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# Portfolio Inertia and Expected Excess Returns in Currency Markets: Evidence from Advanced Economies

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**WP/25/11**



**2025**
JAN

WORKING PAPER

 WP/25/11

**IMF Working Paper**
Western Hemisphere Department

**Portfolio Inertia and Expected Excess Returns in Currency Markets: Evidence from Advanced Economies**

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Authorized for distribution by Rodrigo Valdes
January 2025



**ABSTRACT:** The economic literature has long attributed non-zero expected excess returns in currency markets to time-varying risk premiums demanded by risk-averse investors. This paper, building on Bacchetta and van Wincoop's (2021) portfolio balance framework, shows that such returns can also arise when investors are risk-neutral but face portfolio adjustment costs. Models with adjustment costs but no risk aversion predict a negative correlation between exchange rate levels and expected excess returns, while models with risk aversion but no adjustment costs predict a positive one. Using data from nine inflation-targeting economies with floating exchange rates (2000–2024), we find strong empirical support for the adjustment costs framework. The negative correlation persists even during periods of low market stress, further evidence that portfolio adjustment costs, not risk premium shocks, drive the link between exchange rates and excess returns.  Our model further predicts that one-year expected excess returns should have predictive power for multi-year returns, with longer-term expected returns  as increasing multiples of short-term expectations, and the predictive power strengthening with the horizon. We confirm these findings empirically. We also examine scenarios combining risk aversion and adjustment costs, showing that sufficiently high adjustment costs are essential to generate the observed negative relationship.These findings provide a simpler, testable alternative to literature relying on assumptions about unobservable factors like time-varying risk premiums, intermediary constraints, or noise trader activity.



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|---|---|
| JEL Classification Numbers: | F31, F41, G15, G11, C58 |
| Keywords: | Exchange Rates; Portfolio Balance, Uncovered Interest Parity; Portfolio Adjustment Costs; Risk Premium; Currency Markets; Expected Returns |
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* Previous versions of this paper have benefitted from comments by Mai Dao, Nicolas Fernandez-Arias, Emilio Fernandez Corugedo, Pierre-Olivier Gourinchas, Russell Green, Leslie Lipschitz, Jim Morsink, and Maylin Sun.

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## 1 Introduction and Executive Summary

The economic literature has long assumed that non-zero expected excess returns in currency markets are the result of time-varying risk premiums demanded by risk-averse investors. This paper demonstrates that non-zero expected excess returns can also arise in a portfolio balance model where investors are risk-neutral but face costly portfolio adjustments. The patterns predicted by this framework—such as persistent deviations from uncovered interest parity (UIP) and a negative link between exchange rate levels and expected excess returns—align more closely with observed data than those generated by models assuming risk aversion without adjustment costs.

In their framework, Bacchetta and van Wincoop (2021) incorporate portfolio adjustment costs, which create frictions that slow rebalancing, leading to persistent UIP deviations. Building on this, we compare two distinct scenarios: one where investors are risk-averse but face no adjustment costs, and another where investors are risk-neutral but portfolio adjustment is costly. This comparison isolates the pure effects of adjustment frictions versus risk aversion and demonstrates how adjustment costs alone can generate observed UIP deviations.

The two models yield starkly different predictions:

- The risk-aversion model (without portfolio adjustment costs) predicts a *positive* link between exchange rate levels and longer-term expected excess returns, and a *negative* link between expected exchange rate changes and expected excess returns.

- The portfolio-adjustment-costs model (without risk aversion) predicts a *negative* link between exchange rate levels and longer-term expected excess returns, and a *positive* link between expected exchange rate changes and expected excess returns.

Using data from nine inflation-targeting countries with freely floating exchange rates over 2000–2024, we find strong empirical support for the portfolio-adjustment-costs model:

- There is a robust positive correlation between expected exchange rate changes and expected excess returns, while interest rate differentials show no significant relationship with excess returns—contrary to traditional carry trade theory.

- We document a robust negative link between exchange rate levels and longer-term expected excess returns, consistent with Engel (2016)'s findings on interest rate differentials.

