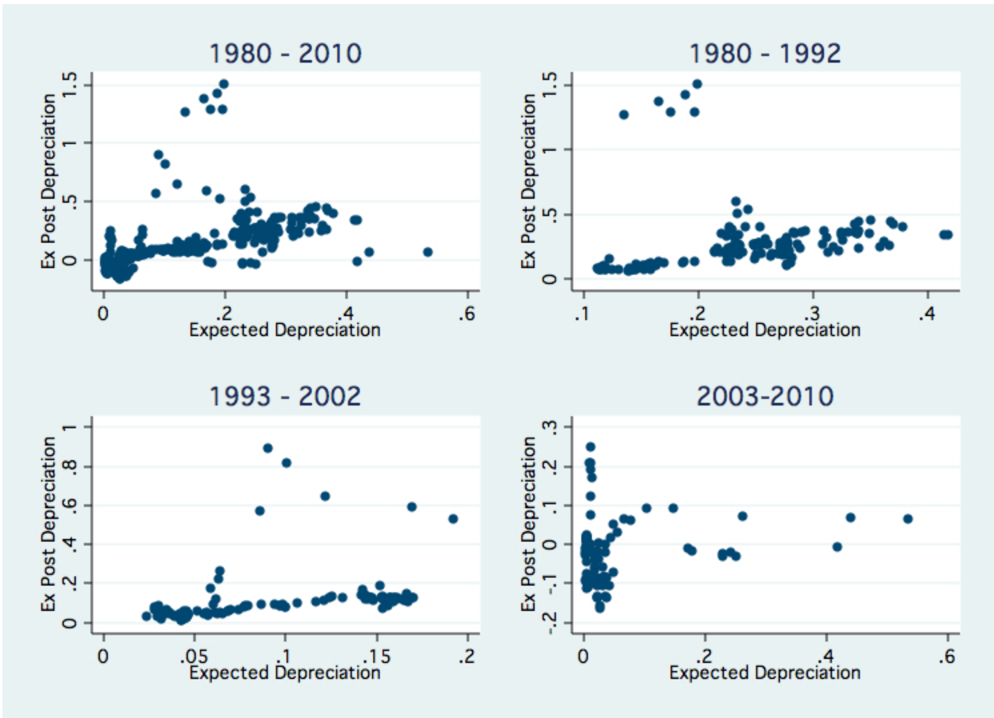

Figure 4: Ex-Post Depreciation on Interest Differential Regression Data

5.2 A Note on the Methodology

5.2.1 Overlapping Observations & ARCH effects

In Section 4.1 we discussed how when the forecast horizon associated with the interest rate differentials (six months) is longer than the data periodicity

[26]This has been widely used in the literature. The most recent example is Frankel and Poonawala (2010), who use the forward premium instead of interest rate differentials.

[27]A second hypothesis that is sometimes tested in the literature jointly with $\gamma_1 = 1$ is $\gamma_0 = 0$, implying no time-invariant bias in the forecast errors. Our focus here is based entirely on γ_1.

(monthly), a problem of overlapping observations arises. The same considerations apply here, and we deal with the problem in the same way. Given the presence of ARCH effects, in addition to the moving average process of order 5, we estimate ARCH models including lags of the first differences of the dependent and independent variables.

5.2.2 Problems with the "Traditional Testing Vehicle"

Moore (1994) argued that the traditional approach used in the literature (and presented in equation (17) above) to test for unbiasedness of the forward premium as a predictor of the ex post depreciation (or that of the interest rate differential) is not generally valid. Its validity relies on a number of restrictive assumptions. The author's argument, invoking the Granger Representation Theorem, is as follows. If the spot and forward rate are two non-stationary and cointegrated variables, then their vector autoregressive representation can be expressed as an error-correction mechanism (ECM) — the cointegrating vector being $\boldsymbol{\beta} = (1, -\beta_1, -\beta_0)$, and the error correction adjustment parameter vector being $\boldsymbol{\alpha} = (\alpha_s, \alpha_f)$. Two related equations are involved here, as in:

$$\begin{aligned}
\Delta S_t &= \alpha_s(S_{t-1} - \beta_1 F_{t-1} - \beta_0) + \sum_{i=1}^{k-1} b_{si}\Delta S_{t-i} + \sum_{i=1}^{k-1} c_{si}\Delta F_{t-i} + \epsilon_{st} \\
\Delta F_t &= \alpha_f(S_{t-1} - \beta_1 F_{t-1} - \beta_0) + \sum_{i=1}^{k-1} b_{fi}\Delta S_{t-i} + \sum_{i=1}^{k-1} c_{fi}\Delta F_{t-i} + \epsilon_{ft} \qquad (18)
\end{aligned}$$

Long run unbiasedness requires, according to the author, cointegration between the spot and the forward rate, with the cointegrating vector being $\boldsymbol{\beta} = (1, -\beta_1 = -1, -\beta_0 = 0)$. In turn, short run unbiasedness requires long run unbiasedness, an ECM adjustment parameter in the spot equation (first one in (18)) equal to -1, and no short run dynamics in the spot equation ($b_{si} = c_{si} = 0$).

