Which Fundamentals Drive Exchange Rates? A Cross-Sectional Perspective[*]

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Abstract

Standard present-value models suggest that exchange rates are driven by expected future fundamentals, implying that exchange rates contain information about future fundamentals. We test this key empirical prediction of present-value models in a sample of 35 currency pairs ranging from 1900 to 2009. Employing a variety of tests, we find that exchange rates have strong and significant predictive power for nominal fundamentals (inflation, money balances, nominal GDP), whereas predictability of real fundamentals and risk premia is much weaker and largely confined to the post-Bretton Woods era. Overall, we uncover ample evidence that future macro fundamentals drive current exchange rates.

JEL Classification: F31; G10.

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1. INTRODUCTION

Whether exchange rates are linked to observable macroeconomic fundamentals has long been controversial in the literature and there is early evidence against such a link dating back to the work of Meese and Rogoff (1983), leading to the so-called "disconnect puzzle".

However, the well-documented finding that exchange rates are only weakly related to contemporaneous (or lagged) macro fundamentals does not mean that exchange rates are truly "disconnected" from fundamentals. In fact, Engel and West (2005) show that the apparently weak relationship between exchange rates and fundamentals can be reconciled within a standard present-value model of asset prices when discount factors are close to unity and fundamentals are nonstationary. In this setting, the exchange rate can be entirely driven by macro fundamentals but the link is such that expectations about future macro fundamentals drive current exchange rates, whereas current and lagged fundamentals are relatively unimportant. Hence, to identify which fundamentals matter most for exchange rates, it is sensible to test for predictability of fundamentals by using lagged exchange rates as predictors.[1]

Engel and West (2005) were the first to provide evidence that exchange rates do indeed Granger-cause fundamentals, a finding which suggests that there is a sensible connection between fundamentals and exchange rates after all. Related to this, Engel and West (2006) find that deviations of real exchange rates from steady state values forecast inflation and output gaps. In a similar vein, Chen, Rogoff, and Rossi (2010) find that "commodity currencies" robustly forecast commodity prices.

Hence, there is some evidence that exchange rates forecast fundamentals, which implies that (expected) fundamentals do indeed matter for exchange rates. However, the evidence is

[1] Quoting Obstfeld and Rogoff (2000, p. 373) : '[...] the *exchange-rate disconnect puzzle* [...] alludes broadly to the exceedingly weak relationship (except, perhaps, in the longer run) between the exchange rate and virtually *any* macroeconomic aggregates. It manifests itself in a variety of ways. For example, Meese and Rogoff (1983) showed that standard macroeconomic exchange-rate models, even with the aid of ex-post data on the fundamentals, forecast exchange rates at short to medium horizons no better than a naive random walk.' Indeed, there is evidence in favor of a sensible predictive relationship from macro factors to exchange rates only at rather long horizons (e.g. Mark, 1995; Mark and Sul, 2001; Abhyankar, Sarno, and Valente, 2005). However, to be clear, this is not the aspect of the puzzle on which we focus in this paper. Instead we focus on the other side of the puzzle that refers to 'the remarkably weak [...] feedback links between the exchange rate and the rest of the economy' (Obstfeld and Rogoff, 2000, p. 373) and analyze whether and how fluctuations in the exchange rate are related to future aggregate macroeconomic variables.

confined to a relatively small set of currencies and economic variables, to the recent floating exchange rate regime since the 1970s, and to tests applied to individual currency pairs. Yet the empirical prediction of the Engel-West framework is very general, and several key fundamental variables qualify as being relevant for exchange rates even in standard exchange rate models. This paper provides a fresh and comprehensive assessment of this prediction of present-value models, and investigates whether exchange rate movements have predictive power for a number of relevant macro fundamentals in a large *cross-section* of countries over a century-long sample. The cross-sectional aspect of our data is especially important since it allows us to conduct tests which average out most of the idiosyncratic noise in individual exchange rates and, thus, to carry out more powerful tests. The key questions that guide our analysis are: (i) is there a link between current exchange rates and future fundamentals consistent with standard present-value models of the exchange rate, and, if so, (ii) which fundamentals matter most? Answers to these questions seem relevant as they have direct implications - among other things - for theoretical exchange rate modeling.

Our empirical analysis is based on long-run data for 35 currencies quoted against the US Dollar (USD) covering the period from 1900 to 2009. In many of our tests, we take a perspective typical of the finance literature, relying mainly on a simple and model-free out-of-sample forecasting exercise and forming groups (or portfolios) of countries depending on their lagged spot rate movements against the USD. The composition of these groups is updated each year and we examine the macro performance of these different groups of countries throughout each annual forecasting period. In addition, we also present results based on more conventional panel regressions (controlling for fixed country and time effects).

Our results show that countries whose currencies strongly appreciated against the USD *in the past* have significantly lower *future* inflation, growth in money balances, nominal GDP growth, and interest rates, compared to countries whose currencies most strongly depreciated against the USD. The differences in fundamentals' growth rates across the two groups of countries is statistically and economically significant and easily exceeds 10% p.a. for inflation and money growth. These relations are very robust across sample periods and test methods, suggesting that future nominal fundamentals matter a lot for current exchange rates. Further nominal variables, such as interest rate differentials and risk premia (deviations from uncovered interest rate parity) also matter, but their importance is largely confined to the post-Bretton Woods sample.[2]

We also investigate the existence of predictability for real macroeconomic fundamentals such as real GDP growth, real money growth, and real exchange rate changes. However, the evidence is not as clear-cut as for nominal fundamentals. We find some evidence of predictability of real exchange rate changes, especially for the post Bretton Woods sample period, whereas real GDP growth is not robustly predictable and its relationship with the current spot rate tends to switch sign across different sample periods. We illustrate, however, how the latter finding can be rationalized by instabilities in the income elasticity of money demand. Real money growth seems the least predictable (by means of past exchange rates), and we only find some predictability at longer horizons.

Finally, it is worthwhile mentioning that almost all predictive relations uncovered in our empirical work are in line with the theoretical predictions (which we turn to in the next section) from a standard monetary exchange rate model. Hence, our findings in a nutshell are as follows. First, fundamentals matter a lot for exchange rates empirically, and it seems that nominal fundamentals are more important than real fundamentals. Second, fundamentals matter in a way consistent with standard present-value logic as exchange rate movements forecast fundamentals. Third, fundamentals generally tend to matter in a way consistent with standard monetary exchange rate models, a workhorse of traditional international finance. Fourth, our main results are robust across methods and also hold when controlling for lagged macro fundamentals.[3]

The paper proceeds as follows. The next section briefly reviews theoretical concepts. Section 3 details the data. Section 4 describes the empirical approach and results. Section 5 provides additional results and robustness, and Section 6 concludes. A separate Internet Appendix to this paper contains additional information and robustness results.

[2] Froot and Ramadorai (2005) find that (expectations about) risk premia are a strong driver of real exchange rates in a VAR-based decomposition based on recent data. Hence, their result is by and large compatible with ours although we are investigating nominal exchange rates.

[3] However, as noted later in the paper, our results are also consistent with other theoretical arguments different from the standard present-value model we choose to focus on. Specifically, it is clear that fundamentals are endogenous and determined jointly with exchange rates in equilibrium, so that the predictability from exchange rates to fundamentals documented here should not be taken necessarily as unidirectional causality.

2. THEORETICAL MOTIVATION

The asset price approach to exchange rates relies on the fact that the exchange rate, as any other asset price, can be written as the discounted present value of future fundamentals:

$$s_t = (1-b)\sum_{i=0}^{\infty} b^i \mathbb{E}_t[f_{t+i}] \tag{1}$$

where s is the log nominal exchange rate, b is a parameter that depends on the structure of an underlying macro model, and f denotes the set of macro fundamentals. The above present-value formulation starts from the general idea that spot rates are driven by fundamentals and expected spot rates, i.e.

$$s_t = (1-b)f_t + b\mathbb{E}_t[s_{t+1}] \tag{2}$$

and equation (1) then follows from iterating forward equation (2) provided that the no-bubbles condition $b^i\mathbb{E}_t[s_{t+i}] = 0$ holds for $i \to \infty$ and that current fundamentals are observable. Thus, equation (1) suggests that current exchange rates should be informative for future fundamentals.

The general formulation in equation (1) takes no stand on which fundamentals to include in exchange rate determination so that the menu of fundamentals will be driven by choosing a particular exchange rate model. For our empirical application below, we rely on a fairly standard but general setup based on the monetary exchange rate model, which is described in equation (7) in Engel and West (2005)

$$s_t = \frac{1}{1+\alpha}\left[-\left(m_t^* - m_t\right) + \gamma\left(y_t^* - y_t\right) + \left(v_{mt}^* - v_{mt}\right) + q_t - \alpha\rho_t\right] + \frac{\alpha}{1+\alpha}\mathbb{E}_t[s_{t+1}] \tag{3}$$

where s is the log spot exchange rate expressed as US dollars per foreign currency unit (USD per FCU), m is the log of the money supply, y is (real) output, v_m is a money demand shock, q denotes the log real exchange rate defined as $q_t = s_t - p_t^* + p_t$, and ρ is the foreign exchange risk premium (i.e. the deviation from uncovered interest rate parity, $\rho_t = \Delta s_t + i_t^* - i_t$); the (log) price level is denoted as p_t, and i_t is the continuous short-term interest rate. Asterisks indicate variables of the foreign country. Finally, γ is the income elasticity of the demand for money and α is the interest rate semi-elasticity of money demand. We refer to Engel and West (2005) and Engel, Mark, and West (2007) for further details of this specification but note here that it is fairly general and does not impose uncovered interest parity.

Iterating the stochastic difference equation in (3) forward and imposing the no-bubbles condition, the current exchange rate s_t can be expressed as

$$s_t = \frac{1}{1+\alpha} \sum_{i=0}^{\infty} \left(\frac{\alpha}{1+\alpha} \right)^i \mathbb{E}_t \begin{bmatrix} -\left(m^*_{t+i} - m_{t+i}\right) + \gamma \left(y^*_{t+i} - y_{t+i}\right) \\ + \left(v^*_{mt+i} - v_{mt+i}\right) + q_{t+i} - \alpha \rho_{t+i} \end{bmatrix} \tag{4}$$

which is identical to equation (1) when setting $b = \alpha/(1-\alpha)$ and f equal to the sum of macro fundamentals in squared brackets.

Most important for our analysis is that the above specification in equation(4) makes a number of theoretical predictions regarding current exchange rates and future fundamentals. Specifically, it says that an appreciation of the foreign currency (a higher s) implies expectations of (i) *lower* money growth differentials (foreign vs. home country), (ii) *higher* real output differentials (provided a stable income elasticity of money demand γ), (iii) *higher* real exchange rates, and (iv) *lower* risk premia in the future. These are the first four predictions we will test for in our empirical work below.[4]

Furthermore, rewriting equation (4) as

$$s_t = \frac{1}{1+\alpha} \sum_{i=0}^{\infty} \left(\frac{\alpha}{1+\alpha} \right)^i \mathbb{E}_t \begin{bmatrix} -\left[(m^*_{t+i} - p^*_{t+i}) - (m_{t+i} - p_{t+i})\right] - (p^*_{t+i} - p_{t+i}) \\ +\gamma \left(y^*_{t+i} - y_{t+i}\right) + \left(v^*_{mt+i} - v_{mt+i}\right) + q_{t+i} - \alpha \rho_{t+i} \end{bmatrix} \tag{5}$$

one can see that the nominal exchange rate should also forecast the evolution of price differentials $(p^*_t - p_t)$ as well as real money differentials $((m^*_t - p^*_t) - (m_t - p_t))$. Empirically, appreciating currencies should experience (v) *lower* future inflation rate differentials and (vi) *lower* real money growth differentials.

[4] We do not investigate money demand shocks since we restrict our empirical analysis to directly observable variables.

Finally, we can also re-parameterize equation(4) as

$$s_t = \frac{1}{1+\alpha}\sum_{i=0}^{\infty}\left(\frac{\alpha}{1+\alpha}\right)^i \mathbb{E}_t \begin{bmatrix} -\left[(m^*_{t+i}-p^*_{t+i})-(m_{t+i}-p_{t+i})\right] \\ -\left[(p^*_{t+i}+y^*_{t+i})-(p_{t+i}+y_{t+i})\right] \\ +(\gamma+1)\left(y^*_{t+i}-y_{t+i}\right)+\left(v^*_{mt+i}-v_{mt+i}\right)+q_{t+i}-\alpha\rho_{t+i} \end{bmatrix} \quad (6)$$

which shows that appreciating exchange rates should forecast (vii) *lower* nominal income differentials $[(p^*_t + y^*_t) - (p_t + y_t)]$. Note that the relation between exchange rates and nominal income differentials, as opposed to real income differentials, is not affected by the income elasticity of money demand γ, a point we will return to below. Overall, therefore, we have a set of clear predictions from this simple setting that we can take to the data for the purpose of evaluating the predictive information content in exchange rates for future economic variables.

