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Pablo Pincheira B. Jorge Selaive C.

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Agustinas 1180
Teléfono: (56-2) 6702475; Fax: (56-2) 6702231

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EXTERNAL IMBALANCES, VALUATION ADJUSTMENTS AND REAL EXCHANGE RATE: EVIDENCE OF PREDICTABILITY IN AN EMERGING ECONOMY

Jorge Selaive C.
Banco Central de Chile

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Resumen

En este trabajo evaluamos la habilidad de una medida de desbalance externo, que combina el canal de comercio y el financiero, para predecir el tipo de cambio real en Chile. Utilizando una base de datos que contiene los activos y pasivos externos en frecuencia trimestral desde 1983 a 2005, y empleando recientes *tests* de habilidad predictiva fuera de muestra, mostramos que nuestra medida de desbalance externo es capaz de predecir el tipo de cambio real en horizontes de hasta 2 años. La evidencia de predictibilidad tiende a ser más fuerte en la medida que se amplía la ventana de estimación de los parámetros. Esto es probablemente producto de la mayor importancia relativa del desbalance externo en la dinámica del tipo de cambio en los últimos años, o de la creciente precisión en la estimación de los parámetros al aumentar el tamaño muestral. Cuando evaluamos los tres componentes de la medida de desbalance externo: razón exportaciones a importaciones, exportaciones a activos y activos a pasivos, encontramos que la capacidad predictiva fuera de muestra es principalmente explicada por los dos últimos cuocientes.

Abstract

We evaluate the ability of a measure of external imbalances that combines the trade and the financial channels to forecast the real effective exchange rate for Chile. By making use of a quarterly database of external assets and liabilities for the period 1983 to 2005, and employing a recently developed test of out-of-sample predictive ability, we show that this measure is able to predict the real exchange rate at horizons of up to 2 years. Out-of-sample evidence of predictability tends to get stronger as the size of the window used to estimate the parameters increases. This is probably because of the greater relative importance of the external balance in the dynamics of the exchange rate in the last few years, or because of the increasing precision of parameter estimates with the sample size. When we break down our measure of external imbalances into its three components: exports to imports ratio, exports to assets ratio and assets to liabilities ratio, we find that out-of-sample predictability is mainly driven by the last two ratios.

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I. Introduction

Recent research has found that current account deficits and the associated net financial inflows are not the only factors that play a role in the evolution of the International Investment Position (IIP). In particular, changes in asset prices and especially in exchange rates affect the stock of assets and liabilities that make up the IIP (Lane and Milesi-Ferreti, LMF, 2005). The growing importance of these factors has been documented for emerging market economies in the last few years. The volume of both gross assets and liabilities has increased sharply; as a result, asset prices and exchange rate fluctuations have generated larger capital gains and losses. This variation of the stock of assets and liabilities associated with unrealized capital gains – triggered by changes in asset prices and exchange rates – have been referred as valuation adjustments.

On the other hand, since the influential papers of Meese and Rogoff (1983a, 1983b) there has been considerable literature which claims that one should not expect much exchange rate predictability with fundamentals. That view has been controversial and puzzling for researchers and policymakers who have continued developing models that investigate the role of new models and use new out-of-sample tests with improved small sample properties. Important contributions in this regard are Clarida and Taylor (1997), Clarida et. al (2003), Clark and West (2006, 2007) and McCraken (2007), among many others.

In a recent paper, Gourinchas and Rey (2005) have shown that *multilateral* real dollar exchange rates are well predicted by a measure of external imbalances that takes into account the trade and financial channels in the external adjustment.[2] The intuition behind the linkage between external assets and the real exchange rate can be found in the so called *transfer problem,* which has the central prediction that the wealth effects and international investment income flows associated with nonzero net foreign asset positions require some degree of real-exchange-rate adjustment in the long run. Even though the short-run co movement between net foreign assets and the real exchange rate depends on the underlying shock, several approaches predict that real appreciations should be associated with accumulation of net foreign assets in the long run. Countries with large external liabilities need to run large trade surpluses in order to service them, and achieving these trade surpluses requires a more depreciated level of the real exchange rate (Lane and Milesi-Ferretti, 2004).

Gourinchas and Rey find that at a one quarter horizon, 11% of the variance of exchange rate is predicted, while for one and three years ahead, 44% and 61% of the variance is predicted. Specifically, they statistically outperform a random walk in an out-of-sample exercise at all horizons between one to twelve quarters ahead, providing relevant evidence that overturn the seminal result of Meese and Rogoff (1983a, 1983b). The financial channel –in addition to the traditional trade channel - is the natural implication of an intertemporal budget constraint that allows for valuation changes in foreign assets and liabilities.

[2] Gourinchas and Rey's approach builds on Lettau and Ludvigson (2001) on the implication of the consumption-wealth ratio for predicting future equity returns. Similarly, Selaive and Tuesta (2005) show theoretical reasons to expect exchange rate predictability using this ratio, and they present forecasting evidence in that direction.

Basically, the change in a country's net foreign asset position need not equal its current account as we mentioned previously. The reason is that the current account does not track unrealized capital gains arising from local and foreign asset prices and currency movements. This valuation effects equal the capital gain on the net foreign asset portfolio – the total net return minus income –, dividends, and earnings distributed.[3] Gourinchas and Rey provide a detailed account of the foreign investment position of the US. They report yields across different types of assets and liabilities, identify the impact of a depreciation of the dollar on different yields, and discuss the channels through which the exchange rate facilitates the adjustment.[4]

Following this line of research, in this work we examine the ability of a measure of external imbalances –and its components - to predict the Chilean real effective exchange rate (RER). Our evidence highlights that a measure of external imbalances that combines the trade and the financial channel contains useful information to predict the Chilean RER at horizons of up to 2 years. We observe promising out-of-sample predictability, and systematic evidence of predictability increasing with the size of the window used to estimate the parameters of the models. This is probably because the external balance of the economy has turned out to be more relevant in the dynamics of the exchange rate in the last few years and/or estimates of the parameters may become more precise as the size of the estimation window increases. When we break down our measure of external imbalances into its three components: exports to imports ratio, exports to assets ratio and assets to liabilities ratio, we find that out-of-sample predictability is mainly driven by the last two ratios.