Under short run unbiasedness, the forecast error is white noise. This can be seen by imposing the condition of short run unbiasedness on the spot equation of (18). This yields:

$$(S_t - F_{t-1}) = \epsilon_{st} \qquad (19)$$

Johansen (1992) argues that in the context of a cointegrating system (as the one outlined in (18)), the estimation of a single equations (as the one of (17)) generates efficiency losses unless there is one variable that is weakly exogenous. That would be implied if only one equation contains an error-correction term. In the case of interest here, where the dependent variable is ΔS_t, then, the forward rate must be weakly exogenous ($\alpha_f = 0$). If that condition holds, efficient estimates are obtained, as shown by Johansen, from:

$$\Delta S_t = b_0\Delta F_t + \alpha_s(S_{t-1} - \beta_1 F_{t-1} - \beta_0) + \sum_{i=1}^{k-1} b_i\Delta S_{t-i} + \sum_{i=1}^{k-1} c_i\Delta F_{t-i} + \epsilon_t \qquad (20)$$

The parameters in equation (20) are related to those of the spot equation of (18) in the following way: $b_0 = \sigma_{sf}\sigma_{ff}^{-1}$, $b_i = b_{si} - \sigma_{sf}\sigma_{ff}^{-1}b_{fi}$, and $c_i = c_{si} - \sigma_{sf}\sigma_{ff}^{-1}c_{fi}$ (where σ_{ij} are the components of the variance covariance matrix of $(\epsilon_{st}, \epsilon_{ft})$. As argued by Moore (1994), if the errors in the two equations in (18) are uncorrelated, so that $\sigma_{sf} = 0$, then (20) is identical to the spot equation of (18).

The author then re-writes (20) as in (21), to better illustrate the number of restrictions imposed when using the traditional testing vehicle for unbiasedness, presented in equation (17):

$$\begin{aligned} \Delta S_t \;&=\; -\alpha_s\beta_0 - \alpha_s(F_{t-1} - S_{t-1}) + b_0\Delta F_t + \alpha_s(1-\beta_1)F_{t-1} + \\ &\quad + \sum_{i=1}^{k-1} b_i \Delta S_{t-i} + \sum_{i=1}^{k-1} c_i \Delta F_{t-i} + \epsilon_t \end{aligned} \tag{21}$$

Only if $b_0 = 0$, $\beta_1 = 1$, $b_i = 0$ and $c_i = 0$, estimating (17) would be analogous to estimating (21). This leads Moore (1994) to conclude that only if:

(1) spot and forward rates are cointegrated,

(2) the forward rate is weakly exogenous, that is to say, the error correction term in the forward equation is zero, implying that the derivative market is driving the underlying market,

(3) the long run condition of unbiasedness holds (i.e. $\beta_1 = 1$),

(4) the cross-equation covariances are zero and

(5) the lag order of the error correction mechanism is exactly equal to one,

then, the traditional testing method of unbiasedness would be valid.

Because these conditions are of empirical nature, we tested each of them using our dataset for the whole period under consideration, using the Johansen procedure. This allows us to test for long and short run unbiasedness in the foreign exchange market in Uruguay, and to assess the validity of testing unbiasedness using a single equation approach, in the traditional way. Results of this analysis are discussed in Section 5.3.

Then, in Section 5.4 we discuss the results obtained when using the traditional testing vehicle, and comment on the compatibility of both approaches.

5.3 The Validity of the Traditional Testing Vehicle

The validity of the traditional approach relies on five conditions outlined above. We consider each of them in turn, and use a system estimation approach to test for long and short run unbiasedness.

Firstly, we choose the lag structure for the vector autoregression represented by equation (18). This choice was motivated on tests of serial correlation on the residuals. The null hypothesis of serially uncorrelated residuals cannot be rejected when a generous structure of 12 lags is chosen. Different information criteria point in the same direction in terms of the lag order (see Tables 12 and 11). This provides the first piece of evidence casting doubt on the validity of the traditional approach to test unbiasedness of expectations in the Uruguayan foreign exchange market.

Secondly, we test for long run unbiasedness. This implies, to begin with, testing for cointegration between the ex-post spot exchange rate and the expected exchange rate. We find evidence of one cointegrating relationship between these two series, and this finding is robust to the choice of the lag structure. In fact, for any lag order between one and twelve, the null hypothesis of the number of cointegrating vectors being no greater than zero is rejected, while the null of the number of cointegrating vectors being no greater than one cannot be rejected (see Table 10). Further to this, we examine the estimated cointegrating vector. The second part of the long run unbiasedness hypothesis is that $\beta_1 = 1$ and $\beta_0 = 0$. For any lag-length in the interval $[1, 12]$, the hypothesis is rejected. However, β_1 is, from an economic point of view, very close to unity (see Table 14). This suggests a substantial kernel of truth for the uncovered interest parity condition for the case of Uruguay.

Thirdly, we test for weak exogeneity of the expected exchange rate. If the expected exchange rate is weakly exogenous, that would imply that there is no significant rectification of any displacement from long-run equilibrium via changes in the expected exchange rate. We then tested the hypothesis of the error correction adjustment parameter in the equation corresponding to the expected exchange rate, $\alpha_f = 0$. Here again, we test the hypothesis using lag orders in the interval $[1, 12]$ and systematically reject it. In line with previous research done for different currency pairs, such as Moore (1994), and MacDonald and Moore (2001), we cannot reject the null of $\alpha_s = 0$.[28] Conceptually, these results suggest that expectations are not driving the exchange rate movements. Instead, this would be consistent with a world in which agents have some sort of information about what is going to happen with the exchange rate, and form expectations accordingly. For the case of Uruguay over the period considered, this is intuitively appealing, as the market is relatively thin, and the main actor was the Central Bank, whose systematic interventions were largely pre-announced. Methodologically, the rejection of weak exogeneity of the expected exchange rate implies that efficiency losses are incurred when using a single equation approach to test unbiasedness of expectations.[29]

To conclude, evidence suggests, firstly, a strong rejection of short-run unbiasedness — or short run validity of the uncovered interest parity, as defined by Moore (1994). Secondly, although long-run unbiasedness is also rejected, $\hat{\beta}_1$ is from an economic point of view, quite close to unity. Thirdly, that caution should be placed in the interpretation of results emerging from using the traditional testing vehicle for unbiasedness.