3. DATA

We employ data for a total of 36 countries (35 exchange rates) with a sample period ranging from 1900 to 2009. Data availability varies across countries and not all countries have data as far back as 1900. The 36 countries are: Argentina, Australia, Austria, Belgium, Brazil, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, India, Indonesia, Ireland, Israel, Italy, Japan, (South) Korea, Mexico, Netherlands, New Zealand, Norway, Portugal, Saudi Arabia, Singapore, South Africa, Spain, Sweden, Switzerland, Taiwan, Thailand, Turkey, United Kingdom, United States, and Venezuela. While the full-sample analysis covers the longest time span available to us from 1900 to 2009 for each country, we additionally work with a sub-sample from 1974 to 2009 to cover a recent time period characterized by relatively open and integrated markets over the post-Bretton Woods period.

For each country, we have available information on spot exchange rates, the consumer price index (CPI), gross domestic product (GDP), money balances (currency in circulation), and short-term interest rates (T-Bills). We obtain these data from Global Financial Data (GFD), which provides access to a host of long-run macro and financial time series. Note that some countries do not have all data available for the full sample period and therefore enter the sample later. Also, we eliminate all euro member countries from the sample in the year of the actual adoption of the euro. Due to data availability, we have to employ annual data for CPI inflation, money growth, and GDP growth.

Spot exchange rates as well as CPI, GDP and money balances are measured at the end of each year and are not yearly averages. To ensure stationarity, we employ annual (log) changes of all macro variables (except for interest rates) in the subsequent analysis. Interest rate data are available at higher frequencies but we use annual data, measured at the end of each year, for consistency. We take the U.S. to be the home country and investigate exchange rates, growth rate differentials and interest rate differentials relative to the U.S. Table 1 shows median growth rates of our macro fundamentals and their availability across countries.[5] We present medians since our data include several time-country combinations of hyperinflations which dominate average growth rates and interest rates. For this reason, we later check the robustness of our results using winsorized time-series of exchange rates, interest rates, and macro fundamentals such that values above (below) the 95th percentile (5th percentile) are set to the 95th percentile (5th percentile).[6]

Table 1 about here

4. EMPIRICAL RESULTS

4.1. Forming country portfolios

Methodology. To investigate whether spot rates have predictive power for macro fundamentals in the cross-section of countries we mainly rely on a simple and robust method borrowed from the finance literature for most of our empirical analysis. Specifically, we form groups (or portfolios) of countries at the end of each year based on their lagged stochastically detrended spot rate (against the USD). The stochastically detrended spot rate ($\mathcal{S}$) is simply

[5]Most exchange rate series extend back to 1900 so that macro variables effectively determine data availability across countries.

[6]Note that we winsorize the growth rates of macro variables and detrended exchange rates and not the level of these variables themselves. The results using winsorized data indicate that our findings do not change qualitatively.

the log spot rate (s) minus its (log) average over the previous ten years ($\overline{s_{t-9;t}}$):

$$\mathcal{S}_t = s_t - \overline{s_{t-9;t}} \tag{7}$$

where exchange rates are in USD per FCU as in the theoretical discussion above so that higher values of $\mathcal{S}$ mean that the foreign currency has appreciated against the USD relative to its recent past.

We allocate the 25% of all countries with the lowest spot rate change (i.e. the largest depreciation against the USD) to group one (G1) and the 25% of all countries with the largest appreciation against the USD to group four (G4), with the remaining countries being allocated to the intermediate groups two or three (G2 and G3, respectively). These groups of countries, or *country portfolios*, then remain unchanged for one calendar year and we track their growth differential against the U.S. with respect to CPI inflation, money balances, nominal GDP, real money balances, and real GDP. In addition, we also compute risk premia (UIP deviations) as well as short-term interest rate differentials and real exchange rate changes against the U.S. over the year following the formation of groups.

Starting at the end of 1909, so that 1910 is our first forecast period, we then repeat this procedure each year to obtain time series of growth rate (and interest rate) differentials against the U.S. for each of the macro variables listed above and for each of the four portfolios. The dynamic rebalancing of country groups hence enables us to look at the *future macro performance* of groups of countries with relatively similar *past exchange rate depreciations*. A simple test of cross-sectional predictability amounts to testing whether there is a significant difference between growth rate differentials of G1 versus G4.[7] Note that taking the difference between two country portfolios, e.g. G1 and G4, effectively cancels out the U.S. component of growth differentials and interest rates so that we are looking at macro growth and interest rate differentials between the two respective groups of countries.

We employ this procedure for two main reasons. First, because it enjoys a number of advantages over standard regression approaches for the questions we want to examine. Forming

[7] As noted above, this procedure is heavily used in the finance literature in the context of equity or bond portfolios. However, this approach has also been used in the international finance literature, e.g. in the context of currency portfolios (see Lustig and Verdelhan, 2007; Menkhoff, Sarno, Schmeling, and Schrimpf, 2012a,b).

portfolios of countries and investigating their average growth rate differentials is nonparametric in the sense that we do not have to assume a specific functional relationship between lagged spot rate movements and future macro growth rates. While we would expect, for example, a monotonically declining pattern of money growth differentials when moving from G1 to G4 based on prediction (i) of the monetary model, the pattern across country portfolios may empirically be increasing, decreasing, or hump-shaped and employing the portfolio approach easily allows for all of these possible patterns.[8] In addition, the portfolio formation approach naturally handles unbalanced panels of data where countries enter the sample at different times (or drop out of the sample, e.g., due to the adoption of the euro). Also, predictive regressions involving persistent predictive variables are prone to biases and statistical problems with nominal significance levels (see e.g. Stambaugh, 1999), which we avoid by directly investigating the spread of growth differentials across country groups.[9] Second, this approach yields results which are readily interpretable in terms of economic significance in an out-of-sample setting, which is our main object of interest. The difference in growth differentials between G1 and G4 directly yields an estimate of how much higher the growth of a given macro factor is in countries with "weak" versus "strong" exchange rates. However, we also complement our main approach of forming portfolios of countries with more standard panel regressions below, for robustness.

Finally, we briefly discuss our choice of predictive variable, namely, the detrended spot exchange rate against the USD. Theory predicts that the spot rate itself should predict future changes in macro fundamentals. However, and as noted in Engel and West (2005), using the level of the spot rate directly can be problematic due to lack of stationarity. Hence, we opt to look at spot rates detrended over the previous ten years to accomplish two things. First, the horizon is long enough to net out short-term noise in exchange rate movements (which we are not interested in) but short enough so that nonstationarity does not become

[8]We do find very similar results with a linear panel regression approach below, however, so that allowing for non-linearities does not seem to be overly important in establishing our empirical results.

[9]This is relevant in our case when using the detrended exchange rate which is indeed persistent. For example, the average first-order autoregressive coefficient for the detrended spot exchange rate across all 35 currency pairs is estimated to be 0.83, with a cross-sectional standard deviation of 0.08; the maximum is 0.96 and the minimum is 0.61. Hence, statistical inference in predictive regressions in this case would have to take account of this persistence, which is notoriously cumbersome.

problematic.[10] Second, detrended spot rates represent deviations in percent and are, thus, directly comparable across countries and useful for sorting countries into portfolios. However, we also compute results based on simple one-year and ten-year (log) exchange rate changes instead of detrended spot rates for all major analyses, and find that our results are not driven by the specific choice of the detrended exchange rate.

Main results. Next we report our main results based on country portfolios. For robustness, we report results based on raw fundamentals and results based on winsorized fundamentals. To start with, the left part of Table 2, Panel A, shows average growth rate differentials (against the U.S.) for CPI inflation for all four groups of countries (G1 – G4) and the difference in average growth rates between G4 and G1 ("Diff"). Panel F shows the same for winsorized fundamentals. Numbers in brackets are t-statistics based on Newey and West (1987) standard errors. We report results both for the full sample period from 1910 to 2009 and for a shorter subperiod from 1974 to 2009. The latter sample period mainly serves as a control for robustness to see whether results for the full period also extend to the post-Bretton Woods era with relatively open capital markets, market integration, and exchange rate convertibility.[11]

We find that future CPI inflation is indeed much higher in countries whose currencies experienced the strongest depreciation against the USD over the previous ten years (G1) relative to countries whose currencies most strongly appreciated against the USD (G4). More specifically, the average annual difference in CPI growth against the U.S. for the full sample period is about 23% (15% for winsorized CPI inflation) for country portfolio G1 and declines monotonically when moving to G2 and G3 to a growth rate differential of about zero for countries with a strong appreciation against the USD in G4. Hence, there is a massive difference in growth rates of -23.32% (-14.77% for winsorized data), which is highly significant. Also, we find a very similar result when restricting the sample to the post-Bretton

[10] We have also experimented with somewhat shorter horizons (e.g. down to horizons of five years) and found that the results reported below are not affected qualitatively.

[11] We are aware of the fact that the full sample period covers different exchange rate regimes and that predictability of fundamentals by exchange rates might be different during fixed and floating exchange rate regimes. However, it seems a natural starting point to look at a very long sample period which contains a maximum of variability in fundamentals and exchange rates both in the time-series and cross-sectional domain in order to maximize statistical efficiency and economic significance.

Woods period. In sum, it appears that lagged spot rate movements have significant predictive power for future inflation in the cross-section of countries, and that this predictive power is economically significant. More importantly, the pattern in inflation differentials squares well with economic intuition and the predictions from traditional models of exchange rate determination outlined in Section 2.

Table 2 about here

Table 2 also reports the same kind of information for growth differentials in money balances (Panels B and G) and nominal GDP (Panels C and H). The evidence is very similar, and similarly impressive, for these two macro factors. There is an almost monotonic decline in growth rates when moving from G1 to G4 for both money and GDP growth differentials and for both sample periods. The smallest difference (in absolute value) between growth rates is about 10% for the full sample and winsorized GDP growth, and therefore all differences are economically large. Hence, spot exchange rates contain a lot of information for future (nominal) macro movements in the cross-section of countries, and the sign of the predictive relation with future money growth is in line with predictions (i), (v), and (vii) in the theoretical motivation (Section 2) above.

Furthermore, we investigate whether lagged spot rate movements are informative about future risk premia (UIP deviations) and report results in Panels D and I of Table 2. Risk premia are computed as $\rho_t = \Delta s_t + i_t^* - i_t$ and, since it is well known that exchange rate changes are hard to forecast at short horizons, we also report results for pure interest rate differentials $i_t^* - i_t$ in Panels E and J of the same table. As might be expected, we find that there is no significant predictability for risk premia in the full country sample, which is strongly dominated by fixed exchange rate regimes. We do find the expected negative pattern (see prediction (iv) in Section 2 above) for the post Bretton Woods sample, however, although the difference between G4 and G1 is not statistically significant. As noted above, we also examine interest rate differentials separately, and we do indeed find clear-cut results in this case. Specifically, looking at Panel E, there is a monotonically declining pattern in interest rate differentials when moving from country groups G1 to G4, and the difference between G1 and G4 is highly significant both in economic terms, -3.04% for the full sample and -6.30% for the later subsample, and in statistical terms with Newey-West based t-values of −3.08 and −3.40. The results are qualitatively identical for winsorized data (Panel J). We take this as being supportive of prediction (iv).

Next, we investigate the spot rate's ability to forecast real fundamentals and look at real money growth, real GDP growth, and real exchange rate changes. We use CPIs to deflate money balances and GDP, and to compute real exchange rates. Results for this exercise are reported in Table 3 and show that the evidence for these real variables is somewhat mixed. Starting with real money growth in Panel A we see some significant evidence in line with the theoretical prediction (vi) for the full sample (about -10% difference between G4 and G1) but not for the recent float. For winsorized data (Panel D), the results are even weaker in that we record no predictability for any of the two sample periods.

Results for real output growth (Panels B and E) are mixed. For the full sample, we find no evidence for the theoretically expected positive relation between exchange rate movements and output differentials (prediction (ii) in Section 2). Even worse, we find a negative pattern for the post-Bretton Woods sample, which is small in absolute magnitude but significant in statistical terms. This finding is striking since it is at odds with one of the central predictions of the monetary model. However, care must be taken when interpreting the evidence on real output differentials. Equation (3) above tells us that exchange rates should forecast real output differentials *multiplied by the income elasticity of money demand*. It is well known that the latter quantity is highly unstable over time in money demand equations, so that it is not especially surprising to find shaky patterns for this particular variable.[12]

Next, we find that detrended nominal exchange rates have some predictive power for real exchange rates (Panels C and F), at least over the recent post Bretton Woods sample. The pattern is such that countries with appreciating currencies (G4) experience an average increase of 3.08% (2.49% for winsorized data) in their future real exchange rates relative to countries with depreciating exchange rates (G1). This positive pattern is well in line with theory (prediction (iii) in Section 2) and strongly statistically significant for the non-winsorized data.

Finally, we plot the time-series of country portfolios' growth rate differentials (the difference between G4 and G1) in Figure 1 to get an idea of how much predictability varies

[12]See Mark and Sul (2003, pp. 657–658) for a discussion, and Knell and Stix (2005) for a survey of this issue.

over time. Intuitively, a larger growth rate (or interest rate) difference in absolute value indicates more predictability by detrended exchange rates. As can be seen from this figure (which plots both raw and winsorized data on the left and right axis, respectively), there is quite some instability over time especially in the mid 1970s with the end of Bretton Woods. However, there are other times of especially large predictability as well, for example around World War I and II.