For our analysis we employ a unique database for Chile that covers the period 1983-2005 at quarterly frequency. This database, especially prepared for Chile, differs from LMF´s in the frequency of components of the external position.[5]

Finally, as another case of an emerging market economy, we would like to mention that Pan (2006) has found that the valuation adjustment channel is less relevant than the trade channel in South Korea.

The next section explains the measure of external imbalances and the data used in the forecasting exercises. The third and fourth sections present the forecasting exercises. The last section concludes.

II. A Measure of External Imbalance with a Role for Valuation Adjustments

A modeling approach for combining the trade and valuation channel has been proposed by Gourinchas and Rey (2005), Alquist and Chinn (2006) and LMF (2005). They derive the

[3] See De Gregorio (2005) for the implications of valuation adjustments in an emerging market economy, and related policy implications.
[4] Tille (2003) explores the relative importance of asset price changes and exchange rate changes for valuation adjustments. He finds that between 1999 and 2001 valuation adjustments were responsible for 37% of the worsening of the U.S NIIP.
[5] Pistelli, Selaive and Valdés (2005) make use of LMF´s database to explore the role of assets, liabilities and valuation adjustments in sudden stops, currency crises and speculative attacks.

following expression for net portfolio return, *ret*, which combines market and exchange rate induced valuation effects:

$$ret_t = \alpha + \beta nxa_{t-1} + Z_{t-1}\Theta + \varepsilon_t \quad (2)$$

where *Z* is a set of control variables, and

$$nxa = \left|\frac{\mu_m}{\mu_x}\right| xm + \left|\frac{\mu_l}{\mu_x}\right| al + \frac{1}{|\mu_x|} xa,$$

where the μ's are normalized weights; *xm* is the deviation from trend of net exports; *al* is the deviation from trend of net assets and *xa* is the deviation from trend of exports to assets. These vectors are estimated as the residuals of a cointegrating relationship between exports and imports (*xm*), assets and liabilities (*al*) and exports and assets (*xa*). Gourinchas and Rey use Stock and Watson´s (1993) dynamic least square technique and estimate single OLS regressions that include leads and lags of the changes in the dependent variable.

The normalized weights μ_x and μ_m correspond to the relative importance of exports and imports in the trade balance in steady state. On the other hand, μ_a and μ_l have similar definitions for assets and liabilities in the net external position. Based on stationarity assumptions of the ratio of assets, liabilities, export and imports over household wealth in US, Gourinchas and Rey define:

$$\mu_x = \frac{\mu_{xw}}{\mu_{xw} - \mu_{mw}}; \mu_x = \mu_m + 1,$$
$$and \quad (3)$$
$$\mu_a = \frac{\mu_{aw}}{\mu_{aw} - \mu_{lw}}; \mu_a = \mu_l + 1,$$

Where μ_{iw} is the ratio of i = exports, imports, assets, liabilities, over household wealth.

In this context, *nxa* can be interpreted as: "approximately the percentage increase in exports necessary to restore external balance (i.e., compensate for the deviation from trend of the net exports to net foreign asset ratio)." (Gourinchas and Rey, 2005).

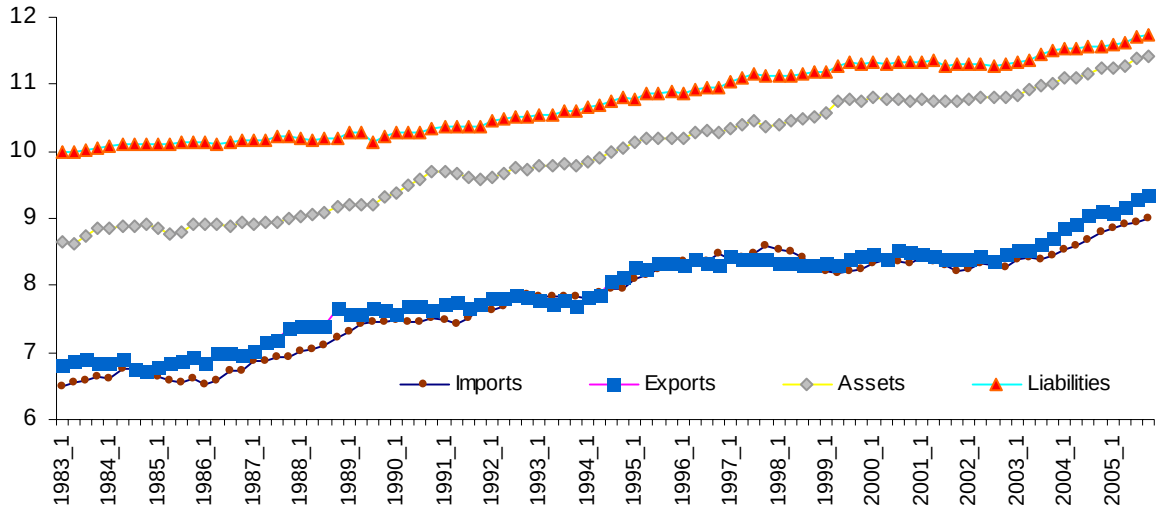
Based on Gourinchas and Rey´s approach we construct a variable similar to *nxa* to carry out inference on predictability for the RER at several horizons. To do so, the database used in this work is a compilation and recalculation of the stocks and flows of the main components of the IIP of Chile for the period 1983-2005 at quarterly frequency.