5.4 The Traditional Testing Vehicle: Results

The results from the analysis of Section 5.3 suggest that equation (17) is mis-specified. We found it pertinent, however, to proceed and estimate it given that this approach is so widely used in the literature. Frankel, for example, considers the single equation procedure to be a parsimonious way of testing a simple hypothesis.[30] Of course, caution should be placed when interpreting the results.

When estimating (17) we find that during the period $1980m02 - 2010m3$ there has been a statistically significant bias in the expectations contained in the

[28] We can only reject it when the lag order of the VAR is 1, case in which serial correlation is severe.

[29] The condition of the cross-equation uncorrelated errors is also violated.

[30] This was expressed by Jeffrey Frankel in a personal communication, dated on Nov. 7th, 2010.

interest rate differentials, as $\hat{\gamma}_1 < 1$ (Column 1 in Table 8). Given the important extrapolative component in expectations that was found in Section 4, this bias is not surprising. What is remarkable is that the bias is lower than the general finding in the literature for developed countries' currencies ($\hat{\gamma}_1 = 0$, and even negative).[31] Our results are in line with the argument of Frankel and Poonawala (2010) that the bias for emerging economies is lower than that for advanced economies, as currencies in the former group have more easily identifiable trends of depreciation than those in the latter group. Also, Gilmore and Hayashi (2008) report $\hat{\gamma}_1$ in the range of $0.5-1.5$ for Argentinean, Chilean and Brazilian currency markets, and Bansal and Dahlquist (2000) also find lower forward premium biases for emerging economies and argue that the bias is positively correlated with GDP per capita and negatively with average inflation and inflation volatility.

We then investigated whether these findings are stable across the sub-periods defined in Section 4. Column 2 reports results for the Pre-TZ regime (1980 − 1992). Surprisingly, the results imply that expectations move in the opposite direction to actual spot rates. However, a closer look at the scatter plot for this sub-period (top-right panel of Figure 4) suggests that the finding is driven by the large depreciation of the peso in 1982. We exclude the extreme event of 1982, and re-estimate equation (17) for the Pre-TZ period starting in 1983 (Column 3). The rationale for this adjustment is as follows: our sample period starts with a drastic exchange rate movement. It is likely that the internalization of this drastic event has happened earlier, out of our sample, which induces a small-sample bias. This can be thought of as the other side of the coin of the 'peso problem'. Our small sample includes the jump but not the whole of the gradual expectation adjustment that is likely to have taken place before the actual depreciation. After adjusting the sub-period to start in 1983, $(Pre - TZ^*)$, we find a strong co-movement of expectations and spot rates, although the bias in the prediction of the interest rate differential is still statistically significant. Results for the TZ period point to the same direction (Column 4). The period Post-TZ, characterized by a floating exchange rate regime, reveals a different pattern: no significant co-movement is found between expectations and spot rates.[32] These results raise a number of issues.

First, the bias of the interest rate differential as a predictor of exchange rate movements is smaller when looking at the whole sample period, than when looking at a set of sub-periods, separately. This is likely to be related to the 'peso problem'. A bias due to the small-sample used arises if interest rate differentials contain information on a small probability of a big change in the exchange rate that happens out of sample. As argued by Flood and Rose (1996), a sufficiently large sample, with a representative number of actual drastic depreciation will attenuate this bias.[33]

Second, the fact that the bias seems to be larger in the Post-TZ than in

[31] For a survey of the original literature, see Hodrick (1987) and Engel (1996).

[32] We also estimated equation (17) using the Newey-West procedure. Newey-West results are in line with those reported here, and the γ_1 coefficient is always highly significant, with the exception of the one estimated for Post-TZ. It is worth mentioning that because using Newey-West the standard errors are larger, now the 95% confidence interval estimates for γ_1, for the whole period, and the sub-periods Pre-TZ and TZ contain 1. This implies that the null of unbiasedness cannot be rejected.

[33] Of course, there is no guarantee that the 15 drastic movements that we have in our sample are enough to make our sample 'large'.

the Pre-TZ period offers some evidence that the drivers of these results are not related to unidentified time-varying risk premia, but instead are associated with expectational failures. This is because if the risk premium is associated with exchange rate volatility, then, given the record of exchange rate volatility one would expect the risk premium to have been (a) higher, and (b) more volatile during Pre-TZ than Post-TZ. However, the bias is found to be smaller during Pre-TZ than during Post-TZ.

Third, the poor performance of the interest rate differential over the Post-TZ period could be attributed to the fact that with a regime in which there are no announcements from the Central Bank, and in the context of low inflation, predicting exchange rate movements becomes more difficult than during Pre-TZ and TZ. It is worth mentioning that this period is characterised by non-systematic interventions of the Central Bank in the foreign exchange market, and erratic messages from both its board of directors and the government, in terms of exchange rate policy. This introduces uncertainty with respect to the underlying model determining the exchange rate and makes it more complex to predict. One could argue that, of the three sub-periods considered, this one is the one in which the resemblance to a developed currency market is the highest, and so is the finding: the interest rate differential does not predict depreciation at all. It fits the 'forward premium puzzle'.[34] This is in line with previous findings. For example Flood and Taylor (1996), Huisman et al. (1998), Lothian and Wu (2005) and Huisman and Mahieu (2006) find that the larger the interest rate differentials are, the better their predictive power. As argued by (MacDonald, 2007, p. 387), in contexts of low inflation, interest rates reflect liquidity effects, while in environments of high inflation, they will reflect Fisher effects. So, the regression of depreciation on interest rate differentials will show a correctly signed association for the high inflation environment, but a wrongly signed one for the low inflation environment.