Figure 1 about here

Overall, a fair conclusion seems to be that exchange rates offer less predictive power for real fundamentals than for nominal fundamentals, although this dichotomy in results is not directly predicted by theory. In addition, these findings are robust when using ten-year (log) exchange rate changes $s_t - s_{t-9}$ instead of detrended exchange rates $\mathcal{S}_t$ as predictors as shown in Tables A.4 and A.5 in the Internet Appendix. We find no substantial differences. Similarly, Table A.6 in the Internet Appendix presents results using one-year (log) exchange rate changes $s_t - s_{t-1}$ but does not yield new insights and confirms the finding that results for real macro fundamentals are somewhat shaky and depend on the particular exchange rate predictor at hand.

Table 3 about here

4.2. Monotonicity tests

To obtain more powerful tests of whether average growth rates are indeed decreasing or increasing across country portfolios, we employ several recent tests proposed by Patton and Timmermann (2010), which are designed to handle questions of exactly this kind. We adapt their general case to our setting with four country portfolios and briefly describe their tests in the following section.

Methodology. Let $\Delta_i = \mu_i - \mu_{i-1}$ be the difference between average growth rates in a macro variable i for two adjacent country portfolios. The hypothesis of a decreasing pattern in average growth rates can be tested by formulating the null and alternative hypotheses as

$$\begin{aligned} H_0 &: \quad \Delta_i \geq 0 \quad \text{for} \quad i = 2, 3, 4 \\ vs. \ H_1 &: \quad \Delta_i < 0 \end{aligned} \tag{8}$$

so that the alternative hypothesis is expected to hold if appreciating exchange rates forecast lower fundamentals' growth rates (or risk premia and interest rate differentials). More compactly, with $\mathbf{\Delta} = [\Delta_2, \Delta_3, \Delta_4]$, the above null and alternative can also be written as $H_0 : \ \mathbf{\Delta} \geq 0$ vs. $H_1 : \ \mathbf{\Delta} < 0$ where vector (in)equalities apply element-wise. Furthermore, the alternative hypothesis demands that $\max_{i=2,3,4} \Delta_i < 0$, which suggests the test statistic $J_T = \max_{i=2,3,4} \widehat{\Delta}_i$, where $\widehat{\Delta}$ denotes the sample estimate of differences in average growth rates $\widehat{\mu}_i - \widehat{\mu}_{i-1}$. Patton and Timmermann (2010) suggest a stationary block bootstrap to compute p-values for this test statistic (Politis and Romano, 1994), which we also employ in our analysis. We report results based on this test for monotonicity as "MR" in our tables for all fundamentals except for real output growth and real exchange rate changes. Here, theory indicates a monotonically increasing pattern so that we reformulate the null and alternative hypotheses accordingly.

In addition, we report three other test results which are related to the test described above and which are also described in Patton and Timmermann (2010). First, we report the "MR^{all}" test which is based not only on differences in average growth of adjacent country groups but on all pairwise comparisons of country portfolios. Second and third, we report results for "Up" and "Down" tests, which are somewhat less restrictive than the monotonicity tests (which require a monotonically declining pattern) and only test for increasing ("Up") or decreasing ("Down") patterns in average growth rates in some parts of the cross-sections. Hence, these tests are likely to have higher power.

Empirical results. Results for the MR, MR^{all}, "Up", and "Down" tests can be found in Tables 2 and 3 in the right part of each table.[13] Results from these tests are largely confirmative of our qualitative discussion above. The MR (MR^{all}, Down) tests tend to be significant

[13] Results for 10-year and 1-year exchange rate changes instead of detrended exchange rates can be found in Tables A.4 – A.6 in the Internet Appendix.

for CPI inflation, money growth, and nominal GDP growth differentials (Panels A – C and F – H of Table 2), especially when looking at the winsorized fundamentals, the only exception being the MR-tests for non-winsorized money growth differentials (Panel B). Results for risk premia (UIP deviations) and short-term interest rate differentials, respectively, are reported in Panels D-E and I-J of Table 2. As above, the evidence for risk premia is fairly weak. However, and similar to our findings above, there is clear evidence for a monotonic pattern in interest rate differentials. Results for real fundamentals are reported in Table 3. There is some evidence of a systematically declining pattern in average growth differentials for real money balances (but only for raw fundamentals and the Down test), and we do not find significant evidence of an increasing pattern in average real GDP growth differentials. However, there is clear evidence of a monotonically increasing pattern for real exchange rate changes both for the full sample period and the more recent subsample.

4.3. Panel regressions

In addition to our results based on country portfolios above, we also examine the key hypothesis of this paper in a more standard panel regression approach (see, e.g., Mark and Sul, 2012, for a discussion of panel regression models in an exchange rate context). To do so, we run predictive regressions of future macro fundamentals y_{t+1} on detrended spot exchange rates

$$y_{i,t+1} = \beta \mathcal{S}_{i,t} + e_{i,t+1} \tag{9}$$

where $e_{i,t+1} = \gamma_i + \theta_{t+1} + \epsilon_{i,t+1}$ so that γ_i is a country fixed effect, θ_{t+1} is a common time effect, and $\epsilon_{i,t+1}$ is an idiosyncratic error term. Note that applying a fixed-effects structure makes the regression relevant for time-series predictability as well, an issue we have not looked at in the country portfolios above. Hence, the panel regressions conducted here also enable us to examine whether lagged spot rate changes are a useful predictor of future growth differentials per se and not solely in a cross-sectional setting.[14] The common time effect serves to account for cross-sectional dependence in the error term. Finally, we employ a panel-jackknife to compute standard errors, which is robust to autocorrelated and heteroskedastic errors.

[14]However, note that these panel regressions are not conducted in a true out-of-sample setting since we are estimating parameters over the whole sample and do not update parameters in a recursive or rolling fashion.

We report results in Table 4 for the full sample (upper panel) and for the period from 1974 to 2009 (bottom panel). Results for winsorized fundamentals are shown in the Internet Appendix in Table A.1. In line with our theoretical discussion above, we find a significantly negative coefficient for detrended exchange rates for CPI inflation, money growth, and GDP growth differentials. Resembling this finding, we also see quite large "within-R^2s" (R_w^2 in the table) across the three fundamentals and both sample periods, reaching 57% and indicating a high degree of time-series predictability. Interestingly, within-R^2s generally increase for the post-Bretton Woods period. Overall, these results largely corroborate the findings from our country portfolios above.

Similar, though not completely identical, to our findings above there is some evidence of predictability for risk premia and short-term interest rate differentials. Risk premia are more predictable during the post-Bretton Woods period with a surprisingly large within-R^2 of 18%. Hence, risk premia seem to matter a lot more for exchange rates during the recent float but are basically unimportant when looking at the full sample. We find the expected negative sign for interest rate differentials for both sample periods but only weak statistical significance at conventional levels.

Table 4 about here

For real variables, we again find very mixed results. There is no significant evidence of predictability in both sample periods for real money growth. For the recent float, the slope in the real output regression has the wrong sign but is very small in magnitude. However, we confirm clear and significant predictability for real exchange rate changes for both sample periods.

As above, we also report results for using simple one-year exchange rate changes $s_{i,t} - s_{i,t-1}$ as predictors instead of detrended exchange rates $\mathcal{S}_{i,t}$ in the Appendix in Table A.8. Results are very similar to those for detrended exchange rates and show, as above, that results for real macro fundamentals are sensitive to which exchange rate predictor is used for forecasting.

In sum, our results based on panel regressions reinforce our point that exchange rates are quite informative about nominal fundamentals, pointing towards a prominent role of nominal fundamentals for the determination of exchange rates. Real fundamentals are harder to forecast with exchange rates (results are more sensitive to the method employed) and, hence, seem to matter less for exchange rate determination.

5. ADDITIONAL RESULTS AND ROBUSTNESS

5.1. Controlling for lagged fundamentals

Our empirical analysis so far shows that exchange rates (detrended exchange rates and exchange rate changes) predict future fundamentals in a way consistent with standard present-value models of exchange rates. This predictive power of exchange rates for fundamentals suggests that (expected) fundamentals drive exchange rates and, thus, supports the central message of present-value models.

However, while our results are well in line with present-value reasoning, it is not inconceivable that other mechanisms actually drive our results. To give a concrete example, consider our finding above that exchange rates are strong predictors of nominal macro fundamentals (CPI inflation, money growth, nominal GDP growth). This finding might be driven by the importance of nominal factors for exchange rates plus standard present-value reasoning, but it might as well be driven by the fact that countries with, e.g., higher lagged inflation tend to have both depreciating exchange rates and higher inflation rates in the future. Under this scenario, lagged inflation is informative about exchange rates as well as future inflation and the predictive power of exchange rates for future inflation is spurious.

To examine this possibility and to provide robustness for our main result, we next present tests which control for lagged macro fundamentals when assessing the predictive power of exchange rates for fundamentals.[15]

Double sorts. We begin by presenting results from double sorts where we do not only sort countries into portfolios based on lagged exchange rates, but where country portfolios are formed along two dimensions. At the end of each year we first sort countries into two groups depending on whether a country's lagged macro fundamental is above or below the cross-sectional median. This yields two groups of countries ("low" and "high"). Next, within the two groups, we sort countries into three portfolios (G1, G2, G3) based on their lagged

[15] This is not a hypothesis coming directly from present-value models but seems nevertheless interesting since it helps to clarify the link between exchange rates and fundamentals.

exchange rates. This procedure is repeated at the end of each year to yield a time-series of six country portfolios and allows us to test for predictability of fundamentals by the exchange rate separately for countries with high lagged macro fundamentals (e.g., high inflation, high risk premia, high real exchange rate changes) and low macro fundamentals.

We report results from these double sorts in Table 5 for all fundamentals and both sample periods (results for winsorized fundamentals are shown in Table A.2 in the Internet Appendix). As can be inferred, there is strong evidence of predictability for inflation, money growth, and nominal GDP growth for both sample periods and for both groups of countries. The difference in growth rates between country group G3 and G1 is naturally larger for countries with "high" lagged growth in fundamentals but we still find significant predictability for countries with "low" lagged growth in fundamentals as well. Hence, it does not seem to be the case that our results are purely driven by a few high inflation countries (outliers) which have persistently higher nominal growth rates and depreciating exchange rates.

Table 5 about here

Results for the other macro fundamentals are similar to what we found for the simple country portfolio sorts above. There is little evidence for risk premium predictability, some evidence for predictability of interest rate differentials, while real money growth is not predictable, and real exchange rate changes are somewhat predictable. In sum, controlling for cross-sectional differences between countries with high versus low lagged fundamentals does not significantly alter our conclusions from the core analysis.[16]

Panel regressions. While our analysis based on double sorts above already suggests that controlling for lagged fundamentals does not change our main conclusion, we now additionally present results for panel regressions which include lagged fundamentals as an additional explanatory variable, since controlling for lagged dependent variables is more naturally done in a regression framework

$$y_{i,t+1} = \beta \mathcal{S}_{i,t} + \phi y_{i,t} + e_{i,t+1} \tag{10}$$

[16] While results in Table 5 are based on detrended exchange rates, we also present results for simple one-year exchange rate changes in Table A.9 in the Internet Appendix. Results are again very similar.

where, as above, $e_{i,t+1} = \gamma_i + \theta_{t+1} + \epsilon_{i,t+1}$ and γ_i is a country fixed effect, θ_{t+1} is a common time effect, and $\epsilon_{i,t+1}$ is an idiosyncratic effect.

Table 6 presents results for these panel regressions (with fixed-effects) where we include one lag of the respective fundamental variable in each regression. Results for winsorized fundamentals are reported in the Internet Appendix in Table A.3. Again, our results are robust to controlling for lagged fundamentals as we still find significant predictability of nominal macro growth (inflation, money, GDP), highly significant risk premium and real GDP predictability for the recent float, and predictability of real exchange rate changes for both sample periods. Table A.10 in the Internet Appendix reports the same set of results for lagged exchange rate changes $s_{i,t} - s_{i,t-1}$ as predictors instead of detrended exchange rates $\mathcal{S}_{i,t}$, yielding similar results.[17] [18]

In sum, we find that our results in the main part of the paper hold even when controlling for lagged macro fundamentals.

5.2. *Country sorts and longer forecast horizons*

We finally present some results on predictability at longer horizons. Remember that the present-value model discussed in Section 2 states that exchange rates forecast the sum of future (discounted) fundamentals over long horizons and not just next year's fundamentals. Hence, in order to examine whether exchange rates depend on fundamentals at longer horizons, we rely on our approach to form country portfolios as in the core analysis but now examine the difference in growth rates between G4 and G1 at horizons ranging from $1, 2, ..., 10$ after portfolio formation.