Figure 1 plots the series that are used as building blocks in the approach that we follow. This picture illustrates the increasing trend in assets and liabilities in line with the associated flows of imports and exports. From this picture, we observe an increasing

international financial integration of the Chilean economy during the last decades. In fact, external assets as a percentage of GDP have increased from 48% in 1990 to 80% in 2005. On other hand, external liabilities were 1.2 times GDP in 2005.

Figure 1. Imports, exports assets and liabilities: 1983.1-2005.4

(Natural log of number in millions of USD)



Source: Authors´ calculations

For Chile, the calibration of the normalized weights used by Gourinchas and Rey is not straightforward. There is no time-series information on household wealth. On the other hand, to use average shares of exports, imports, gross foreign assets and liabilities relative to other denominators may be either arbitrary or may have the problem of estimating steady state variables from a short period of time.[6] In this context, we take a different –more statistic- methodological approach which is to combine the vectors *xm*, *al* and *xa* using weights associated to their principal component. By doing so, we acknowledge that the economic interpretation of this variable may differ from that given by Gourinchas and Rey.

Specifically, we define the variable NXAP and its real time variant $NXAP^R$, as follows,

$$NXAP = \lambda_1 xm + \lambda_2 la + \lambda_3 xa$$
$$NXAP^R = \lambda_1^R xm^R + \lambda_2^R la^R + \lambda_3^R xa^R$$

where the λ´s correspond to the coefficients associated to the principal component of the vectors *xm*, *la* and *xa*.[7] The difference between NXAP and $NXAP^R$ is given only by the definition of the information set at the moment of prediction: $NXAP^R$ is a real time variable, meaning that it is built using estimates of the required cointegrating relationships

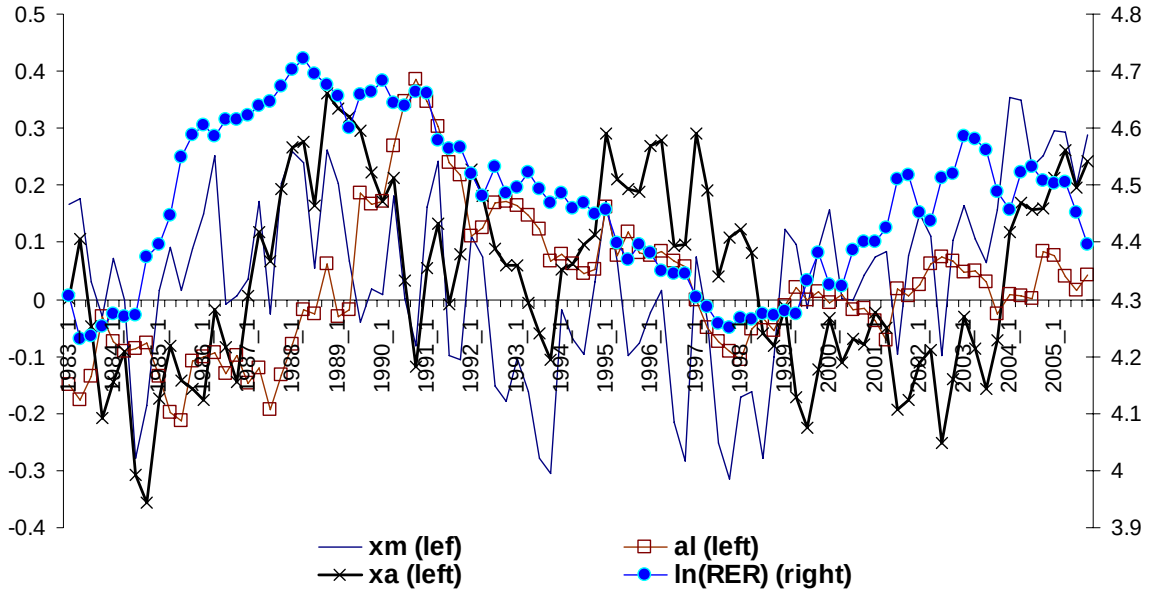
[6] Pan (2006) uses the gross national income instead of household wealth.
[7] Principal components analysis has been used extensively in the financial and economic literature. See Flury (1988).

and principal components weights with information available just at the moment of prediction (that is to say, with information of the last R available observations and up to time *t*). NXAP is built in the same fashion as $NXAP^R$ but using the full sample information for the estimation of the required cointegrating relationships and principal components weights. Predictive exercises with $NXAP^R$ are called out-of-sample, whereas exercises with NXAP are called pseudo out-of-sample.[8]

Figure 2 shows the Chilean real effective exchange rate and our estimates of the three vectors *xm*, *la* and *xa*. We observe that the three series commove with the RER, yet show higher variability[9].

Figure 2. Residual Cointegrating Vectors and RER

(estimated with full sample, 1983.I-2005.IV)



Source: Authors´ calculations and Gourinchas and Rey (2005)

We also evaluate that ability that each component of $NXAP^R$ has to predict the real effective exchange rate in Chile. This is done to identify the vectors which are driving the predictive ability of NXAP and $NXAP^R$. We notice that Pan (2006) examines the role of the trade and financial channel separately, associating the predictive ability of *xm* to the former channel.

[8] Unfortunately, we do not have real time vintages of the variables, so we work with revised data.

[9] Effective Real Exchange Rate is defined as domestic relative to foreign prices. We reject the null of a unit root for all estimated residuals of the cointegrating relationships at a 10% percent significance level, which supports our assumption of stationarity for these residuals.

In a nutshell, we have a measure of external imbalances that we have called NXAP, derived following Gourinchas and Rey in combination with a principal components analysis. In the next section we evaluate the ability of the aforementioned measure of external imbalances and its components to predict changes in the Chilean RER.

III. Econometric Setup

We use an econometric set up based on Mark (1995) and very similar to that in Gourinchas and Rey (2005) and Clark and West (2006, 2007).