An additional explanation related to the 'peso problem' can be found through a close examination of the scatter of ex-post depreciation and the expectations contained in the interest rate differential, reported in the bottom-right panel of Figure 4. Expectations have been predominantly biased upwards. While the interest rate differentials have been systematically positive, actual depreciation alternated between positive (30 periods) and negative (56 periods). Given the history of exchange rate movements in Uruguay, it seems reasonable to attribute a portion of that bias to a perennial discount in the peso, as agents have the perception of a small probability of a large peso depreciation.[35]

[34]This is further evidence that is in line with Frankel and Poonawala (2010). They argue that the bias is larger for developed countries' currencies, and reach this finding by exploiting their panel structure. An analogy can be drawn here. Exploiting the time series structure of our data, we find the bias to be largest when the market most resembles one of a developed economy.

[35]For all periods, the null of no ARCH effects in the residuals is overwhelmingly rejected by the data for all specifications.

Table 3: Ex-Post Depreciation on Interest Rate Differentials Regressions

	(1) All Period		(2) Pre-TZ		(3) Pre-TZ*		(4) TZ		(5) Post-TZ	
D.V. Actual Dep.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Expected Dep.	0.748***	(0.008)	-0.132***	(0.032)	0.723***	(0.032)	0.634***	(0.032)	0.011	(0.285)
Constant	0.004***	(0.001)	0.286***	(0.008)	0.081***	(0.008)	0.019***	(0.003)	-0.026***	(0.010)
ARCH										
L.arch	2.675***	(0.065)	1.892***	(0.168)	1.596***	(0.266)	1.194***	(0.241)	0.713	(0.446)
Constant	0.000***	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000***	(0.000)	0.001***	(0.000)
Observations	357		156		120		120		81	
AIC	-971.122		-292.497		-359.173		-525.847		-213.692	
BIC	-955.611		-280.298		-348.023		-514.697		-204.114	
Arch LM Test	254.2		116.6		65.9		74.9		62.9	
ADF on Residuals	-6.672		-4.504		-4.726		-3.041		-3.601	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, CV for ADF on Res with 2 non-stationary vars. 3.78 at 1%, 3.25, at 5%, 2.98 at 10%
Standard errors in parentheses. C.V. for the Arch LM Test: 3.84.

6 Conclusions

This paper adds to the literature on exchange rate expectation generating mechanisms and the uncovered interest parity testing. The empirical departures from the uncovered interest parity are well-known in the literature, which has mostly focused on developed economies. These departures, in turn, have brought about research on the drivers of expectation generating mechanisms but tend to have ignored that these mechanisms may change over time.

This paper draws upon the Uruguayan case over the period 1980-2010. The Uruguayan case is interesting because during the period it exhibited two distinctive features of emerging economies: a movement from high to low inflation levels, and changes in exchange rate policies. Both features are likely to have a direct bearing on exchange rate expectations formation, and on the correlation between exchange rate changes and the interest rate differentials.

First, this paper explores how much weight agents placed on the past behaviour of exchange rates to form expectations, and what determines that weight. Our contribution is motivated from the conjecture that economic conditions related to exchange rate determination and the degree of inertia in the economy changed significantly during the period. In line with this, we reveal that the extrapolative component associated with expectations changes over time. The identified evolution of the extrapolative component in expectation formation, jointly with our finding that agents internalize in their expectations policy announcements and external events that may affect exchange rate fundamentals, points to some degree of rationality and smooth adaptation to different environments.

We also find, using alternative testing frameworks, that there have been statistically significant departures from the uncovered interest parity over the period. Overall, the prediction bias for the case of Uruguay is significantly lower than that found for developed economies. However, the result is not homogeneous across periods. During Pre-TZ and TZ periods, the prediction of the interest rate differential performs quite well, during the period characterized by a relatively freely floating exchange rate regime — or at least, lack of announcements about target values for the exchange rate — and low inflation, the interest rate differential has no predictive power over the exchange rate movements.

In light of our findings on the drivers of expectations mechanisms, we can claim that as long as what it takes to predict well is rather simple — i.e. look backwards, follow policy announcements, the interest rate differential performs well. However, once the exchange rate determination model becomes intricate, or at least unfamiliar — regimes in which the Central Bank does not pre-announce a target for the exchange rate have not been frequent in Uruguay— agents fail in their attempt to accurately predict exchange rate depreciations. The 'forward premium puzzle' does not seem so puzzling in this case.

Although the focus of this paper is on the Uruguayan economy and this might raise some doubts on the external validity of the results, it offers some interesting insights on the process of adaptation of expectation generating mechanisms, and its implications on agents' forecasting ability across different environments.

However, a few caveats are in order. First, we use interest rate differentials as an indirect measure of expectations. Within those differentials there is a risk-premium. We have argued above why these results are not likely to be driven by the risk premium, though strictly, we would need to use survey data on exchange rate expectations, which unfortunately are not available for Uruguay over the period of analysis. Second, we have not found a way of simultaneously treating the ARCH effects and the non-invertible moving average process in the residuals. The ad-hoc approach used attempted to do so, although this has not proved to be entirely satisfactory. On the one hand, we obtain ARCH estimates exceeding unity in some cases, which violates the stationarity condition for the conditional variance. This is suggesting that the processes are not stable in how they absorb shocks to volatility. On the other hand, there is still some evidence of serial correlation, which led us to re-estimate all models using the Newey-West correction procedures. The results found are in line with those obtained using ARCH models (Newey-West estimates of the key coefficients estimated here also reported here). Finally, it is worth noting that both ARCH models and Newey-West procedures rely on asymptotic properties, while our sample size is relatively modest. For these reasons, the reported estimates of the standard errors should be interpreted with some caution.