Figure 2 plots the (average) difference in growth rates for the first ten years after portfolio formation for each macro fundamental and the sample period from 1909 to 1999 (since the

[17]Including lagged dependent variables in fixed-effects panel regressions can potentially lead to biased estimates since the error term is not independent of the lagged dependent variable (Arellano and Bond, 1991; Blundell and Bond, 1998). However, these problems associated with dynamic panel models are by and large relevant for panels with small T and large N, whereas we are dealing with a large T and small N. Hence, accounting for these features does not seem sensible in our setup.

[18]Finally, we also carry out standard Granger-causality tests (see, e.g., Engel and West, 2005, in the context of present-value models), where we pool over all countries to obtain more powerful tests compared to separate tests on individual currencies. We employ simple exchange rate changes in these tests since we want to have non-overlapping observations and report standard errors based on a jackknife. Since these tests are based on VAR estimates, they also control for lagged dependent variables. The test results further corroborate our earlier results.

last 10-year forecast horizon starts in 2000).[19] Shaded areas correspond to 95% confidence intervals based on Newey and West (1987) standard errors.

Figure 2 about here

Results are relatively stable across time. There is a slight tendency for inflation, money growth, and nominal GDP growth differentials to revert back to zero but this reversion is not very strong.

Figure 3 shows the same exercise for the post-Bretton Woods period. Limiting the sample period to 1974 – 1999 (again, the last ten years are only included as "forecast periods") naturally leads to wider confidence intervals for most fundamentals but also produces some additional patterns. For example, the shaky evidence of risk premium predictability in Table 3 is largely confined to very short horizons of one year since at longer horizons there is significant evidence of predictability. The opposite holds true for real exchange rate changes where predictability dies out after about five to six years. Finally, we find that the theoretically expected negative relationship between current exchange rates and future real money growth only holds at longer horizons of seven to ten years whereas there is no significant predictability at shorter horizons.

Figure 3 about here

In sum, our main conclusions are unaffected by investigating longer forecast horizons. However, this longer perspective yields additional insights on the impact of future fundamentals for current exchange rates. In fact, exchange rates forecast growth in inflation, money, and nominal GDP for long horizons which, again, highlights the importance of nominal factors for exchange rates. Other fundamentals, like risk premia or real money growth, may look unimportant from a short-run perspective but seem to matter more when looking at longer forecast horizons and can still have a large impact when discount factors are close to unity (Engel and West, 2005; Sarno and Sojli, 2009).

[19] Note that the difference in growth rates for year 1 after portfolio formation can differ from the respective values in Tables 2 and 3 due to the different sample periods.

6. CONCLUSION

We investigate whether exchange rates forecast fundamentals over a long sample ranging from 1900 to 2009 and for a broad set of 36 countries covering major currencies and currencies of emerging markets. Our results robustly indicate that spot exchange rates do have significant predictive power for future fundamentals in a model-free, out-of-sample forecasting exercise which rests on forming country portfolios based on lagged spot exchange rate movements. These findings also obtain in more standard panel regressions and are robust to controlling for lagged macro fundamentals. Hence, future fundamentals seem to matter a lot for the determination of current exchange rates. It is important to note that, while our results are consistent with the logic of a standard present-value model, they are also compatible with a different mechanism whereby exchange rate fluctuations affect future economic fundamentals. In other words, our empirical evidence is not necessarily confined to supporting the present-value model that links exchange rates to macro variables through an expectations mechanism, but it could be due to the fact that, for example, an exchange rate depreciation increases net exports and, hence, output. More generally, the fundamentals considered here are endogenously determined together with exchange rates in equilibrium, which is consistent with several alternative theories of exchange rate determination.

The results suggest that nominal macro fundamentals (CPI inflation, money growth, GDP growth) are most robustly related to exchange rates. Risk premia (UIP deviations) and real exchange rate changes only seem to matter during the recent float in the post-Bretton Woods period and seem to play a minor role more generally. Real macro aggregates, such as real output and real money, have no clear and meaningful relation to current exchange rates and, hence, appear relatively unimportant for exchange rate determination. Overall, we view the evidence in this paper as indicative of a meaningful link between exchange rates and macro fundamentals, suggesting that nominal fundamentals are most important for the determination of exchange rates whereas real factors matter only to a limited degree.

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Table 1. Data description

	Inflation		Money		GDP		Int. rates	
Country	Start	Median	Start	Median	Start	Median	Start	Median
Argentina	1902	9.13	1902	16.42	1902	15.58	1978	14.47
Australia	1903	3.05	1902	5.86	1902	8.04	1901	3.51
Austria	1902	2.77	1902	6.30	1915	4.92	1901	4.76
Belgium	1922	2.94	1902	4.01	1949	6.22	1901	4.47
Brazil	1902	10.69	1902	16.68	1902	17.90	1995	22.50
Canada	1912	2.70	1902	6.45	1928	7.29	1934	3.73
Denmark	1902	2.45	1902	5.45	1923	6.43	1901	5.06
Finland	1922	4.41	1902	7.91	1928	10.08	1901	6.79
France	1902	4.39	1902	6.30	1902	8.28	1901	3.45
Germany	1902	2.15	1902	7.20	1902	4.29	1901	3.73
Greece	1924	8.52	1915	14.49	1902	10.29	1913	9.06
Hong Kong	1949	4.13	1970	12.18	1962	12.06	1968	4.80
India	1902	4.75	1902	9.32	1923	8.38	1901	6.68
Indonesia	1950	9.81	1902	12.05	1923	14.90	1990	13.14
Ireland	1924	3.12	1902	6.08	1950	9.47	1901	4.82
Israel	1950	8.65	1950	16.11	1952	18.02	1985	11.73
Italy	1902	4.35	1902	8.45	1902	8.96	1901	5.39
Japan	1902	2.62	1902	8.27	1902	6.98	1901	5.10
Korea (Rep.)	1950	7.65	1952	17.73	1913	10.06	1988	NA
Mexico	1902	5.41	1903	11.64	1927	13.68	1962	9.98
Netherlands	1902	2.74	1902	4.52	1902	5.30	1901	3.33
New Zealand	1916	3.32	1902	5.19	1933	7.72	1923	6.39
Norway	1902	2.85	1902	5.57	1902	7.06	1901	4.01
Portugal	1932	4.47	1915	6.92	1952	11.26	1901	5.54
Saudi Arabia	1973	1.20	1962	7.45	1962	9.90	1992	4.05
Singapore	1950	1.31	1965	7.76	1959	10.11	1960	3.81
S. Africa	1902	4.09	1914	9.14	1913	9.86	1936	4.82
Spain	1902	3.97	1902	6.36	1902	7.98	1901	4.62
Sweden	1902	3.00	1902	5.45	1902	8.18	1901	4.68
Switzerland	1902	1.75	1902	3.85	1931	5.56	1901	2.77
Taiwan	1902	3.54	1902	12.53	1914	11.24	1962	5.36
Thailand	1950	3.61	1904	8.79	1948	9.67	1946	6.98
Turkey	1924	9.59	1933	23.12	1952	25.44	1973	42.23
UK	1902	2.53	1902	4.93	1902	5.67	1901	4.18
Venezuela	1915	6.72	1910	13.72	1952	13.12	1948	8.55

Notes: This table shows the first available observation ("Start") as well as median annual (log) growth rates (in percent) for CPI inflation, growth in money balances, GDP growth, and (levels of) short-term interest rates for all countries in our sample.

Table 2. Country portfolios: Nominal fundamentals

	G1	G2	G3	G4	Diff	MR	MR^{all}	Up	Down
				Non-winsorized fundamentals					
PANEL A. CPI inflation differential									
1910 – 2009	23.29	1.67	0.77	-0.04	-23.32	0.00	0.00	0.87	0.00
	[2.90]	[4.65]	[2.04]	[-0.08]	[-2.86]				
1974 – 2009	18.70	1.77	0.45	-1.29	-19.99	0.00	0.00	0.79	0.00
	[4.46]	[3.64]	[1.14]	[-3.79]	[-4.71]				
PANEL B. Money growth differential									
1910 – 2009	23.06	2.68	2.58	-1.36	-24.43	0.09	0.09	0.90	0.00
	[3.47]	[2.34]	[1.51]	[-0.81]	[-3.36]				
1974 – 2009	19.14	-0.15	0.67	-3.87	-23.01	0.37	0.42	0.65	0.00
	[5.62]	[-0.09]	[0.53]	[-1.45]	[-5.56]				
PANEL C. GDP growth differential									
1910 – 2009	17.19	2.55	0.95	0.70	-16.50	0.02	0.02	0.92	0.00
	[2.78]	[2.88]	[1.41]	[0.74]	[-2.82]				
1974 – 2009	20.52	3.42	1.90	-0.62	-21.14	0.00	0.00	0.93	0.00
	[5.14]	[6.23]	[3.16]	[-1.48]	[-5.33]				
PANEL D. Risk premia (UIP deviations)									
1910 – 2009	-5.23	8.34	-0.08	0.11	5.34	0.92	0.89	0.08	0.48
	[-1.78]	[0.98]	[-0.17]	[0.27]	[1.84]				
1974 – 2009	1.38	0.66	0.87	1.05	-0.33	0.46	0.50	0.49	0.39
	[1.60]	[0.83]	[1.02]	[1.13]	[-0.37]				
PANEL E. Interest rate differentials									
1910 – 2009	3.16	2.55	0.27	0.11	-3.04	0.00	0.00	0.89	0.06
	[3.24]	[1.21]	[4.44]	[1.39]	[-3.08]				
1974 – 2009	6.34	0.49	0.32	0.03	-6.30	0.03	0.03	0.74	0.00
	[3.48]	[3.58]	[2.36]	[0.23]	[-3.40]				

(continued)

Table 2. (continued)

	G1	G2	G3	G4	Diff	MR	MR^{all}	Up	Down
					Winsorized fundamentals				
PANEL F. CPI inflation differential									
1910 – 2009	14.56	1.72	0.76	-0.21	-14.77	0.00	0.00	0.85	0.00
	[4.49]	[5.15]	[2.19]	[-0.65]	[-4.41]				
1974 – 2009	17.54	1.75	0.46	-1.25	-18.79	0.00	0.00	0.79	0.00
	[4.83]	[3.65]	[1.19]	[-3.67]	[-5.10]				
PANEL G. Money growth differential									
1910 – 2009	15.14	3.11	1.33	0.57	-14.57	0.00	0.00	0.93	0.00
	[6.28]	[3.80]	[1.96]	[0.77]	[-5.50]				
1974 – 2009	17.96	1.56	0.75	-1.29	-19.24	0.00	0.00	0.96	0.00
	[6.18]	[2.16]	[0.78]	[-1.88]	[-6.12]				
PANEL H. GDP growth differential									
1910 – 2009	9.41	1.94	0.72	-0.27	-9.68	0.00	0.00	0.82	0.01
	[4.32]	[2.38]	[1.10]	[-0.41]	[-4.52]				
1974 – 2009	19.41	3.42	1.89	-0.62	-20.02	0.00	0.00	0.93	0.00
	[5.63]	[6.24]	[3.17]	[-1.49]	[-5.81]				
PANEL I. Risk premia (UIP deviations)									
1910 – 2009	-3.42	-1.03	-0.38	-0.49	2.92	0.82	0.78	0.19	0.76
	[-1.44]	[-0.94]	[-0.46]	[-0.65]	[1.30]				
1974 – 2009	1.81	0.40	0.43	-0.59	-2.40	0.07	0.07	0.93	0.20
	[1.32]	[0.26]	[0.25]	[-0.36]	[-1.53]				
PANEL J. Interest rate differentials									
1910 – 2009	2.61	0.38	0.27	0.15	-2.46	0.01	0.01	0.75	0.03
	[3.15]	[6.52]	[4.60]	[2.28]	[-2.90]				
1974 – 2009	6.16	0.48	0.31	0.03	-6.13	0.02	0.02	0.74	0.00
	[3.58]	[3.66]	[2.45]	[0.24]	[-3.49]				

Notes: The table reports average growth rates for four groups of countries (G1, ..., G4) which are formed depending on their detrended spot exchange rate against the USD. G1 contains the 25% of all countries that have depreciated most against the USD whereas G4 contains the 25% of all countries with the highest appreciation against the USD. The country portfolios are re-balanced annually. "Diff" report the difference in average growth rates between G4 and G1. MR and MR^{all} report p-values from a test for a monotonic decline in means from G1 to G4, whereas "Up" and "Down" test for a generally increasing or declining pattern, respectively (see Patton and Timmermann, 2010). Panels A – E report results based on the raw fundamentals whereas Panels F – J report results for winsorized fundamentals.