While alternative models incorporating risk premium shocks might generate similar patterns, they fall short in explaining our findings. First, the negative relationship between exchange rates and expected excess returns persists even during periods of low market stress (VIX $<$ 20). Second, exchange rates show very weak correlation with the VIX, with $R^2$ values near zero for most countries, suggesting that risk-driven explanations are insufficient. Moreover, risk premium shocks are relatively rare, with the VIX exceeding 30 in only 10.6 percent of all months since 2000. Even in low-volatility periods (VIX $<$ 20), the negative link between exchange rates and expected excess returns remains strong and highly significant, underscoring the role of portfolio adjustment frictions.

Alternative models, such as those involving noise trader behavior, also attempt to explain the observed negative link between exchange rate levels and expected excess returns. For example, demand shocks by noise traders for euro bonds increase the euro-dollar exchange rate. To meet this demand, financial intermediaries take short positions in euro bonds and require compensation for exchange rate risk, which manifests as positive expected excess returns. This mechanism creates a negative link between the exchange rate level and expected excess returns. However, while noise trader behavior can generate the observed negative link between exchange rate levels and expected excess returns, it implies systematic losses for noise traders, raising questions about their long-term sustainability in currency markets.

More broadly, while advances involving intermediary constraints, noise trader behavior, or exogenous shocks provide valuable insights into UIP deviations, these mechanisms often rely on complex, difficult-to-measure factors. In contrast, this paper focuses on portfolio adjustment costs, offering a simpler and more testable explanation for UIP deviations that closely matches observed data.

While our theoretical analysis focuses on two polar cases—pure risk aversion without portfolio adjustment costs and pure adjustment costs without risk aversion—we also examine intermediate cases. Our findings reveal that in the presence of risk aversion, portfolio adjustment costs must be sufficiently high to generate the negative relationship between exchange rates and expected excess returns. This underscores the central role of adjustment frictions, suggesting that risk aversion alone cannot account for observed patterns in currency markets.

Our model further predicts that one-year expected excess returns should have predictive power for multi-year returns, with longer-term expected returns increasing as multiples of short-term expectations, and predictive power strengthening with the horizon. We confirm these findings empirically, mirroring the results of Bakker (2024) on multi-year exchange rate predictability.

The remainder of the paper is structured as follows. Section 2 outlines the motivation, emphasizing key empirical departures from UIP and the role of portfolio adjustment costs. Section 3 reviews the literature on excess returns, portfolio adjustment, and structural factors contributing to deviations from UIP. Section 4 introduces the theoretical model, contrasting the effects of risk aversion with those of portfolio adjustment frictions. Section 5 derives the model's key predictions. Section 6 presents the empirical results, focusing on the positive relationship between expected exchange rate changes and excess returns. Section 7 examines whether the negative link between exchange rate levels and expected excess returns could be driven by risk premium shocks. Section 8 investigates the predictive power of short-term expected excess returns for multi-year returns. Section 9 extends the analysis to consider the joint effects of risk aversion and portfolio adjustment costs on the link between exchange rate levels and expected excess returns. Section 10 concludes with a summary of the findings and their implications. The annexes provide technical derivations and supporting material.

## 2 Motivation: How to explain Non-Zero Expected Excess Returns

Uncovered Interest Rate Parity (UIP) predicts that expected exchange rate changes should precisely offset interest rate differentials, resulting in zero expected excess returns. The data decisively reject this prediction.

Using a monthly survey dataset provided by Das et al. (2022), we examine twelve-month-ahead expected excess returns for the period 2000–2024 for nine advanced, inflation-targeting economies with freely floating exchange rates. Several key observations emerge:

- Expected excess returns are not zero. They can be quite substantial, with magnitudes that challenge standard explanations based solely on risk aversion (Figure 2.1).
- They fluctuate between positive and negative, spending roughly equal time in each territory (Figure 2.2).
- Expected excess returns exhibit high persistence over time; they are more persistent than measures of financial market volatility such as the VIX (Figures 2.3 and 2.4).
- There is a notable negative relationship between exchange rate levels and expected excess returns (Figure 2.5).