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Table 4: Descriptive Statistics on Main Variables

	Depreciation	Expected Depreciation	CPI Inflation
		All Period	
Mean	15.5%	14.6%	16.4%
Std. Dev.	22.0%	11.1%	13.6%
95th Perc..	44.7%	33.7%	38.9%
		Pre-TZ	
Mean	27.9%	24.1%	28.5%
Std. Dev.	24.3%	6.9%	11.1%
95th Perc.	53.6%	35.8%	50.5%
		TZ	
Mean	11.7%	9.2%	10.1%
Std. Dev.	14.3%	5.2%	8.0%
95th Perc.	52.7%	16.7%	23.6%
		Post-TZ	
Mean	-1.8%	5.1%	4.7%
Std. Dev.	8.4%	9.7%	3.7%
95th Perc..	17.3%	25.1%	17.1%
		Tranquil Periods	
Mean	12.2%	14.7%	16.9%
Std. Dev.	13.1%	11.3%	13.7%
95th Perc.	36.4%	33.8%	39.1%
		During Jumps	
Mean	92.3%	12.7%	8.8%
Std. Dev.	38.6%	8.0%	10.0%
95th Perc.	150.3%	23.4%	32.1%
		After Jumps	
Mean	13.2%	30.8%	24.1%
Std. Dev.	8.5%	9.1%	7.9%
95th Perc.	26.8%	53.5%	36.7%

Notes: Variables are measured over a 6-month period.

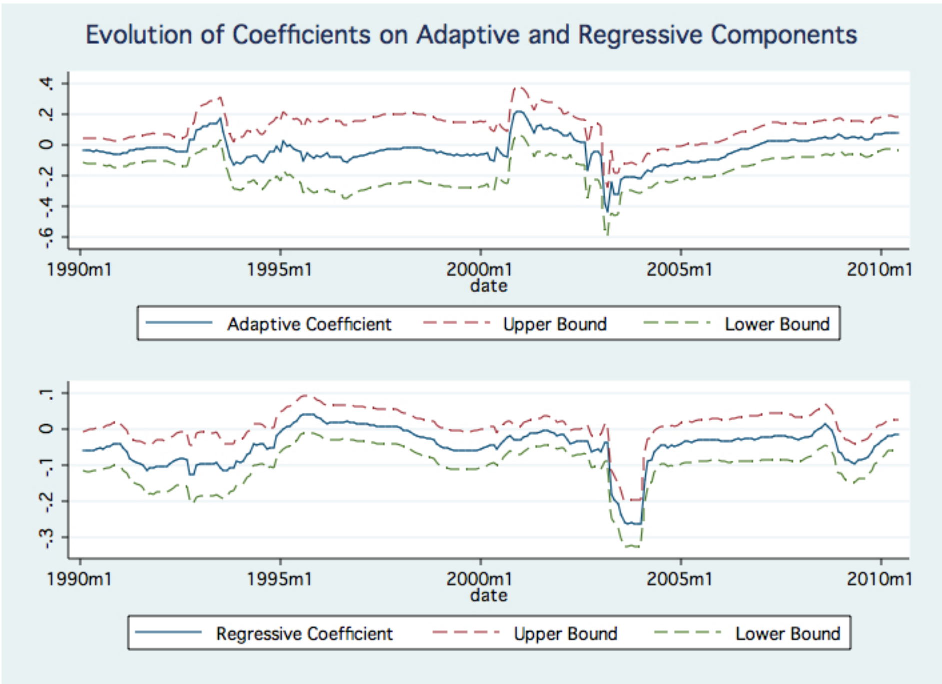

Figure 5: Coefficients of Adaptive and Regressive Components - Rolling Regressions

Table 5: Unit Root Tests on Main Variables

Period	Trend	Lags	Test Stat	CV 1%	CV 5%	CV 10%
Actual Depreciation						
All	No	1	-5.418	-3.452	-2.876	-2.57
All	No	3	-5.555	-3.452	-2.876	-2.57
All	No	6	-2.968	-3.452	-2.876	-2.57
All	No	12	-2.463	-3.452	-2.876	-2.57
All	Yes	1	-6.54	-3.986	-3.426	-3.13
All	Yes	3	-6.95	-3.986	-3.426	-3.13
All	Yes	6	-4.278	-3.986	-3.426	-3.13
Pre TZ	Yes	3	-4.788	-4.023	-3.443	-3.143
Pre TZ	Yes	6	-2.854	-4.024	-3.443	-3.143
Pre TZ	Yes	12	-2.736	-4.026	-3.444	-3.144
TZ	Yes	1	-2.706	-4.035	-3.448	-3.148
TZ	Yes	3	1.046	-4.035	-3.448	-3.148
TZ	Yes	6	0.281	-4.035	-3.448	-3.148
TZ	Yes	12	1.716	-4.035	-3.448	-3.148
Post TZ	Yes	1	-3.279	-4.071	-3.464	-3.158
Post TZ	Yes	3	-2.85	-4.071	-3.464	-3.158
Post TZ	Yes	6	-2.215	-4.071	-3.464	-3.158
Post TZ	Yes	12	-2.034	-4.071	-3.464	-3.158
Interest Rate Differential						
Period	**Trend**	**Lags**	**Test Stat**	**CV 1%**	**CV 5%**	**CV 10%**
All	No	1	-1.641	-3.451	-2.876	-2.57
All	No	3	-1.686	-3.451	-2.876	-2.57
All	No	6	-1.711	-3.452	-2.876	-2.57
All	No	12	-1.523	-3.452	-2.876	-2.57
All	Yes	1	-2.724	-3.986	-3.426	-3.13
All	Yes	3	-2.828	-3.986	-3.426	-3.13
All	Yes	6	-2.91	-3.986	-3.426	-3.13
All	Yes	12	-2.912	-3.986	-3.426	-3.13
Pre TZ	Yes	1	-1.431	-4.022	-3.443	-3.143
Pre TZ	Yes	3	-1.581	-4.023	-3.443	-3.143
Pre TZ	Yes	6	-0.877	-4.024	-3.443	-3.143
Pre TZ	Yes	12	-0.892	-4.026	-3.444	-3.144
TZ	Yes	1	3.782	-4.035	-3.448	-3.148
TZ	Yes	3	3.456	-4.035	-3.448	-3.148
TZ	Yes	6	2.765	-4.035	-3.448	-3.148
TZ	Yes	12	2.773	-4.035	-3.448	-3.148
Post TZ	Yes	1	-2.08	-4.058	-3.458	-3.155
Post TZ	Yes	3	-2.168	-4.058	-3.458	-3.155
Post TZ	Yes	6	-2.425	-4.058	-3.458	-3.155
Post TZ	Yes	12	-2.522	-4.058	-3.458	-3.155