In our forecasting exercise we compare the predictive ability that our measure of external imbalances has to forecast RER returns at different horizons. We compare this predictive ability against three simple benchmarks: A driftless random walk, a random walk with drift and an AR(1) with drift . We also evaluate the ability of the components of our measure of external imbalances to forecast the Chilean RER. More formally we have

$$H_A: \quad RERR_{t+k} = \alpha_k + \beta_k x_t + \varepsilon_{t,t+k} \qquad (4)$$

$$H_{01}: \quad RERR_{t+k} = \varepsilon_{1t+1,t+k} \qquad (5)$$

$$H_{02}: \quad RERR_{t+k} = \alpha_k + \varepsilon_{2t+1,t+k} \qquad (6)$$

$$H_{03}: \quad RERR_{t+k} = \lambda_k + \gamma R_t + \varepsilon_{3t+1,t+k} \qquad (7)$$

where $RERR_t$ represents the quarterly change in the logarithm of the Chilean RER at time t, $\varepsilon_{it+1,t+k}$, i=1,..3 and $\varepsilon_{t+1,t+k}$ are random perturbations uncorrelated with information available previous to time t and x_t represents a predictor.

Initially we have $T+2 = 92$ observations of the RER at quarterly frequency ranging from 1983Q1 until 2005Q4. We drop one observation to evaluate predictability against an AR(1) model so we end up with 91 available observations. We evaluate predictability of RER returns at 8 forecasting horizons: *1* to 8 quarters ahead. Therefore the series of RER returns k step ahead contains $T+1-k$ observations. We estimate equations *(4), (6) and (7)* by rolling[10] OLS, so we split the full sample in an estimation window of size R-k and a predictive window of size $T+2-k-R$.

We carry out exercises of out-of-sample inference about predictive ability comparing model (4) to model (5), model (4) to model (6) and model (4) to model (7).[11] Regardless of

[10] Out-of-sample exercises usually update parameter estimates according to some variation of three major updating schemes: fixed, rolling or recursive. We will restrict to the rolling scheme because it is appropriate when working with time series that may have experienced breaks, and also because in the tests due to Clark and West we do not want parameter uncertainty to vanish asymptotically.

[11] Evaluation of predictive ability is usually carried out with two different approaches: in sample and out-of-sample. Both approaches have advantages and disadvantages. For instance, in-sample analyses have the advantage of using all the available observations for estimation of unknown population parameters. This is in opposition to out-of-sample analyses, which split the available data in estimation and predictive windows. Fewer observations are of no help when attempting to get precise estimates of parameters in stationary environments. In fact, Inoue and Kilian (2003) argue that splitting the available sample in two different windows may reduce the power of out-of-sample tests in comparison to in-sample tests. The latter tests, however, are considered to be more sensitive to data mining-induced overfitting problems, as mentioned by Clark (2004).

the critics that may surround out-of-sample analyses, we consider that they are more appropriate to evaluate predictive ability in the application we are interested here. This is partly because we want to properly compare our results with those of the relevant literature, and partly because they better reflect the difficulty faced by a policy maker when confronted with a real time forecasting task.

When comparing models (4) and (7) we apply the traditional asymptotically normal test developed by West (1996) and Diebold and Mariano (1995) with quadratic loss.[12] When comparing models (4-6) we notice that models (5) and (6) are nested in model (4) so asymptotic normality of this test does not hold anymore, see McCraken (2007). Instead, we rely in two out of sample tests recently developed by Clark and West (2006) and Clark and West (2007) that are appropriate in nested environments. The first test, called Mean Square Prediction Error–Adjusted (MSPE-Adj) is applied to evaluate the predictive ability of the alternative model (4) against the driftless random walk in model (5).[13] This test is asymptotically normal. For the comparison of model (4) and model (6) we use a variant of the MSPE–Adj test developed by Clark and West (2007). The distribution of this statistic under the null is shown to be well approximated by a normal distribution[14].

We are aware that out-of-sample analyses may be too stringent to evaluate predictive ability with sample sizes typically available for countries like Chile. For this reason we complement our out-of-sample (OOS) results with pseudo out-of-sample (POOS) results. The difference between our OOS and POOS results is simply given by the construction of the variables used for prediction. Our OOS analyses consider prediction using real time variants of the variables ($NXAP^R$, xm^R, xa^R and al^R). Instead, our POOS analyses consider prediction only with NXAP, *xm*, *xa* and *al*, variables which include information of the whole sample.

IV. Evaluation of Predictive Ability

As mentioned before, we show results for our measure of external imbalances (NXAP) and its three components *xm*, *xa* and *al*. We also use a real time variant of the variables that we denote by $NXAP^R$, xm^R, xa^R and al^R. We estimate model (4) with each of these four vectors. We then compare the predictive ability of these variables using the three benchmarks given by models 5- 7. For each version of model (4) we engage in four empirical exercises. First, we assume that the number of observations used for the first estimation (R-k) is fixed at 65-k. Then we compute our statistics and analyze whether the tests are able to reject the three proposed null models at different significance levels.

[12] The *asymptotic irrelevance* discussed by West (1996) allows us to rely in standard normal critical values without further corrections originated by parameter uncertainty.

[13] A useful interpretation of this test is given by Pincheira (2006). In this paper it is shown that the rejection of the null model via the MSPE –Adjusted test implies the existence of a deterministic shrinkage factor for which the alternative model will display lower mean square prediction error.

[14] Notice that we are interested in one sided test because if the alternative model is the correct model, the core statistics in the tests developed by Clark and West should be positive. Similarly when comparing model (4) to model (7) via the Diebold and Mariano statistic, we expect the true model to display lower out-of-sample mean square prediction error. Finally, estimates of the variance of the test statistics are computed with HAC estimation according to Newey and West (1987) and Newey and West (1994).