Table 3. Country portfolios: Real fundamentals

	G1	G2	G3	G4	Diff	MR	MR^{all}	Up	Down
				Non-winsorized fundamentals					
PANEL A. Real money growth differential									
1910 – 2009	8.50	0.28	1.71	-1.22	-9.72	0.58	0.53	0.47	0.02
	[2.05]	[0.31]	[1.06]	[-0.80]	[-2.06]				
1974 – 2009	1.53	-1.91	0.17	-2.63	-4.16	0.84	0.89	0.20	0.05
	[1.02]	[-1.24]	[0.15]	[-0.98]	[-1.32]				
PANEL B. Real GDP growth differential									
1910 – 2009	1.01	0.11	-0.19	0.60	-0.41	0.31	0.31	0.36	0.70
	[0.15]	[0.15]	[-0.29]	[0.75]	[-0.07]				
1974 – 2009	3.19	1.65	1.45	0.63	-2.56	1.00	1.00	0.93	0.00
	[3.01]	[4.06]	[2.99]	[1.53]	[-3.14]				
PANEL C. Real exchange rate changes									
1910 – 2009	-1.77	0.29	0.40	1.04	2.81	0.04	0.04	0.20	0.89
	[-0.81]	[0.31]	[0.49]	[1.07]	[1.27]				
1974 – 2009	-1.14	-0.69	-0.06	1.94	3.08	0.00	0.00	0.05	0.97
	[-0.66]	[-0.45]	[-0.04]	[1.22]	[2.20]				
				Winsorized fundamentals					
PANEL D. Real money growth differential									
1910 – 2009	0.60	0.79	0.57	0.77	0.17	0.28	0.28	0.71	0.77
	[0.42]	[1.21]	[0.89]	[1.17]	[0.15]				
1974 – 2009	0.36	-0.18	0.26	-0.03	-0.39	0.39	0.37	0.64	0.59
	[0.25]	[-0.27]	[0.33]	[-0.05]	[-0.31]				
PANEL E. Real GDP growth differential									
1910 – 2009	-6.18	-0.10	-0.07	-0.01	6.18	0.14	0.13	0.15	0.85
	[-1.59]	[-0.14]	[-0.10]	[-0.01]	[1.74]				
1974 – 2009	2.08	1.65	1.44	0.63	-1.45	1.00	1.00	0.89	0.00
	[3.08]	[4.06]	[2.98]	[1.55]	[-2.79]				
PANEL F. Real exchange rate changes									
1910 – 2009	-0.10	0.25	0.37	0.98	1.08	0.06	0.06	0.29	0.89
	[-0.08]	[0.29]	[0.49]	[1.18]	[0.97]				
1974 – 2009	-0.86	-0.64	-0.15	1.63	2.49	0.00	0.00	0.09	0.97
	[-0.53]	[-0.42]	[-0.11]	[1.10]	[1.83]				

Notes: The table reports average growth rates for four groups of countries (G1, ..., G4) which are formed depending on their detrended spot exchange rate against the USD. G1 contains the 25% of all countries that have depreciated most against the USD whereas G4 contains the 25% of all countries with the highest appreciation against the USD. The country portfolios are re-balanced annually. "Diff" report the difference in average growth rates between G4 and G1. MR and MR^{all} report p-values from a test for a monotonic decline (increase for real exchange rates changes) in means from G1 to G4, whereas "Up" and "Down" test for a generally increasing or declining pattern, respectively (see Patton and Timmermann, 2010). Panels A – C in the upper part of the table report results based on the raw fundamentals whereas Panels D – F report results for winsorized fundamentals.

Table 4. Panel regressions

	INF	MON	GDP	RP	IR	RMON	RGDP	RER
Sample period: 1910 – 2009								
const.	0.01	-0.22	0.01	-0.21	0.01	-0.24	-0.05	-0.07
	[0.56]	[-0.85]	[1.07]	[-0.97]	[0.82]	[-0.90]	[-2.44]	[-3.59]
$\mathcal{S}_t$	-0.60	-0.53	-0.29	2.49	-0.07	0.07	0.38	0.11
	[-3.66]	[-3.65]	[-2.86]	[1.11]	[-1.90]	[1.85]	[1.67]	[3.13]
ϱ	0.02	0.01	0.01	0.04	0.02	0.01	0.02	0.02
R^2	0.25	0.18	0.11	0.07	0.04	0.07	0.08	0.16
R^2_w	0.23	0.17	0.09	0.08	0.04	0.07	0.09	0.17
R^2_b	0.73	0.75	0.79	0.00	0.40	0.03	0.00	0.21
$F_{\alpha_i=0}$	1.56	0.90	0.66	1.42	1.19	0.56	1.28	1.22
	(0.10)	(0.62)	(0.88)	(0.16)	(0.31)	(0.95)	(0.23)	(0.26)
obs	3004	3099	2818	2511	2503	2939	2732	3004
Sample period: 1974 – 2009								
	INF	MON	GDP	RP	IR	RMON	RGDP	RER
const.	0.01	-0.22	0.01	0.01	0.01	-0.24	-0.04	-0.07
	[0.38]	[-0.82]	[0.51]	[2.35]	[1.94]	[-0.89]	[-3.45]	[-3.52]
$\mathcal{S}_t$	-0.54	-0.50	-0.56	-0.07	-0.16	0.04	-0.02	0.11
	[-4.00]	[-3.24]	[-3.96]	[-2.95]	[-1.76]	[1.74]	[-2.07]	[2.99]
ϱ	0.15	0.05	0.17	0.08	0.14	0.04	0.05	0.11
R^2	0.64	0.46	0.68	0.16	0.33	0.04	0.18	0.24
R^2_w	0.52	0.30	0.57	0.18	0.24	0.05	0.19	0.30
R^2_b	0.90	0.90	0.91	0.18	0.63	0.05	0.14	0.05
$F_{\alpha_i=0}$	4.55	1.75	4.85	2.01	3.91	1.08	1.66	1.85
	(0.00)	(0.05)	(0.00)	(0.02)	(0.00)	(0.41)	(0.07)	(0.04)
obs	1152	1137	1149	1062	1062	1137	1149	1152

Notes: This table shows results from panel regressions with country- and time fixed-effects of future inflation differentials (INF), money growth differentials (MON), GDP growth differentials (GDP), risk premia (RP) short-term interest rate differentials (IR), real money growth differentials (RMON), real GDP growth differentials (RGDP), or real exchange rate changes (RER) on detrended spot exchange rates against the USD $\mathcal{S}_t$, where a higher value means a larger appreciation against the USD. R^2 denotes the overall regression R-squared, while R^2_w and R^2_b are the "within" (time-series) and "between" (cross-sectional) R-squareds. ϱ denotes the fraction of variance due to individual intercepts, $F_{\alpha_i=0}$ reports the test statistic for the null that all country fixed-effects are equal to zero (p-value in parenthesis) and obs denotes the total number of observations. t-statistics are based on jackknife standard errors.

Table 5. Country portfolios: Double sorts

	1909-2009				1974-2009			
	Panel A. Nominal fundamentals							
	G1	G2	G3	Diff	G1	G2	G3	Diff
INF low	1.28	-0.22	-0.60	-1.88	0.42	-0.57	-1.67	-2.09
	[2.73]	[-0.51]	[-1.39]	[-3.62]	[0.81]	[-2.72]	[-4.43]	[-2.96]
INF high	38.99	4.37	2.11	-36.88	40.07	5.12	1.82	-38.26
	[4.16]	[4.40]	[3.96]	[-3.93]	[4.25]	[5.05]	[2.75]	[-4.17]
MON low	4.21	1.84	-2.48	-6.69	-0.72	0.22	-4.79	-4.07
	[3.02]	[1.17]	[-1.28]	[-2.86]	[-0.51]	[0.14]	[-1.43]	[-1.02]
MON high	35.20	5.98	3.63	-31.57	39.78	5.66	2.07	-37.71
	[4.65]	[6.35]	[3.82]	[-4.03]	[4.77]	[5.52]	[1.21]	[-4.43]
GDP low	9.96	-0.54	0.41	-9.55	1.70	0.36	-1.56	-3.25
	[1.32]	[-0.70]	[0.34]	[-1.42]	[2.22]	[0.56]	[-2.74]	[-3.17]
GDP high	25.05	6.05	3.68	-21.37	42.13	7.07	3.96	-38.17
	[5.04]	[5.40]	[4.29]	[-4.44]	[4.67]	[7.09]	[5.21]	[-4.44]
RP low	-8243.17	16.66	0.04	8243.21	1.37	0.47	0.66	-0.71
	[-1.12]	[0.98]	[0.11]	[1.12]	[1.83]	[0.60]	[0.95]	[-1.81]
RP high	-1.73	-1.03	0.27	2.00	1.39	0.95	1.41	0.02
	[-0.92]	[-1.05]	[0.61]	[1.06]	[1.18]	[0.85]	[1.55]	[0.01]
IR low	3.53	0.04	-0.07	-3.60	0.05	0.08	-0.25	-0.31
	[1.04]	[0.89]	[-1.04]	[-1.06]	[0.47]	[0.73]	[-1.84]	[-1.78]
IR high	4.56	0.73	0.53	-4.02	8.79	1.15	0.78	-8.01
	[3.07]	[6.22]	[4.21]	[-2.79]	[3.10]	[5.38]	[5.85]	[-2.91]
	Panel B. Real fundamentals							
	G1	G2	G3	Diff	G1	G2	G3	Diff
RMON high	-0.34	0.05	-0.40	-0.06	-2.76	-0.76	-3.44	-0.68
	[-0.20]	[0.06]	[-0.26]	[-0.03]	[-1.64]	[-0.51]	[-1.00]	[-0.16]
RMON low	-0.33	1.79	1.10	1.43	1.01	0.71	2.26	1.25
	[-0.19]	[1.84]	[0.48]	[0.71]	[0.75]	[0.56]	[2.00]	[1.24]
RGDP high	-12.54	0.42	-0.13	12.41	0.79	0.16	-0.40	-1.18
	[-0.86]	[0.65]	[-0.19]	[0.84]	[0.93]	[0.44]	[-0.79]	[-1.32]
RGDP low	0.82	0.68	2.06	1.24	2.64	3.09	2.44	-0.21
	[0.69]	[0.92]	[2.30]	[0.97]	[3.87]	[4.53]	[4.00]	[-0.30]
RER low	2.16	0.36	0.51	-1.66	-0.37	0.47	1.16	1.53
	[1.50]	[0.36]	[0.60]	[-1.21]	[-0.19]	[0.28]	[0.72]	[1.14]
RER high	-4.03	0.29	1.38	5.41	-2.51	-0.36	1.29	3.80
	[-2.02]	[0.35]	[1.58]	[2.74]	[-1.65]	[-0.24]	[1.00]	[5.10]

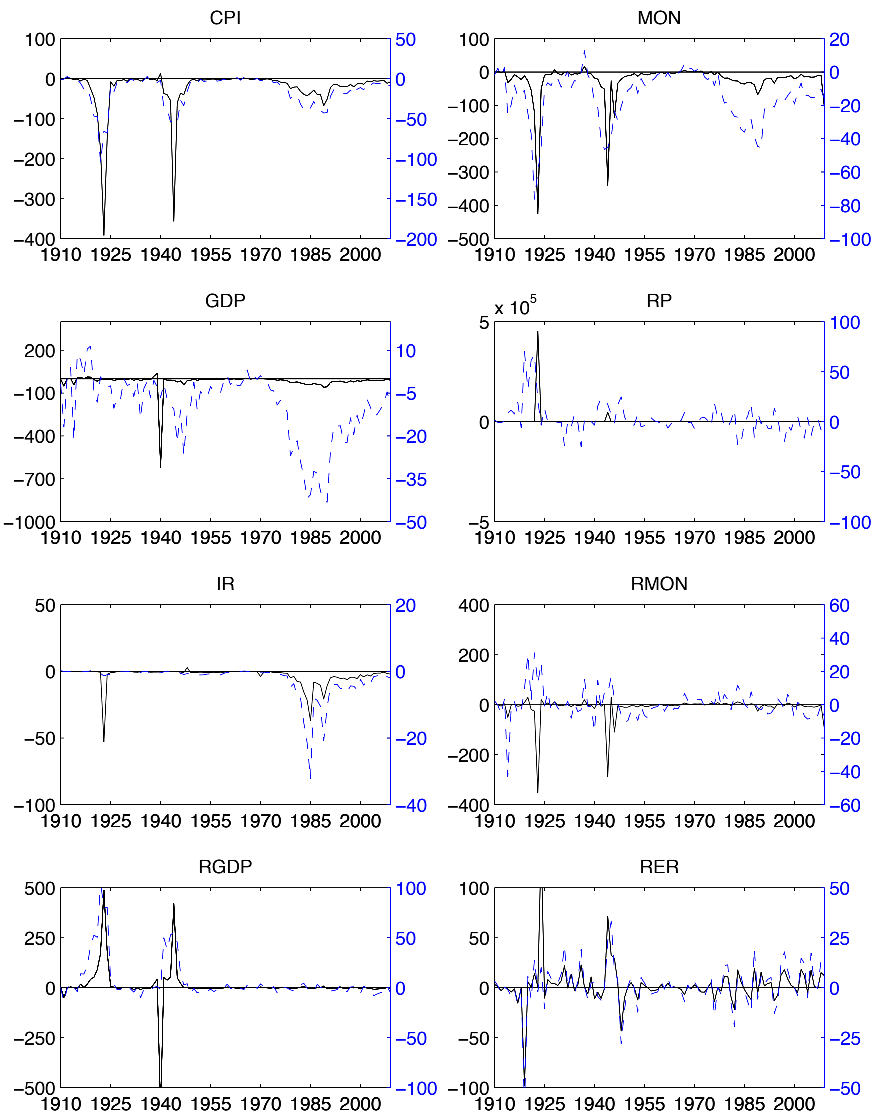
Notes: The table reports average growth rates for country portfolios based on double sorts where countries are first sorted into two groups according to their lagged fundamentals (along the median of the cross-sectional distribution of the lagged fundamental) and then into three portfolios depending on their lagged (detrended) exchange rate.