Augmented Dickey-Fuller Test Results Displayed Above. CV stands for Critical Value

Table 6: Newey-West: Expectation Generating Mechanism Regressions

Dep.Var: $i - i^*$	(1) Extrap		(2) MILERA		(3) ADL Extrap	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Lagged Dep	0.704***	(0.030)	0.454***	(0.040)	0.102***	(0.020)
Lagged Jump	0.257***	(0.046)	0.201***	(0.037)	-0.005	(0.021)
Inter Lagged Jump*Dep	-0.620***	(0.057)	-0.367***	(0.057)	-0.019	(0.031)
Trend Tablita	0.001**	(0.001)	0.003***	(0.001)	0.001***	(0.000)
Slope TZ to come	0.028	(0.019)	0.008	(0.014)	-0.004	(0.006)
Mexican Debt Crisis	0.002	(0.034)	0.013	(0.029)	-0.003	(0.020)
Tablita Argentina	-0.021	(0.028)	0.006	(0.023)	-0.059***	(0.015)
Austral Collapse	0.043	(0.028)	0.009	(0.020)	0.000	(0.010)
Cruzado Collapse	0.032	(0.027)	-0.003	(0.019)	0.010	(0.009)
Cruzeiro Depreciation	0.053	(0.039)	-0.005	(0.030)	0.006	(0.019)
Forward Contracts BROU	-0.005	(0.022)	-0.003	(0.016)	-0.010	(0.007)
Forward Contracts BCU	-0.012	(0.031)	-0.020	(0.023)	-0.022*	(0.013)
Hyper in Argentina	0.041**	(0.020)	0.021	(0.014)	0.013**	(0.006)
Collor	-0.036	(0.037)	-0.012	(0.031)	0.003	(0.020)
1st SlopeTZ	0.012	(0.012)	0.021**	(0.010)	0.002	(0.003)
2nd SlopeTZ	-0.031*	(0.019)	0.011	(0.014)	-0.007	(0.005)
3rd SlopeTZ	-0.039**	(0.020)	0.006	(0.015)	-0.007	(0.006)
4th SlopeTZ	-0.022	(0.017)	0.006	(0.012)	-0.005	(0.005)
Tequila	0.011	(0.038)	0.023	(0.030)	0.013	(0.019)
Real	-0.022	(0.017)	0.015	(0.013)	-0.000	(0.005)
Argentina	-0.009	(0.029)	0.036*	(0.021)	0.015	(0.009)
Var in Forex Reserves	0.028*	(0.016)	0.016	(0.014)	-0.007	(0.009)
Lagged Δ CPI			0.249***	(0.043)		
L. Fore Error			0.130***	(0.043)		
L. Diseq E			-0.122***	(0.027)		
L. Actual Dev					0.060***	(0.018)
L2. Actual Dev					-0.038***	(0.013)
L.Expected Depreciation					0.712***	(0.053)
L2.Expected Depreciation					0.314***	(0.067)
L3.Expected Depreciation					-0.424***	(0.065)
L4.Expected Depreciation					0.161**	(0.066)
L5.Expected Depreciation					0.233***	(0.063)
L6.Expected Depreciation					-0.164***	(0.049)
Constant	0.050***	(0.007)	0.031***	(0.006)	0.006***	(0.002)
Observations	351		345		351	
AIC	-1218.887		-1357.233		-1720.353	
BIC	-1091.481		-1218.866		-1585.226	
ADF on Res	-6.275		-7.773		-13.025	

Standard errors in parentheses. CV for ADF on Res with 2 non-stationary vars. 3.78 at 1%, 3.25, at 5%, 2.98 at 10%
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Newey-West Time-Varying Extrapolating Factor Regressions