Second, we analyze how robust the results from the first empirical exercise are when we slightly change the size of the estimation window. We carry out eleven forecast evaluations moving R from 65 to 75 and record the percentage of rejections at the 10% significance level.

Finally we repeat steps 1 and 2 assuming that the number of observations used for the first estimation (R-k) is fixed at 35-k, and then we move R from 35 to 45 to record the percentage of rejections at the 10% significance level as a robustness check.

We choose the estimation window size at R-k =65-k and R-k=35-k mainly because these numbers represent roughly one and two thirds of the sample, respectively. In fact, the average estimation window for all the horizons considered has about 60 and 30 observations when R is set to 65 and 35 respectively. For the sake of brevity, we only report tables for the exercises with R fixed at 65 and 35. Tables corresponding to the robustness checks are available upon request.

In the next two subsections we present tables with our forecasting evaluations. Figures reported in the tables correspond to t-type statistics from the tests by West (1996) and Diebold and Mariano (1995). We also present the t-type statistics corresponding to the tests by Clark and West.

IV.1. Pseudo Out-of-Sample Exercise (POOS).

In this subsection we present forecasting results corresponding to a POOS exercise. We evaluate whether the variable NXAP and its individual components are able to predict RER returns at several horizons. We recall that this exercise is called POOS because the cointegrating relationships as well as the principal component coefficients are obtained using the full sample available. Panel 1 in the tables shows t-type statistics when the estimation window is set to R-k=65-k whereas panel 2 shows these statistics when the estimation window is set to R-k=35-k. Purely out-of-sample exercises are reported in subsection IV.2.

Table 1
Pseudo Out-of-Sample Forecast Evaluation of Changes in the Chilean RER External Imbalances Based on Gourinchas and Rey´s Variable (NXAP)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel 1: Estimation Window of Size R-k = 65-k								
	Predictive Horizon in Quarters							
Benchmark	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RW	***1.03***	***0.88***	***1.70****	***2.63*****	***2.26****	***2.28****	***2.41*****	***1.59****
RW-drift	***0.96***	***0.90***	***1.77****	***2.86*****	***2.63*****	***2.88*****	***3.21*****	***2.46*****
AR(1)	***0.36***	***0.64***	***1.45****	***2.07****	***1.86****	***2.03****	***2.04****	***1.51****
Panel 2: Estimation Window of Size R-k = 35-k								
Benchmark	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RW	***-0.39***	***-0.95***	***-0.29***	***0.27***	***-0.18***	***-0.59***	***-0.85***	***-1.15***
RW-drift	***0.83***	***0.16***	***1.24***	***1.94****	***1.82****	***1.52****	***1.39****	***0.99***
AR(1)	***0.60***	***0.45***	***0.44***	***1.20***	***1.51****	***0.55***	***0.23***	***0.42***

Notes:

- *Rejection at 10%, **Rejection at 5%, ***Rejection at 1%
- Pseudo out-of-sample means that the predictor is computed with information of the full sample.
- We consider three different null models for changes of the RER: a driftless random walk, a random walk with drift and an AR(1).
- Alternative model is: ln(RER_t+k)-ln(RER_t)=a +b*ln(Z_t)+u_t
- Z is a variable capturing external imbalances (NAXP), k denotes the predictive horizon.
- Updating scheme of the parameter estimates is done via rolling OLS.
- Panel 1 considers a rolling window of size R= 65-k for estimation of the parameters. Panel 2 considers R= 35-k.
- Total number of observations is 91-k.
- We report t-type statistics from tests by Diebold and Mariano (1995) and West (1996), and Clark and West (2006, 2007).
- HAC estimation is computed according to Newey and West (1987) with optimal lag selection based upon Newey and West (1994).
- Quarterly data from 1983:1 to 2005:4.

Source: Author´s calculations.

Results on panel 1 of table 1 show statistically significant evidence of predictability for horizons beyond 2 quarters ahead. At these horizons, our measure of external imbalances outperforms the driftless random walk and the random walk with drift either at the 10%, 5% or 1% significance level. Furthermore, the AR(1) model is also outperformed by our model with a measure of external imbalances at the same horizons at least at a 10% significance level.

Panel 2 on table 1 shows weaker results. We recall that the difference between panel 1 and 2 is that in panel 2 the size of the estimation window is about a half of the size used in panel 1. For this size of the estimation window, our model with the measure of external imbalances does not outperform a driftless random walk at any horizon. Statistically significant evidence of predictability is found, however, when our model with the measure of external imbalances is compared to a random walk with drift. In this case, our model

forecasts better within a range of 4 and 7 quarters ahead. Finally, our model only outperforms an AR(1) with statistical significance at 5 quarters ahead.

Table 2
Pseudo Out- of-Sample Forecast Evaluation of Changes in the Chilean RER
The Predictive Variable is an Exports to Assets Ratio (XA)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel 1: Estimation Window of Size R-k = 65-k								
	Predictive Horizon in Quarters							
Benchmark	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RW	***1.21***	***1.11***	***1.97****	***2.55*****	***2.23****	***2.15****	***1.96****	***1.46****
RW-drift	***1.17***	***1.13***	***1.89****	***2.55*****	***2.49*****	***2.66*****	***2.66*****	***2.20****
AR(1)	***0.47***	***0.66***	***1.18***	***1.48****	***1.45****	***1.55****	***1.39****	***0.88***
Panel 2: Estimation Window of Size R-k = 35-k								
Benchmark	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RW	***0.51***	***-0.29***	***0.40***	***0.73***	***0.18***	***-0.34***	***-0.79***	***-1.18***
RW-drift	***1.30****	***0.69***	***1.49****	***1.89****	***1.43****	***1.22***	***0.95***	***0.34***
AR(1)	***0.81***	***0.50***	***0.80***	***1.35****	***1.01***	***0.13***	***-0.43***	***-0.55***

Notes:

- *Rejection at 10%, **Rejection at 5%, ***Rejection at 1%
- Pseudo out-of-sample means that the predictor is computed with information of the full sample.
- We consider three different null models for the returns of the RER: a driftless random walk, a random walk with drift and an AR(1).
- Alternative model is: ln(RER_t+k)-ln(RER_t)=a +b*ln(Z_t)+u_t
- Z is Exports to Assets ratio (XA), k denotes the predictive horizon.
- Updating scheme of the parameter estimates is done via rolling OLS.
- Panel 1 considers a rolling window of size R= 65-k for estimation of the parameters. Panel 2 considers R= 35-k.
- Total number of observations is 91-k.
- We report t-type statistics from tests by Diebold and Mariano (1995) and West (1996), and Clark and West (2006, 2007).
- HAC estimation is computed according to Newey and West (1987) with optimal lag selection based upon Newey and West (1994).
- Quarterly data from 1983:1 to 2005:4.

Source: Author´s calculations.

Table 2 shows results of predictability when the predictor is the exports to assets ratio, which is one of the components of the NXAP vector. We observe similar results to those of table 1: panel 1 shows statistically significant evidence of predictability for several horizons beyond 2 quarters ahead and panel 2 shows no evidence of predictability against the driftless random walk, evidence of predictability against the random walk with drift only between 3 and 5 quarters ahead and evidence of predictability against the simple AR(1) only at 4 quarters ahead. These results are quite consistent with results in table 1.

Table 3
Pseudo Out- of-Sample Forecast Evaluation of Changes in the Chilean RER
The Predictive Variable is an Assets to Liabilities Ratio (AL)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel 1: Estimation Window of Size R-k = 65-k								
Predictive Horizon in Quarters								
Benchmark	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RW	***0.53***	***0.84***	***1.29****	***1.50****	***1.37****	***1.86*****	***1.89*****	***1.49****
RW-drift	***0.46***	***0.97***	***1.54****	***1.74*****	***1.60****	***2.06*****	***1.97*****	***1.79*****
AR(1)	***0.07***	***1.14***	***1.58****	***1.45****	***1.12***	***1.60****	***1.19***	***0.59***
Panel 2: Estimation Window of Size R-k = 35-k								
Benchmark	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RW	***0.23***	***0.46***	***0.73***	***1.15***	***1.01***	***0.87***	***0.76***	***0.57***
RW-drift	***1.66*****	***2.11*****	***2.68*****	***3.16*****	***3.73*****	***4.06*****	***3.68*****	***3.47*****
AR(1)	***1.63****	***2.06*****	***2.01*****	***3.51*****	***3.83*****	***3.91*****	***3.62*****	***3.57*****

Notes:

- *Rejection at 10%, **Rejection at 5%, ***Rejection at 1%
- Pseudo out-of-sample means that the predictor is computed with information of the full sample.
- We consider three different null models for the changes of the RER: a driftless random walk, a random walk with drift and an AR(1).
- Alternative model is: ln(RER_t+k)-ln(RER_t)=a +b*ln(Z_t)+u_t
- Z is the Assets to Liabilities ratio (AL), k denotes the predictive horizon.
- Updating scheme of the parameter estimates is done via rolling OLS.
- Panel 1 considers a rolling window of size R= 65-k for estimation of the parameters. Panel 2 considers R= 35-k.
- Total number of observations is 91-k.
- We report t-type statistics from tests by Diebold and Mariano (1995) and West (1996), and Clark and West (2006, 2007).
- HAC estimation is computed according to Newey and West (1987) with optimal lag selection based upon Newey and West (1994).
- Quarterly data from 1983:1 to 2005:4.

Source: Author´s calculations.

When we explore the predictive ability contained in the assets to liabilities ratio we see a somewhat different picture. Panel 1 in table 3 still shows statistically significant evidence of predictability for several horizons beyond 2 quarters ahead. Panel 2 on table 3, however, shows strong evidence of predictability against the random walk with drift for all horizons. Panel 2 also shows that the assets to liabilities ratio strongly outperforms the simple AR(1) at every horizon. Surprisingly, the driftless random walk cannot be outperformed at any horizon, although the t-statistics display the correct sign. Results from panel 2 are in sharp contrast with those from tables 1-2 in which evidence of predictability was hardly found when the estimation window was set at R-k =35-k.

We do not report tables for the pseudo out-of-sample exercises when the predictor is the exports to imports ratio (*xm*). This is simply because there is nothing really to show. In

other words, *xm* is drastically outperformed by our three benchmarks at any single horizon in both exercises with R set at R=65 and R=35[15].

In the next subsection we explore whether the results presented here still stands when an out-of-sample exercise is followed.

IV.2. Out-of-Sample Exercises.

In this subsection we present forecasting results corresponding to an out-of-sample exercise evaluating the ability of the variables $NXAP^R$, xm^R, xa^R and al^R to predict RER returns at several horizons. We recall that $NXAP^R$, xm^R, xa^R and al^R are variables built similarly to NXAP, *xm*, *xa* and *al*, but in an out-of-sample fashion. Differing from the construction of NXAP, *xm*, *xa* and *al*, now the cointegrating relationships as well as the calculation of the principal component coefficients is based on information available at the moment of prediction. In other words, when the size of the estimation window is set to R-k=35-k, we use information available only until 1991Q1 and when the size of the estimation window is set to R-k=65-k, we use information available only until 1999Q3. Therefore these are out-of-sample exercises in the sense that the information used for prediction does not contain observations used for evaluation. Consequently, these exercises are more stringent than those presented in the previous subsection.