Table 6. Panel regressions: Controlling for lagged dependent variables

Sample period: 1910 – 2009								
	INF	MON	GDP	RP	IR	RMON	RGDP	RER
$\mathcal{S}_t$	-0.45	-0.48	-0.28	2.70	-0.07	0.07	0.36	0.12
	[-2.76]	[-3.24]	[-2.37]	[1.10]	[-1.71]	[1.84]	[1.32]	[2.60]
$y_{i,t}$	0.24	0.08	0.03	-0.05	-0.02	-0.04	0.08	-0.16
	[1.64]	[2.06]	[0.09]	[-3.97]	[-0.07]	[-0.90]	[0.24]	[-3.03]
ϱ	0.01	0.01	0.01	0.05	0.02	0.01	0.02	0.02
R^2	0.30	0.19	0.11	0.07	0.04	0.07	0.08	0.21
R^2_w	0.28	0.17	0.09	0.09	0.04	0.07	0.09	0.19
R^2_b	0.82	0.77	0.81	0.00	0.35	0.05	0.00	0.30
$F_{\alpha_i=0}$	0.88	0.76	0.61	1.59	1.21	0.60	1.07	1.05
	(0.65)	(0.78)	(0.92)	(0.10)	(0.29)	(0.93)	(0.42)	(0.38)
obs	2,989	3,091	2,797	2,486	2,486	2,923	2,709	2,989
Sample period: 1974 – 2009								
	INF	MON	GDP	RP	IR	RMON	RGDP	RER
$\mathcal{S}_t$	-0.18	-0.40	-0.27	-0.04	-0.09	0.05	-0.02	0.09
	[-2.55]	[-3.05]	[-3.03]	[-2.06]	[-1.66]	[1.83]	[-2.46]	[3.00]
$y_{i,t}$	0.59	0.18	0.50	0.02	0.35	-0.10	0.11	-0.13
	[5.58]	[0.98]	[9.89]	[0.36]	[2.09]	[-0.50]	[1.84]	[-1.52]
ϱ	0.02	0.04	0.06	0.07	0.06	0.05	0.04	0.10
R^2	0.76	0.48	0.78	0.17	0.43	0.04	0.19	0.22
R^2_w	0.65	0.32	0.67	0.19	0.31	0.06	0.19	0.29
R^2_b	0.98	0.93	0.97	0.11	0.83	0.12	0.25	0.05
$F_{\alpha_i=0}$	0.70	1.12	1.25	1.70	1.53	1.23	1.35	1.89
	(0.85)	(0.38)	(0.26)	(0.06)	(0.11)	(0.27)	(0.19)	(0.05)
obs	1,152	1,137	1,149	1,056	1,056	1,137	1,149	1,152

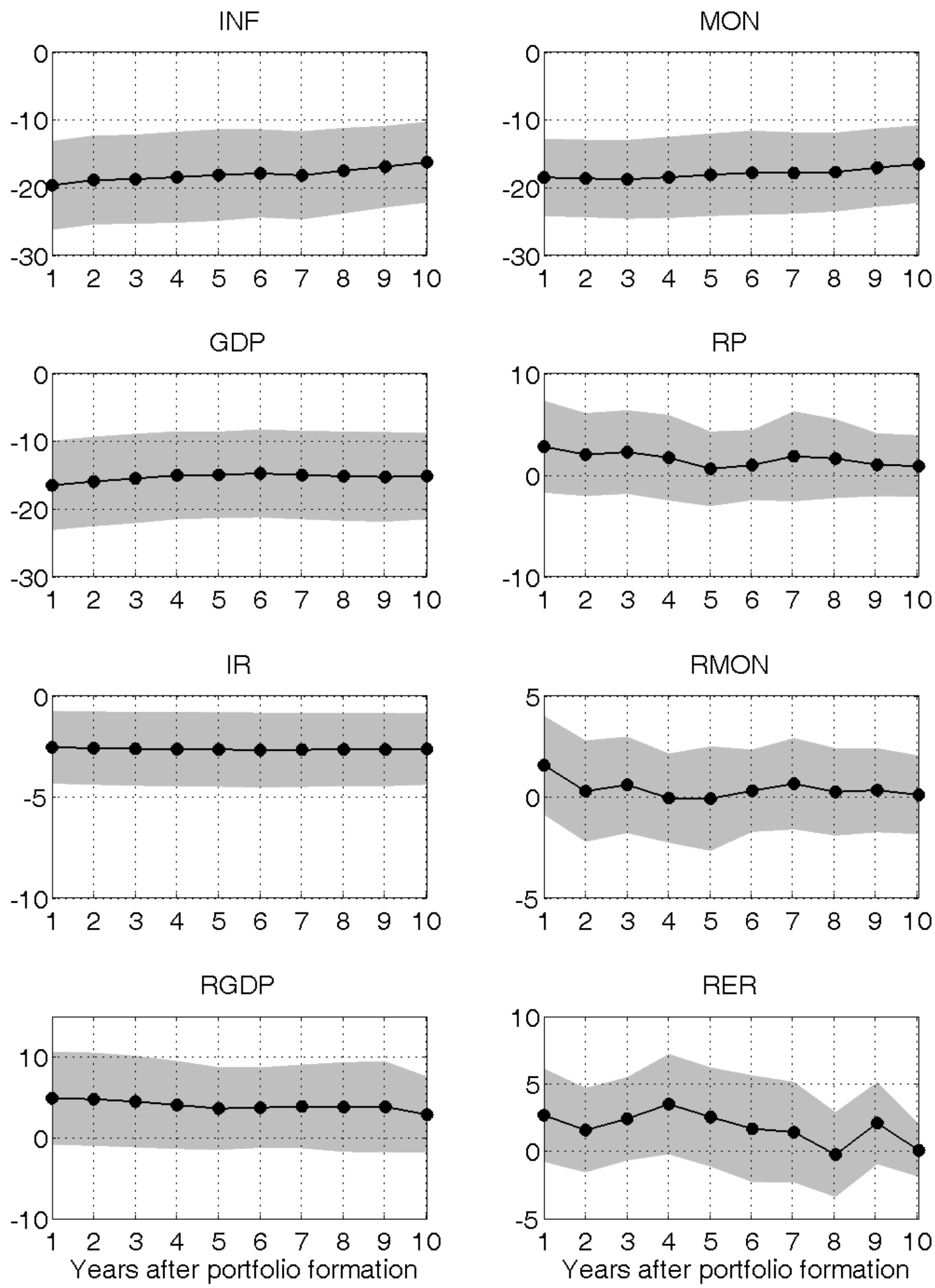
Notes: The setup of this table is identical to Table 4 but the panel regressions additionally contain one lag of the dependent variable ($y_{i,t}$). We do not report the constant to conserve space.

Figure 1. Country portfolio growth rates over time



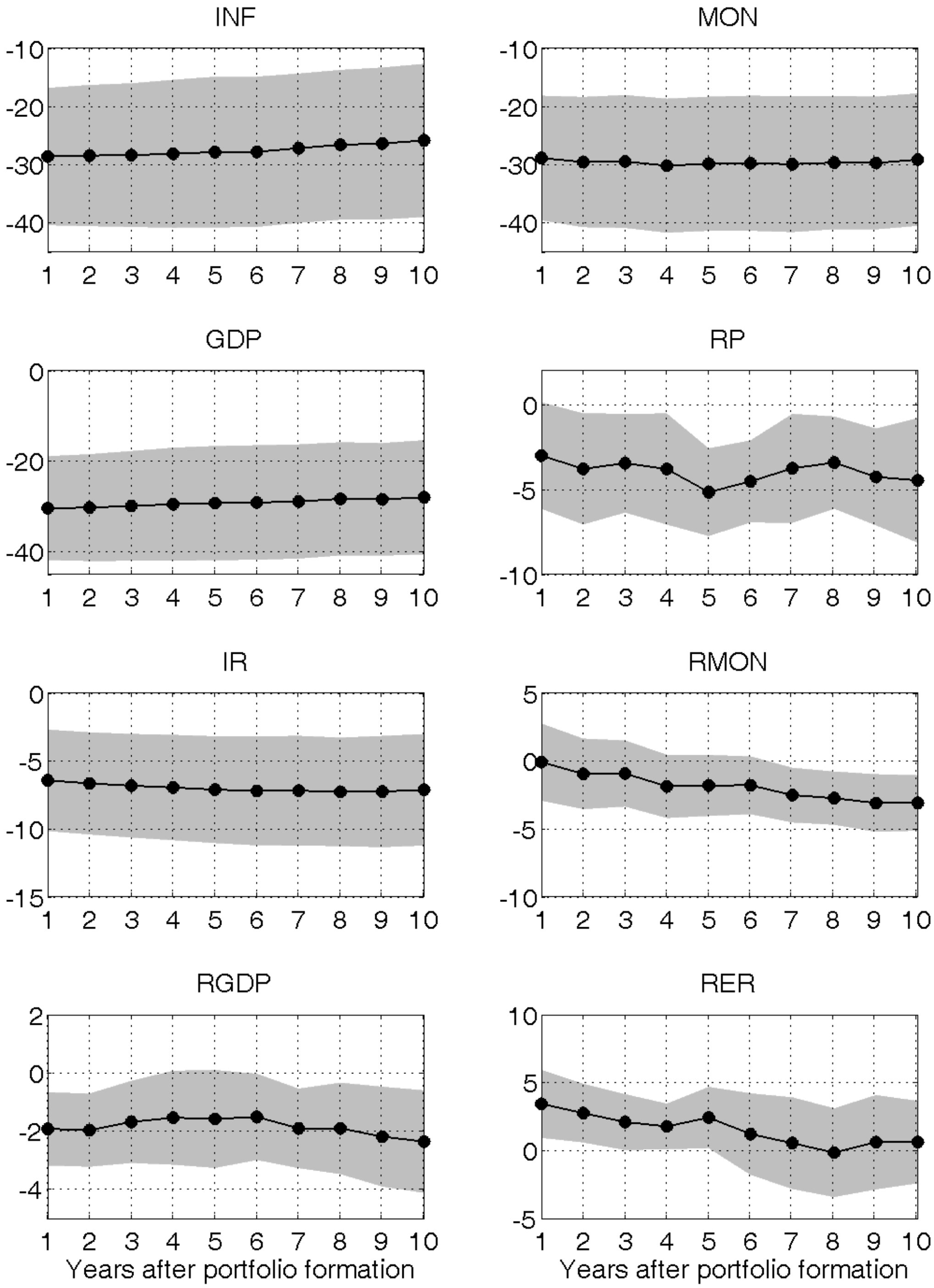
Notes: This figure shows the difference in fundamentals' growth rates (or risk premia) between countries in group 4 (G4) and group 1 (G1). Growth rates (or risk premia) are in percent. The eight subfigures correspond to CPI inflation (CPI), growth in money balances (MON), GDP growth (GDP), risk premia (RP), interest rate differentials (IR), real money growth (RMON), real GDP growth (RGDP), and changes in real exchange rates (RER). The sample period is 1909 – 2009. The left axes and solid lines correspond to raw macro fundamentals whereas the right axes and dashed lines show results for winsorized macro fundamentals.

Figure 2. Country portfolio growth rates over longer horizons



Notes: This figure shows average annual differences in growth rates (or interest rates) of country portfolios (G4-G1) over $1, 2, ..., 10$ years after portfolio formation for CPI inflation (CPI), growth in money balances (MON), GDP growth (GDP), risk premia (RP), interest rate differentials (IR), real money growth (RMON), real GDP growth (RGDP), and changes in real exchange rates (RER). The sample period is 1910 – 2010.

Figure 3. Country portfolio growth rates over longer horizons: Post-Bretton Woods sample



Notes: This figure shows average annual differences in growth rates (or interest rates) of country portfolios (G4-G1) over $1, 2, ..., 10$ years after portfolio formation for CPI inflation (CPI), growth in money balances (MON), GDP growth (GDP), risk premia (RP), interest rate differentials (IR), real money growth (RMON), real GDP growth (RGDP), and changes in real exchange rates (RER). The sample period is 1974 – 1999.

Internet Appendix for

Which Fundamentals Drive Exchange Rates? A Cross-Sectional Perspective

Table A.1. Panel regressions

This table is identical to Table 4 in the main text but here we winsorize all macro fundamentals' time-series.