Dep.Var: $i - i^{*}$	(1) Pre TZ		(2) TZ		(3) Post-TZ		(4) Whole Per. TV	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Lagged Dep	0.426***	(0.061)	0.253***	(0.053)	0.137***	(0.041)	-2.134***	(0.326)
Lagged Jump	0.178***	(0.044)					0.133***	(0.036)
Inter Lagged Jump*Dep	-0.459***	(0.081)					-0.280***	(0.056)
Lagged Δ CPI	0.211***	(0.039)	0.220***	(0.053)	0.436***	(0.110)	0.107**	(0.043)
L. Fore Error	0.103	(0.085)	0.041	(0.089)	0.081**	(0.033)	0.043	(0.039)
L. Diseq E	-0.097	(0.067)	-0.037	(0.023)	0.003	(0.015)	-0.122***	(0.024)
Slope TZ to come	0.003	(0.011)					-0.006	(0.012)
Tablita Argentina	0.105**	(0.044)					0.033	(0.021)
Austral Collapse	0.009	(0.015)					0.029	(0.018)
Cruzado Collapse	-0.010	(0.014)					0.015	(0.017)
Cruzeiro Depreciation	-0.015	(0.020)					-0.013	(0.026)
Hyper in Argentina	0.013	(0.010)					0.006	(0.012)
Collor	0.008	(0.022)					-0.030	(0.026)
Var in Forex Reserves	-0.028**	(0.014)	-0.018	(0.012)	0.015	(0.016)	0.030**	(0.012)
1st SlopeTZ			0.041***	(0.009)			0.016*	(0.009)
2nd SlopeTZ			0.018**	(0.007)			-0.005	(0.013)
3rd SlopeTZ			0.000	(0.006)			-0.004	(0.013)
4th SlopeTZ			-0.002	(0.004)			0.001	(0.011)
Tequila			0.008	(0.008)			0.017	(0.026)
Real			-0.002	(0.003)			0.011	(0.011)
Argentina			0.032***	(0.006)			0.028	(0.018)
T.V. Extrapol							0.014***	(0.002)
T.V. Extrapol Sq.							-0.000***	(0.000)
Trend Tablita							0.004***	(0.001)
Mexican Debt Crisis							0.014	(0.025)
Forward Contracts BROU							0.021	(0.014)
Forward Contracts BCU							-0.005	(0.020)
Constant	0.063***	(0.019)	0.038***	(0.010)	-0.003	(0.004)	0.035***	(0.005)
Observations	119		113		81		345	
AIC	-539.131		-760.972		-501.504		-1456.860	
BIC	-469.653		-698.242		-463.193		-1310.805	
ADF on Res	-4.956		-4.229		-3.969		-7.707	

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Newey-West Results on Expectations' Hypotheses

Dep. Var.: $i - i^*$	**All Period**		**Pre-TZ**		**TZ**		**Post-TZ**	
Table 1	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Lagged Dep.	0.703***	(23.48)	0.528***	(8.45)	0.393***	(6.54)	0.180***	(5.48)
Lagged Jump	0.250***	(5.52)	0.202***	(4.79)				
Lagged Jump*Dep.	-0.612***	(-10.80)	-0.557***	(-7.88)				
Table 2								
Lagged Dep.	-2.721***	(-8.10)	-0.500***	(-3.83)	1.029***	(2.76)	4.534***	(9.10)
Lagged Jump	0.177***	(4.58)	0.114***	(3.64)				
Lagged Jump*Dep.	-0.426***	(-8.10)	-0.268***	(-4.58)				
T.V. Extrapol	0.0179***	(10.44)	0.00277***	(8.04)	-0.00143*	(-1.74)	-0.00748***	(-7.97)
T.V. Extrapol Sq.	-0.0000219***	(-10.63)						
Table 3								
Lagged Dep.	0.596***	(16.72)	0.426***	(7.33)	0.331***	(5.35)	0.242***	(3.43)
Lagged Jump	0.207***	(4.72)	0.153***	(3.86)				
Lagged Jump*Dep.	-0.495***	(-8.40)	-0.447***	(-6.72)				
Lagged Inflation*Dep.	2.453***	(4.56)	1.511***	(4.16)	3.447***	(2.58)	29.14***	(5.34)

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Newey-West Results on the Unbiasedness Hypothesis

Dep. Var.: Δs	**All Period**		**Pre-TZ**		**TZ**		**Post-TZ**	
Table 4	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Actual Depreciation	0.969***	(5.62)	0.758***	(2.74)	0.967**	(2.02)	0.138	(0.86)
Constant	0.0121	(0.38)	0.0681	(0.90)	0.0275	(0.54)	-0.0256	(-1.31)
Observations	357		120		114		86	
AIC	-162.6		-252.1		-130.7		-181.3	
BIC	-154.9		-246.6		-125.2		-176.4	

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Trace Test for Cointegration Rank

Lags VECM	Max Rank	Parms	LL	Trace Stat	Crit. Val.
1	0	2	-695.230	70.288	15.41
	1	5	-660.387	0.600	3.76
2	0	6	-596.810	86.031	15.41
	1	9	-554.259	0.929	3.76
3	0	10	-582.578	88.932	15.41
	1	13	-538.377	0.531	3.76
4	0	14	-571.298	98.650	15.41
	1	17	-522.299	0.653	3.76
5	0	18	-553.729	156.965	15.41
	1	21	-475.517	0.541	3.76
6	0	22	-486.736	102.931	15.41
	1	25	-435.586	0.631	3.76
7	0	26	-357.183	36.983	15.41
	1	29	-339.183	0.984	3.76
8	0	30	-293.360	68.535	15.41
	1	33	-259.721	1.257	3.76
9	0	34	-262.241	38.650	15.41
	1	37	-243.558	1.285	3.76
10	0	38	-255.553	51.058	15.41
	1	41	-230.593	1.138	3.76
11	0	42	-251.784	50.062	15.41
	1	45	-227.256	1.007	3.76
12	0	46	-232.636	53.187	15.41
	1	49	-206.392	0.699	3.76

Table 11: Information Criteria for Determination of Lag Order

Lags	LL	LR	df	P-Value	FPE	AIC	HQIC	SBIC
0	-2024.57				433.758	11.748	11.757	11.771
1	-650.429	2748.3	4	0.000	0.154	3.805	3.832	3.872
2	-547.997	204.86	4	0.000	0.087	3.235	3.279	3.346
3	-533.26	29.474	4	0.000	0.082	3.173	3.235	3.328
4	-518.003	30.514	4	0.000	0.077	3.107	3.187	3.308
5	-472.683	90.64	4	0.000	0.060	2.868	2.965	3.113
6	-433.741	77.884	4	0.000	0.049	2.665	2.781	2.955
7	-338.787	189.91	4	0.000	0.029	2.138	2.271	2.472
8	-260.073	157.43	4	0.000	0.019	1.705	1.856	2.084
9	-243.79	32.567	4	0.000	0.018	1.634	1.802	2.057
10	-230.681	26.218	4	0.000	0.017	1.581	1.767	2.049
11	-227.09	7.1828	4	0.127	0.017	1.583	1.787	2.096
12	-206.043	42.095	4	0.000	0.015	1.484	1.706	2.041