Table 4
Out-of-Sample Forecast Evaluation of Quarterly Changes in the Chilean RER External Imbalances Based on Gourinchas and Rey´s Variable ($NXAP^R$)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel 1: Estimation Window of Size R-k = 65-k								
	Predictive Horizon in Quarters							
Benchmark	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RW	***0.90***	***0.63***	***1.42****	***2.36****	***2.05****	***1.97****	***2.06****	***1.34****
RW-drift	***0.82***	***0.64***	***1.53****	***2.75*****	***2.56*****	***2.77*****	***3.26*****	***2.43*****
AR(1)	***0.23***	***0.51***	***1.34****	***1.87****	***1.79****	***2.03****	***1.99****	***1.44****
Panel 2: Estimation Window of Size R-k = 35-k								
Benchmark	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RW	***-1.22***	***-1.28***	***-1.11***	***-1.14***	***-1.29***	***-1.33***	***-1.45***	***-1.56***
RW-drift	***-1.78***	***-0.67***	***-0.55***	***-0.54***	***-0.80***	***-0.55***	***-0.14***	***0.06***
AR(1)	***-0.01***	***-0.34***	***-0.86***	***0.16***	***0.15***	***-0.84***	***-0.73***	***0.16***

Notes:

- *Rejection at 10%, **Rejection at 5%, ***Rejection at 1%
- We consider three different null models for the returns of the RER: a driftless random walk, a random walk with drift and an AR(1).
- Each panel considers alternative models as follows: ln(RER_t+k)-ln(RER_t)=a +b*ln(Z_t)+u_t
- Z is a measure of external imbalances ($NXAP^R$). k denotes the predictive horizon.

[15] Tables are available upon request.

- Updating scheme of the parameter estimates is done via rolling OLS.
- We pick a rolling window of size 65-k in Panel 1 and of size 35-k in Panel 2 for estimation of the parameters.
- Total number of observations is 91-k.
- We report t-type statistics from tests by Diebold and Mariano (1995) and West (1996), and Clark and West (2006, 2007).
- HAC estimation is computed according to Newey and West (1987) with optimal lag selection based upon Newey and West (1994).
- Quarterly data from 1983:1 to 2005:4.

Source: Author´s calculations.

As expected, statistics reported in table 4 are, with only a couple of exceptions, lower than those reported in table 1. In fact, panel 2 shows no statistically significant evidence of predictability whatsoever.

The striking result is provided on panel 1 of table 4. Despite the fact that reported statistics are, in general, a little lower than those in panel 1 of table 1, they show statistically significant evidence of predictability for horizons beyond 2 quarters ahead. At these horizons, our measure of external imbalances outperforms both versions of a random walk either at the 10%, 5% or 1% significance level. Similarly, the AR(1) model is also outperformed by our model at the same horizons at least at a 10% significance level.

Our robustness check, available upon request, shows that these results are indeed robust to small variations in the size of the estimation window R-k.

Table 5 below displays forecasting results corresponding to an out-of-sample exercise evaluating the ability of the variables xm^R, xa^R and al^R to predict RER returns at several horizons when the size of the estimation window is set to R-k=65-k. We see that the main findings emphasized in the pseudo out-of-sample exercises are confirmed when an out-of-sample exercise is carried out instead. Panel 1 in table 5 shows that the export to imports ratio has no ability to predict the Chilean RER. Panel 2 and 3 show t-statistics that are fairly similar to those obtained in the pseudo out-of-sample evaluation. Basically they confirm that both the exports to assets ratio and the assets to liabilities ratio display ability to predict the Chilean RER at several horizons beyond two quarters. We notice also, that the hardest benchmark to beat is the AR(1) model. This is especially relevant for the exports to assets ratio, that displays t-statistics that are significant only when the predictive horizon is 6 quarters ahead. Nevertheless some others t-statistics are nearly close to become significant.

Table 6 below displays forecasting results corresponding to an out-of-sample exercise evaluating the ability of the variables xm^R, xa^R and al^R to predict RER returns at several horizons when the size of the estimation window is now set to R-k=35-k. Panel 1 in table 6 confirms that the exports to imports ratio has no ability to predict the Chilean RER as we earlier saw with the pseudo out-of-sample exercise. Panel 2 show t-statistics that are relatively different to those obtained in the pseudo out-of-sample evaluation, but equally weak in terms of predictability. In fact we find that the exports to assets ratio beats both variants of the random walk only when prediction is made 4 quarters ahead. Furthermore, the AR(1) is never beaten. Finally, Panel 3 shows quite different results from those of the pseudo-out-of-sample exercise. Now, we see no RER predictability based upon the assets to

liabilities ratio. We tend to believe that the small size of the sample is playing an important role for this result.

Table 5
Out-of-Sample Forecast Evaluation of Quarterly Changes in the Chilean RER
Components of the External Imbalances´ Variable

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel 1: The Predictive Variable the Exports to Imports ratio (XM)								
	Predictive Horizon in Quarters							
Benchmark	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RW	*-2.12*	*-216*	*-2.03*	*-2.79*	*-2.58*	*-2.51*	*-2.73*	*-2.70*
RW-drift	*-2.14*	*-1.36*	*-1.20*	*-2.11*	*-2.13*	*-2.01*	*-2.08*	*-2.48*
AR(1)	*-2.04*	*-1.21*	*-1.23*	*-1.64*	*-2.13*	*-2.46*	*-2.83*	*-2.62*
Panel 2: The Predictive Variable is the Exports to Assets ratio (XA)								
	Predictive Horizon in Quarters							
Benchmark	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RW	*1.19*	*1.10*	*1.87***	*2.38***	*2.16***	*2.11***	*1.95***	*1.54**
RW-drift	*1.16*	*1.12*	*1.83***	*2.43****	*2.43****	*2.59****	*2.60****	*2.23***
AR(1)	*0.38*	*0.57*	*1.00*	*1.23*	*1.26*	*1.34**	*1.17*	*0.71*
Panel 3: The Predictive Variable is the Assets to Liabilities ratio (AL)								
	Predictive Horizon in Quarters							
Benchmark	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RW	*0.54*	*0.85*	*1.31**	*1.53**	*1.40**	*1.89***	*1.91***	*1.53**
RW-drift	*0.47*	*0.98*	*1.55**	*1.75***	*1.62**	*2.08***	*1.99***	*1.81***
AR(1)	*0.08*	*1.14*	*1.58**	*1.46**	*1.13*	*1.60**	*1.21*	*0.63*