Sample period: 1910 – 2009								
	INF	MON	GDP	RP	IR	RMON	RGDP	RER
const.	0.00	0.03	0.00	0.07	0.00	0.01	-0.05	-0.08
	[0.55]	[1.47]	[0.28]	[3.36]	[0.04]	[0.52]	[-3.49]	[-3.58]
$\mathcal{S}_t$	-0.35	-0.30	-0.28	0.04	-0.05	0.04	0.12	0.11
	[-5.24]	[-4.20]	[-3.31]	[0.81]	[-1.55]	[2.39]	[1.78]	[3.11]
ϱ	0.02	0.03	0.06	0.09	0.31	0.03	0.08	0.02
R^2	0.52	0.47	0.48	0.25	0.22	0.19	0.19	0.15
R^2_w	0.47	0.41	0.43	0.26	0.13	0.19	0.21	0.16
R^2_b	0.90	0.91	0.79	0.03	0.68	0.01	0.03	0.21
$F_{\alpha_i=0}$	1.98	2.51	6.22	3.43	12.96	2.08	6.35	1.23
	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)	(0.27)
obs	3004	3099	2818	2503	2503	2939	2732	3004

Sample period: 1974 – 2009								
	INF	MON	GDP	RP	IR	RMON	RGDP	RER
const.	0.00	0.04	0.01	0.08	0.01	0.01	-0.04	-0.07
	[0.50]	[1.41]	[0.58]	[5.06]	[2.05]	[0.43]	[-3.50]	[-3.51]
$\mathcal{S}_t$	-0.49	-0.48	-0.52	-0.15	-0.15	0.04	-0.01	0.11
	[-3.71]	[-3.11]	[-3.71]	[-7.56]	[-1.75]	[3.66]	[-1.46]	[3.02]
ϱ	0.16	0.13	0.17	0.12	0.15	0.10	0.06	0.12
R^2	0.68	0.66	0.71	0.26	0.35	0.10	0.22	0.23
R^2_w	0.56	0.50	0.60	0.30	0.25	0.14	0.22	0.31
R^2_b	0.90	0.89	0.91	0.25	0.64	0.00	0.19	0.03
$F_{\alpha_i=0}$	5.24	4.63	5.26	2.40	4.32	2.67	2.12	1.81
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.02)	(0.04)
obs	1152	1137	1149	1062	1062	1137	1149	1152

Table A.2. Country portfolios: Double sorts

The table is identical to Table 5 in the main text but here we winsorize all macro fundamentals' time-series.

	1910-2009				1974-2009			
	Panel A. Nominal fundamentals							
	G1	G2	G3	Diff	G1	G2	G3	Diff
INF low	1.34	-0.14	-0.72	-2.06	0.42	-0.57	-1.63	-2.05
	[2.94]	[-0.35]	[-2.27]	[-4.52]	[0.81]	[-2.72]	[-4.28]	[-2.88]
INF high	27.48	4.38	1.94	-25.53	37.85	5.08	1.82	-36.03
	[5.99]	[4.84]	[4.36]	[-5.66]	[4.50]	[5.07]	[2.82]	[-4.43]
MON low	3.72	0.55	-0.08	-3.80	0.92	-0.72	-1.67	-2.59
	[4.51]	[0.75]	[-0.12]	[-5.62]	[1.39]	[-0.89]	[-2.04]	[-3.93]
MON high	26.00	5.80	4.03	-21.97	38.24	5.28	3.30	-34.94
	[6.80]	[7.36]	[4.89]	[-5.49]	[5.04]	[5.30]	[2.42]	[-4.47]
GDP low	1.22	-0.64	-0.63	-1.84	1.69	0.36	-1.50	-3.19
	[1.29]	[-0.78]	[-0.89]	[-2.22]	[2.25]	[0.57]	[-2.68]	[-3.16]
GDP high	23.11	4.91	2.76	-20.36	40.23	7.04	3.96	-36.27
	[5.01]	[5.35]	[3.72]	[-4.77]	[4.91]	[7.11]	[5.26]	[-4.67]
RP low	-4.99	-1.75	-0.94	4.04	1.16	-0.25	-0.22	-1.39
	[-1.78]	[-1.45]	[-1.22]	[1.53]	[0.65]	[-0.16]	[-0.14]	[-1.00]
RP high	0.02	-0.30	-0.28	-0.30	2.52	0.76	-0.82	-3.34
	[0.02]	[-0.28]	[-0.36]	[-0.26]	[1.48]	[0.38]	[-0.47]	[-2.13]
IR low	0.08	0.04	-0.07	-0.14	0.06	0.07	-0.25	-0.31
	[1.52]	[0.92]	[-1.04]	[-2.07]	[0.54]	[0.70]	[-1.94]	[-1.86]
IR high	3.59	0.77	0.61	-2.98	8.53	1.12	0.77	-7.76
	[2.93]	[7.69]	[8.40]	[-2.51]	[3.20]	[5.52]	[6.04]	[-2.99]
	Panel B. Real fundamentals							
	G1	G2	G3	Diff	G1	G2	G3	Diff
RMON high	-2.29	-0.38	0.31	2.60	-1.73	-1.25	-0.62	1.11
	[-1.29]	[-0.71]	[0.42]	[1.49]	[-1.64]	[-1.85]	[-0.68]	[0.97]
RMON low	2.19	2.36	2.08	-0.11	1.85	1.73	2.47	0.62
	[2.42]	[3.16]	[3.04]	[-0.15]	[1.51]	[1.88]	[2.44]	[0.63]
RGDP high	-8.77	-0.34	-0.96	7.81	0.44	0.20	-0.34	-0.79
	[-1.96]	[-0.49]	[-1.61]	[1.85]	[0.64]	[0.57]	[-0.70]	[-1.18]
RGDP low	1.35	0.61	1.35	0.00	3.27	3.10	2.38	-0.89
	[1.04]	[0.79]	[2.00]	[0.00]	[4.20]	[4.70]	[4.01]	[-1.09]
RER low	1.28	0.41	0.35	-0.92	-0.66	0.37	0.78	1.44
	[1.04]	[0.47]	[0.46]	[-0.78]	[-0.36]	[0.23]	[0.53]	[1.07]
RER high	-0.96	0.40	1.42	2.35	-2.00	-0.22	1.36	3.35
	[-0.85]	[0.53]	[1.77]	[2.50]	[-1.37]	[-0.16]	[1.03]	[4.62]

Table A.3. Panel regressions: Controlling for lagged dependent variables

The setup of this table is identical to Table 4 but we winsorize the macro fundamentals.

Sample period: 1910 – 2009								
	INF	MON	GDP	RP	IR	RMON	RGDP	RER
$\mathcal{S}_t$	-0.09	-0.13	-0.09	-0.01	-0.02	0.03	0.03	0.10
	[-2.55]	[-3.71]	[-2.89]	[-0.19]	[-1.54]	[2.42]	[1.35]	[2.51]
$y_{i,t}$	0.66	0.52	0.66	0.27	0.49	0.12	0.60	-0.15
	[10.02]	[5.36]	[9.70]	[4.15]	[4.01]	[2.41]	[7.69]	[-3.14]
ϱ	0.01	0.01	0.01	0.03	0.13	0.02	0.01	0.02
R^2	0.69	0.61	0.72	0.32	0.47	0.20	0.49	0.17
R^2_w	0.65	0.56	0.67	0.31	0.33	0.21	0.48	0.18
R^2_b	0.99	0.98	0.98	0.68	0.98	0.05	0.92	0.30
$F_{\alpha_i=0}$	0.49	0.88	1.19	1.69	3.65	1.54	1.10	1.15
	(0.98)	(0.65)	(0.31)	(0.07)	(0.00)	(0.11)	(0.39)	(0.34)
obs	2,989	3,091	2,797	2,486	2,486	2,923	2,709	2,989
Sample period: 1974 – 2009								
	INF	MON	GDP	RP	IR	RMON	RGDP	RER
$\mathcal{S}_t$	-0.13	-0.24	-0.22	-0.13	-0.08	0.03	-0.02	0.10
	[-3.11]	[-3.00]	[-3.13]	[-5.46]	[-1.75]	[2.80]	[-2.01]	[3.08]
$y_{i,t}$	0.67	0.49	0.56	0.15	0.40	0.11	0.14	-0.11
	[10.32]	[12.84]	[10.22]	[2.41]	[2.11]	[2.16]	[2.56]	[-1.60]
ϱ	0.02	0.05	0.05	0.11	0.06	0.07	0.05	0.11
R^2	0.81	0.75	0.81	0.26	0.48	0.13	0.24	0.24
R^2_w	0.71	0.61	0.71	0.31	0.35	0.15	0.24	0.32
R^2_b	0.99	0.97	0.98	0.22	0.86	0.04	0.37	0.04
$F_{\alpha_i=0}$	0.63	1.26	1.10	1.91	1.44	1.86	1.56	1.73
	(0.91)	(0.25)	(0.29)	(0.03)	(0.14)	(0.04)	(0.10)	(0.06)
obs	1,152	1,137	1,149	1,056	1,056	1,137	1,149	1,152

Table A.4. Country portfolios: Nominal fundamentals, 10-year exchange rate changes

The setup of this table is identical to Table 2 but here we use 10-year exchange rate changes instead of detrended exchange rates to sort countries into groups.

	G1	G2	G3	G4	Diff	MR	MR^{all}	Up	Down
Panel A. CPI inflation differential									
1910 – 2009	14.37	1.98	0.75	-0.15	-14.52	0.00	0.00	0.81	0.00
	[4.51]	[4.60]	[2.43]	[-0.45]	[-4.37]				
1974 – 2009	17.66	1.81	0.23	-1.17	-18.83	0.00	0.00	0.74	0.00
	[4.94]	[3.67]	[0.68]	[-3.38]	[-5.17]				
Panel B. Money growth differential									
1910 – 2009	14.38	3.46	1.55	0.69	-13.69	0.00	0.00	0.95	0.00
	[6.23]	[4.04]	[2.77]	[0.93]	[-5.58]				
1974 – 2009	17.94	1.85	0.59	-1.40	-19.34	0.00	0.00	0.92	0.00
	[6.26]	[2.50]	[0.59]	[-2.42]	[-6.71]				
Panel C. GDP growth differential									
1910 – 2009	8.72	2.13	1.23	-0.23	-8.95	0.01	0.01	0.84	0.00
	[3.96]	[2.36]	[2.04]	[-0.33]	[-4.18]				
1974 – 2009	19.42	3.26	1.68	-0.32	-19.75	0.00	0.00	0.90	0.00
	[5.67]	[6.70]	[2.87]	[-0.67]	[-5.84]				
Panel D. Risk premia (UIP deviations)									
1910 – 2009	-3.37	-1.20	-0.30	-0.44	2.93	0.72	0.70	0.22	0.82
	[-1.41]	[-1.08]	[-0.40]	[-0.56]	[1.30]				
1974 – 2009	2.23	0.16	0.04	-0.40	-2.64	0.04	0.03	0.92	0.07
	[1.55]	[0.11]	[0.03]	[-0.23]	[-1.83]				
Panel E. Interest rate differentials									
1910 – 2009	2.61	0.41	0.27	0.12	-2.48	0.00	0.00	0.75	0.03
	[3.16]	[7.05]	[4.32]	[2.05]	[-2.90]				
1974 – 2009	6.16	0.58	0.32	-0.04	-6.20	0.00	0.00	0.84	0.00
	[3.57]	[5.18]	[2.20]	[-0.38]	[-3.48]				

Table A.5. Country portfolios: Real fundamentals, 10-year exchange rate changes

The setup of this table is identical to Table 3 but here we use 10-year exchange rate changes instead of detrended exchange rates to sort countries into groups.

	G1	G2	G3	G4	Diff	MR	MR^{all}	Up	Down
PANEL A. Real money growth differential									
1910 – 2009	-0.05	0.94	0.95	0.81	0.86	0.55	0.48	0.48	0.82
	[-0.03]	[1.28]	[1.60]	[1.32]	[0.66]				
1974 – 2009	0.23	0.04	0.37	-0.25	-0.49	0.31	0.30	0.70	0.53
	[0.18]	[0.06]	[0.39]	[-0.43]	[-0.42]				
PANEL B. Real GDP growth differential									
1910 – 2009	-6.57	-0.10	0.35	0.02	6.59	0.65	0.68	0.10	0.41
	[-1.71]	[-0.14]	[0.56]	[0.03]	[1.88]				
1974 – 2009	1.92	1.53	1.44	0.85	-1.07	0.93	0.99	0.94	0.06
	[2.73]	[4.27]	[3.05]	[1.95]	[-2.22]				
PANEL C. Real exchange rate changes									
1910 – 2009	-0.24	0.33	0.66	0.79	1.03	0.07	0.07	0.31	0.86
	[-0.19]	[0.42]	[0.84]	[0.94]	[0.89]				
1974 – 2009	-1.47	-0.11	0.55	1.08	2.56	0.00	0.00	0.07	0.94
	[-0.87]	[-0.09]	[0.41]	[0.69]	[2.31]				

Table A.6. Country portfolios: Nominal fundamentals and simple exchange rate changes

The setup of this table is identical to Table 2 but here we sort countries into portfolios based on simple (annual) exchange rate changes (instead of detrended spot exchange rates).