Table 12: Serial Correlation Criteria for Determination of Lag Order

Lags VECM	Lags in Test	Chi2	DofF	P-Value
1	1	30.465	4	0.000
	2	39.370	4	0.000
	3	37.625	4	0.000
	4	102.124	4	0.000
	5	35.234	4	0.000
2	1	30.147	4	0.000
	2	19.091	4	0.001
	3	63.395	4	0.000
	4	107.869	4	0.000
	5	15.979	4	0.003
3	1	30.400	4	0.000
	2	39.331	4	0.000
	3	37.638	4	0.000
	4	102.043	4	0.000
	5	35.260	4	0.000
4	1	89.437	4	0
	2	20.619	4	0.0004
	3	52.458	4	0.000
	4	133.492	4	0.000
	5	20.521	4	0.0004
5	1	75.836	4	0.000
	2	177.733	4	0.000
	3	130.787	4	0.000
	4	33.967	4	0.000
	5	63.294	4	0.000
6	1	183.944	4	0.000
	2	261.372	4	0.000
	3	84.496	4	0.000
	4	15.404	4	0.004
	5	32.493	4	0.000
7	1	150.680	4	0.000
	2	7.206	4	0.125
	3	31.019	4	0.000
	4	30.407	4	0.000
	5	66.865	4	0.000
8	1	31.097	4	0.000
	2	46.080	4	0.000
	3	10.355	4	0.035
	4	6.382	4	0.172
	5	23.969	4	0.000
9	1	24.844	4	0.000
	2	17.122	4	0.002
	3	9.032	4	0.060
	4	10.190	4	0.037
	5	26.617	4	0.000
10	1	6.874	4	0.143
	2	16.972	4	0.002
	3	13.662	4	0.008
	4	11.764	4	0.019
	5	7.297	4	0.121
11	1	39.197	4	0.000
	2	7.851	4	0.097
	3	14.444	4	0.006
	4	19.421	4	0.001
	5	7.222	4	0.125
12	1	15.264	4	0.004
	2	5.401	4	0.249
	3	6.798	4	0.147
	4	6.463	4	0.167
	5	2.188	4	0.701

Table 13: Weak Exogeneity Tests

Lags	Equation	Coefficient	S.E.	t-stat	P-Value	Lower Bound	Upper Bound
1	Forward Eq	-0.162	0.021	-7.77	0	-0.202	-0.121
	Spot Eq.	-0.049	0.012	-4.08	0	-0.073	-0.026
2	Forward Eq	-0.193	0.020	-9.74	0	-0.232	-0.154
	Spot Eq.	-0.002	0.012	-0.17	0.864	-0.025	0.021
3	Forward Eq	-0.220	0.022	-9.92	0	-0.263	-0.176
	Spot Eq.	-0.0003	0.013	-0.02	0.983	-0.025	0.025
4	Forward Eq	-0.254	0.024	-10.5	0	-0.301	-0.207
	Spot Eq.	-0.001	0.015	-0.07	0.947	-0.029	0.028
5	Forward Eq	-0.342	0.025	-13.49	0	-0.392	-0.292
	Spot Eq.	0.033	0.016	2.06	0.04	0.002	0.065
6	Forward Eq	-0.292	0.029	-10.23	0	-0.348	-0.236
	Spot Eq.	0.046	0.020	2.26	0.024	0.006	0.086
7	Forward Eq	-0.142	0.025	-5.62	0	-0.191	-0.092
	Spot Eq.	0.034	0.024	1.46	0.145	-0.012	0.081
8	Forward Eq	-0.163	0.021	-7.64	0	-0.205	-0.121
	Spot Eq.	0.042	0.024	1.74	0.082	-0.005	0.090
9	Forward Eq	-0.129	0.023	-5.59	0	-0.174	-0.083
	Spot Eq.	0.027	0.027	0.98	0.328	-0.027	0.080
10	Forward Eq	-0.163	0.024	-6.92	0	-0.209	-0.117
	Spot Eq.	0.001	0.028	0.04	0.97	-0.054	0.056
11	Forward Eq	-0.167	0.025	-6.58	0	-0.217	-0.118
	Spot Eq.	0.026	0.030	0.87	0.384	-0.033	0.086
12	Forward Eq	-0.181	0.026	-6.96	0	-0.232	-0.130
	Spot Eq.	0.017	0.033	0.52	0.6	-0.047	0.081

Table 14: Cointegration Coefficient

Lags in VECM	Coeff.	S.E.	t-stat	P-Value	Upper Bound	Lower Bound
1	0.944	0.021	45.100	0.000	0.985	0.903
2	0.947	0.017	55.310	0.000	0.981	0.914
3	0.946	0.015	63.330	0.000	0.975	0.917
4	0.943	0.012	75.650	0.000	0.968	0.919
5	0.944	0.008	114.120	0.000	0.961	0.928
6	0.948	0.009	110.140	0.000	0.965	0.931
7	0.956	0.013	71.180	0.000	0.982	0.930
8	0.965	0.009	102.170	0.000	0.984	0.947
9	0.962	0.012	81.460	0.000	0.985	0.939
10	0.964	0.010	98.970	0.000	0.983	0.945
11	0.963	0.009	104.360	0.000	0.981	0.945
12	0.959	0.008	115.580	0.000	0.975	0.943