Notes:

- *Rejection at 10%, **Rejection at 5%, ***Rejection at 1%
- We consider three different null models for the returns of the RER: a driftless random walk, a random walk with drift and an AR(1).
- Each panel considers alternative models as follows: ln(RER_t+k)-ln(RER_t)=a +b*ln(Z_t)+u_t
- Z is the Exports to Imports ratio (XM) in Panel 1, the Exports to Assets ratio in Panel 2 and the Assets to Liabilities ratio in Panel 3.
- Updating scheme of the parameter estimates is done via rolling OLS.
- We pick a rolling window of size 65-k for estimation of the parameters. k denotes the predictive horizon.
- Total number of observations is 91-k.
- We report t-type statistics from tests by Diebold and Mariano (1995) and West (1996), and Clark and West (2006, 2007).
- HAC estimation is computed according to Newey and West (1987) with optimal lag selection based upon Newey and West (1994).
- Quarterly data from 1983:1 to 2005:4.

Source: Author´s calculations.

Table 6
Out-of-Sample Forecast Evaluation of Quarterly Changes in the Chilean RER
Components of the External Imbalances´ Variable

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel 1: The Predictive Variable the Exports to Imports ratio (XM)								
	Predictive Horizon in Quarters							
Benchmark	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RW	*-1.85*	*-1.13*	*-0.72*	*-1.15*	*-1.18*	*-1.14*	*-0.90*	*-0.93*
RW-drift	*-1.97*	*-1.44*	*-1.31*	*-1.89*	*-1.98*	*-1.89*	*-1.26*	*-1.13*
AR(1)	*-1.34*	*-0.88*	*-1.43*	*-1.27*	*-1.09*	*-1.75*	*-1.51*	*-0.90*
Panel 2: The Predictive Variable is the Exports to Assets ratio (XA)								
	Predictive Horizon in Quarters							
Benchmark	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RW	*0.58*	*0.52*	*1.27*	*1.43**	*1.18*	*1.01*	*0.59*	*0.09*
RW-drift	*1.08*	*0.94*	*1.43**	*1.48**	*1.20*	*1.10*	*0.89*	*0.50*
AR(1)	*0.35*	*0.18*	*0.29*	*0.56*	*0.27*	*-0.30*	*-0.65*	*-1.03*
Panel 3: The Predictive Variable is the Assets to Liabilities ratio (AL)								
	Predictive Horizon in Quarters							
Benchmark	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RW	*-0.70*	*-0.66*	*-0.55*	*-0.71*	*-0.65*	*-1.07*	*-1.76*	*-2.06*
RW-drift	*-0.29*	*-0.33*	*-0.31*	*-0.22*	*0.00*	*-0.01*	*-0.21*	*-0.18*
AR(1)	*-0.32*	*-0.71*	*-1.30*	*-1.15*	*-0.68*	*-1.19*	*-1.54*	*-1.38*

Notes:

- *Rejection at 10%, **Rejection at 5%, ***Rejection at 1%
- We consider three different null models for the returns of the RER: a driftless random walk, a random walk with drift and an AR(1).
- Each panel considers alternative models as follows: ln(RER_t+k)-ln(RER_t)=a +b*ln(Z_t)+u_t
- Z is the Exports to Imports ratio (XM) in Panel 1, the Exports to Assets ratio in Panel 2 and the Assets to Liabilities ratio in Panel 3.
- Updating scheme of the parameter estimates is done via rolling OLS.
- We pick a rolling window of size 35-k for estimation of the parameters. k denotes the predictive horizon.
- Total number of observations is 91-k.
- We report t-type statistics from tests by Diebold and Mariano (1995) and West (1996), and Clark and West (2006, 2007).
- HAC estimation is computed according to Newey and West (1987) with optimal lag selection based upon Newey and West (1994).
- Quarterly data from 1983:1 to 2005:4.

Source: Author´s calculations.

In summary, in this work we provide evidence of out-of-sample predictability of RER returns using a measure of external imbalances which considers the financial channel. We observe that systematic evidence of predictability increases with the size of the estimation window. We also detect that predictability is mainly driven by two components of our

measure of external imbalances: the exports to assets ratio and the assets to liabilities ratio. Interestingly, no predictive ability is found when the export to imports ratio is used as a predictor.

V. Concluding Remarks

There is considerable literature which claims that one should not expect much exchange rate predictability with fundamentals. Our objective in this paper is to bring insight about the ability of a measure of external imbalances to predict the real exchange rate of an emerging market economy. We use a variable that combines the trade and valuation channel for Chile, which is basically a linear combination of a set of variables constructed as in Gourinchas and Rey (2005).

The evidence in this article highlights that a measure of external imbalances contains useful information to predict the Chilean real exchange rate at horizons up to 2 years. Interestingly, evidence of predictability increases with the size of the window used to estimate the parameters of the models under evaluation. This is probably because the external balance has turned out to be more relevant in the dynamics of the real exchange rate in the last few years, or because estimates of the parameters become more precise as the size of the estimation window increases.

We also detect that predictability is mainly driven by two components of our measure of external imbalances: the exports to assets ratio and the assets to liabilities ratio. Interestingly, no predictive ability is found when the exports to imports ratio is used as a predictor.

Our results suggest that researchers and policymakers should bring more attention to external imbalances to understand the future dynamics of real exchange rate. Further research should pursue an extensive analysis of the role that the external balance may have to predict other variables such as growth of net exports and returns of assets and liabilities. The comparison with other benchmarks, such as monetary models may also be desirable.

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