	G1	G2	G3	G4	Diff	MR	MR^{all}	Up	Down
PANEL A. CPI inflation differential									
1910 – 2009	12.06	1.78	1.08	0.96	-11.09	0.06	0.06	0.87	0.00
	[4.17]	[5.21]	[3.02]	[2.83]	[-3.88]				
1974 – 2009	14.82	2.27	1.28	0.07	-14.75	0.00	0.00	0.89	0.00
	[4.30]	[5.55]	[2.67]	[0.22]	[-4.38]				
PANEL B. Money growth differential									
1910 – 2009	11.12	3.43	2.46	2.40	-8.72	0.07	0.07	0.90	0.00
	[5.18]	[4.67]	[3.43]	[2.98]	[-3.75]				
1974 – 2009	13.63	2.55	1.43	1.54	-12.10	0.08	0.08	0.92	0.00
	[4.56]	[2.79]	[1.62]	[2.43]	[-3.62]				
PANEL C. GDP growth differential									
1910 – 2009	7.22	2.60	0.37	0.97	-6.24	0.52	0.47	0.51	0.00
	[3.65]	[3.61]	[0.45]	[1.41]	[-3.33]				
1974 – 2009	16.03	4.37	2.41	1.34	-14.70	0.00	0.00	0.96	0.00
	[4.73]	[7.44]	[3.67]	[2.84]	[-4.41]				
PANEL D. Risk premia (UIP deviations)									
1910 – 2009	-3.10	-0.93	0.46	-0.82	2.28	0.87	0.90	0.07	0.05
	[-1.61]	[-0.91]	[0.56]	[-0.86]	[1.59]				
1974 – 2009	0.85	0.70	0.71	-0.05	-0.90	0.09	0.09	0.91	0.36
	[0.70]	[0.45]	[0.42]	[-0.03]	[-0.69]				
PANEL E. Interest rate differentials									
1910 – 2009	2.22	0.46	0.37	0.32	-1.91	0.00	0.00	0.93	0.05
	[2.80]	[7.75]	[5.93]	[5.58]	[-2.41]				
1974 – 2009	5.38	0.67	0.59	0.39	-4.99	0.00	0.00	0.92	0.02
	[3.07]	[7.78]	[5.57]	[3.39]	[-2.82]				

Table A.7. Country portfolios: Real fundamentals and simple exchange rate changes

The setup of this table is identical to Table 3 but here we sort countries into portfolios based on simple (annual) exchange rate changes (instead of detrended spot exchange rates).

	G1	G2	G3	G4	Diff	MR	MR^{all}	Up	Down
PANEL A. Real money growth differential									
1910 – 2009	-0.99	1.33	1.32	1.35	2.34	0.98	0.97	0.02	0.93
	[-0.79]	[1.94]	[2.08]	[1.85]	[2.44]				
1974 – 2009	-1.22	0.28	0.13	1.40	2.63	1.00	1.00	0.00	0.80
	[-1.11]	[0.31]	[0.19]	[2.06]	[2.86]				
PANEL B. Real GDP growth differential									
1910 – 2009	-5.45	0.55	-0.89	-0.03	5.41	1.00	1.00	0.03	0.03
	[-1.63]	[0.72]	[-1.06]	[-0.06]	[1.84]				
1974 – 2009	1.30	2.08	1.23	1.24	-0.06	0.99	0.98	0.15	0.01
	[2.04]	[4.21]	[2.86]	[2.75]	[-0.11]				
PANEL C. Real exchange rate changes									
1910 – 2009	-1.90	0.29	-0.20	0.65	2.55	0.38	0.34	0.14	0.65
	[-0.96]	[0.29]	[-0.23]	[0.67]	[1.34]				
1974 – 2009	-0.69	-0.85	0.21	1.45	2.14	0.24	0.24	0.03	0.76
	[-0.44]	[-0.61]	[0.12]	[0.93]	[1.57]				

Table A.8. Panel regressions: Exchange rate changes

The setup of this table is identical to Table A.1 but we use lagged spot exchange rate changes Δs_t as predictor variable instead of detrended spot rates.

	INF	MON	GDP	RP	IR	RMON	RGDP	RER
Sample period: 1901 – 2009								
const.	-0.07	-0.02	-0.06	0.08	-0.01	0.02	-0.02	-0.06
	[-3.19]	[-0.91]	[-2.61]	[3.32]	[-0.77]	[0.85]	[-1.24]	[-2.57]
Δs_t	-0.63	-0.53	-0.45	0.10	-0.08	0.08	0.21	0.16
	[-8.72]	[-4.42]	[-2.59]	[1.11]	[-1.12]	[1.98]	[1.55]	[2.79]
ϱ	0.03	0.06	0.11	0.09	0.35	0.03	0.06	0.01
R^2	0.58	0.49	0.48	0.26	0.19	0.20	0.22	0.15
R^2_w	0.54	0.44	0.45	0.27	0.13	0.20	0.23	0.16
R^2_b	0.97	0.95	0.81	0.03	0.81	0.01	0.06	0.17
$F_{\alpha_i=0}$	2.67	5.13	9.83	3.60	15.94	2.03	5.46	0.61
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)	(0.93)
obs	3,023	3,125	2,835	2,521	2,521	2,957	2,744	3,023
Sample period: 1974 – 2009								
	INF	MON	GDP	RP	IR	RMON	RGDP	RER
const.	-0.08	-0.04	-0.09	0.06	-0.02	0.01	-0.04	-0.06
	[-2.88]	[-1.65]	[-3.30]	[3.63]	[-0.95]	[0.72]	[-1.65]	[-2.49]
Δs_t	-0.70	-0.69	-0.75	-0.14	-0.25	0.05	-0.03	0.11
	[-4.81]	[-3.41]	[-4.99]	[-2.90]	[-1.44]	[1.33]	[-1.65]	[1.67]
ϱ	0.11	0.14	0.12	0.04	0.09	0.07	0.06	0.03
R^2	0.73	0.70	0.78	0.27	0.41	0.12	0.22	0.26
R^2_w	0.61	0.57	0.68	0.26	0.28	0.14	0.23	0.29
R^2_b	0.99	0.98	0.99	0.37	0.86	0.00	0.13	0.01
$F_{\alpha_i=0}$	2.82	3.69	2.96	1.17	2.66	2.46	2.28	0.73
	(0.00)	(0.00)	(0.00)	(0.33)	(0.00)	(0.01)	(0.01)	(0.82)
obs	1,152	1,137	1,149	1,062	1,062	1,137	1,149	1,152

Table A.9. Country portfolios: Double sorts and spot rate changes

The setup of this table is identical to Table A.2 but here we sort on lagged exchange rate changes Δs_t instead of detrended spot exchange rates.

	1909-2009				1974-2009			
	Panel A. Nominal fundamentals							
	G1	G2	G3	Diff	G1	G2	G3	Diff
INF low	0.81	0.17	-0.52	-1.33	0.00	-0.56	-1.21	-1.21
	[1.82]	[0.48]	[-1.53]	[-3.37]	[-0.01]	[-2.41]	[-4.00]	[-2.51]
INF high	24.85	4.61	3.44	-21.41	35.67	5.31	3.71	-31.96
	[5.57]	[5.44]	[6.47]	[-5.07]	[4.23]	[4.91]	[5.02]	[-4.01]
MON low	2.44	0.64	0.48	-1.96	-0.67	-0.33	-0.46	0.20
	[2.88]	[0.77]	[0.74]	[-2.55]	[-0.81]	[-0.43]	[-0.76]	[0.30]
MON high	22.59	6.06	5.80	-16.78	34.90	6.25	5.33	-29.57
	[5.83]	[6.85]	[6.55]	[-4.15]	[4.41]	[5.37]	[3.97]	[-3.58]
GDP low	0.83	-0.33	-0.07	-0.90	1.03	0.57	-1.05	-2.08
	[0.88]	[-0.42]	[-0.08]	[-0.84]	[1.60]	[0.95]	[-2.32]	[-2.81]
GDP high	20.69	5.24	3.91	-16.79	37.95	7.83	5.49	-32.46
	[4.56]	[5.83]	[4.99]	[-4.04]	[4.63]	[7.29]	[6.89]	[-4.23]
RP low	-4.91	-1.97	-0.58	4.33	0.43	-0.21	0.56	0.13
	[-2.00]	[-1.49]	[-0.61]	[1.89]	[0.28]	[-0.12]	[0.33]	[0.09]
RP high	0.52	0.92	-1.30	-1.82	2.11	1.62	-1.23	-3.33
	[0.50]	[1.25]	[-1.08]	[-1.62]	[1.24]	[0.95]	[-0.71]	[-3.36]
IR low	0.05	0.00	-0.01	-0.06	-0.04	-0.04	-0.05	-0.01
	[1.05]	[-0.05]	[-0.14]	[-1.22]	[-0.37]	[-0.47]	[-0.43]	[-0.09]
IR high	3.30	0.83	0.79	-2.51	7.95	1.33	1.15	-6.81
	[2.74]	[8.35]	[8.48]	[-2.20]	[2.96]	[10.87]	[7.50]	[-2.64]
	Panel B. Real fundamentals							
	G1	G2	G3	Diff	G1	G2	G3	Diff
RMON high	-3.20	0.72	0.08	3.28	-2.60	-0.46	-0.42	2.19
	[-2.59]	[0.93]	[0.09]	[3.10]	[-2.73]	[-0.58]	[-0.54]	[2.16]
RMON low	0.75	3.33	2.76	2.01	0.79	2.75	2.57	1.78
	[0.84]	[4.61]	[3.74]	[2.70]	[0.69]	[2.60]	[2.38]	[1.79]
RGDP high	-7.50	0.02	-1.22	6.28	0.03	0.52	-0.21	-0.25
	[-1.88]	[0.03]	[-1.86]	[1.72]	[0.05]	[1.59]	[-0.43]	[-0.38]
RGDP low	1.27	0.86	1.19	-0.09	2.95	3.61	2.23	-0.71
	[1.19]	[1.09]	[1.78]	[-0.10]	[3.54]	[5.26]	[4.23]	[-0.85]
RER low	1.69	-0.68	0.85	-0.84	-0.35	0.12	1.59	1.94
	[1.49]	[-0.76]	[0.89]	[-0.69]	[-0.21]	[0.07]	[0.95]	[1.59]
RER high	-3.92	0.37	0.94	4.87	-2.32	0.34	0.32	2.64
	[-2.07]	[0.44]	[1.23]	[2.75]	[-1.47]	[0.27]	[0.22]	[3.12]

Table A.10. Panel regressions: Exchange rate changes and lagged dependent variables

The setup of this table is identical to Table A.3 but we use (annual) spot exchange rate changes (instead of detrended exchange rates) as predictor variable in the panel regression.

Sample period: 1910 – 2009								
	INF	MON	GDP	RP	IR	RMON	RGDP	RER
Δs_t	-0.21	-0.27	-0.15	-0.01	-0.03	0.07	0.05	0.11
	[-2.99]	[-4.17]	[-1.70]	[-0.12]	[-0.98]	[1.91]	[1.03]	[1.84]
$y_{i,t}$	0.60	0.48	0.64	0.28	0.49	0.10	0.59	-0.14
	[9.48]	[8.37]	[8.75]	[2.52]	[5.93]	[2.26]	[8.88]	[-2.09]
ϱ	0.01	0.02	0.02	0.03	0.17	0.02	0.01	0.01
R^2	0.70	0.62	0.72	0.32	0.46	0.21	0.49	0.17
R^2_w	0.66	0.57	0.68	0.31	0.33	0.21	0.48	0.17
R^2_b	0.99	0.99	0.99	0.70	0.99	0.03	0.94	0.32
$F_{\alpha_i=0}$	1.04	1.83	1.98	1.67	4.58	1.66	1.14	0.50
	(0.45)	(0.04)	(0.03)	(0.07)	(0.00)	(0.07)	(0.36)	(0.98)
obs	3,140	3,288	2,903	2,630	2,630	3,065	2,804	3,140
Sample period: 1974 – 2009								
	INF	MON	GDP	RP	IR	RMON	RGDP	RER
Δs_t	-0.17	-0.40	-0.42	-0.18	-0.15	0.04	-0.05	0.09
	[-3.62]	[-2.21]	[-3.12]	[-4.65]	[-1.21]	[1.12]	[-2.09]	[1.36]
$y_{i,t}$	0.66	0.40	0.44	0.21	0.35	0.11	0.17	-0.07
	[22.45]	[3.53]	[4.17]	[3.29]	[10.06]	[2.18]	[3.00]	[-0.96]
ϱ	0.05	0.07	0.05	0.03	0.05	0.06	0.05	0.02
R^2	0.81	0.76	0.83	0.29	0.50	0.15	0.25	0.27
R^2_w	0.70	0.62	0.74	0.29	0.36	0.15	0.25	0.29
R^2_b	0.99	0.99	0.99	0.45	0.98	0.19	0.33	0.02
$F_{\alpha_i=0}$	1.16	1.55	1.03	0.85	1.13	1.76	1.70	0.61
	(0.33)	(0.10)	(0.47)	(0.68)	(0.36)	(0.05)	(0.06)	(0.93)
obs	1,152	1,137	1,149	1,056	1,056	1,137	1,149	1,152