The literature has traditionally focused on risk aversion as the explanation for non-zero expected excess returns. However, if risk aversion is constant, it does not seem able to explain the observed patterns.

In theory, risk aversion implies a *positive* relationship between expected excess returns and currency value. For example, if US investors can choose between a US time deposit (a risk-free asset) and a euro time deposit (a risky asset due to exchange rate fluctuations), higher expected excess returns on the euro should lead to a larger portfolio share of euros, increasing the euro's value. Conversely, lower expected excess returns on the euro would lead to a larger portfolio share of US dollars and a depreciated euro. Similarly, European investors would avoid US dollars if expected excess returns on the euro are positive.

Contrary to the predictions of risk-aversion models, the data reveal a robust *negative* relationship between expected excess returns and exchange rate levels.

We propose an alternative explanation: portfolio adjustment costs, which differ from risk aversion in their predicted relationship between exchange rate levels and expected excess returns. Risk aversion implies a negative link, while portfolio adjustment costs imply a positive one. The strong positive relationship we find in the data suggests that portfolio adjustment costs, rather than risk aversion, explains expected excess returns.

**Figure 2.1. Expected 12-months excess returns, 2000-2024**

(Monthly data)

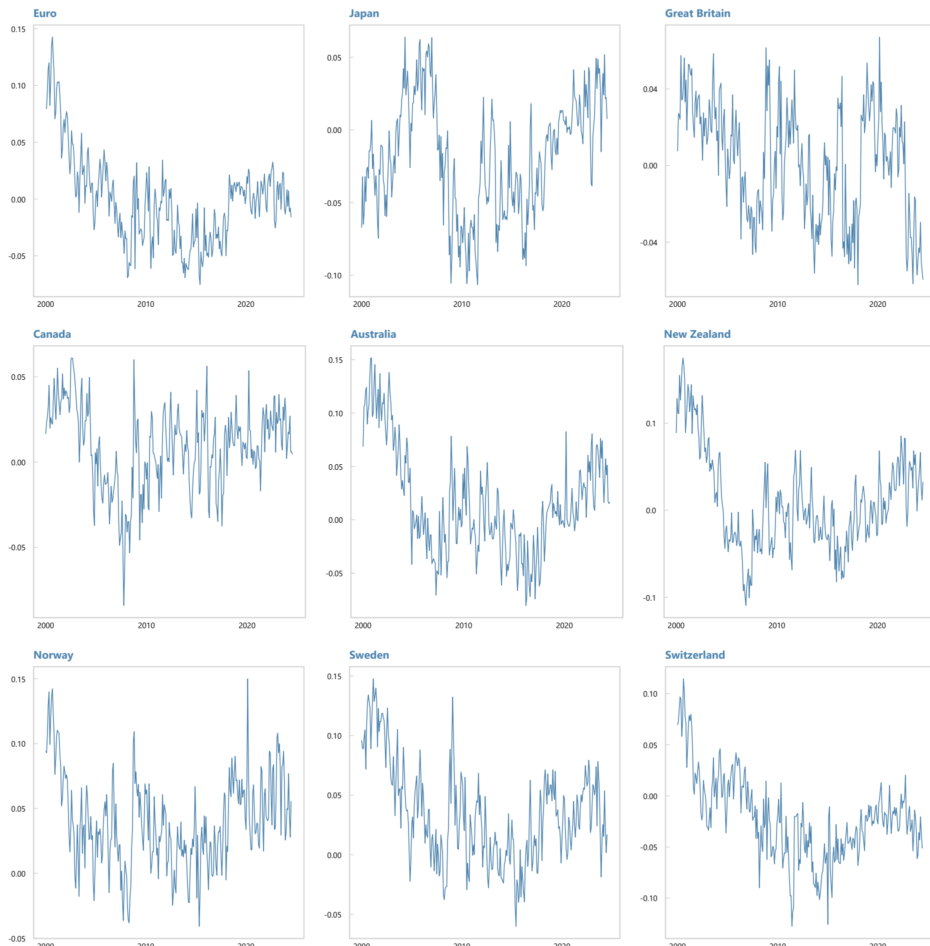
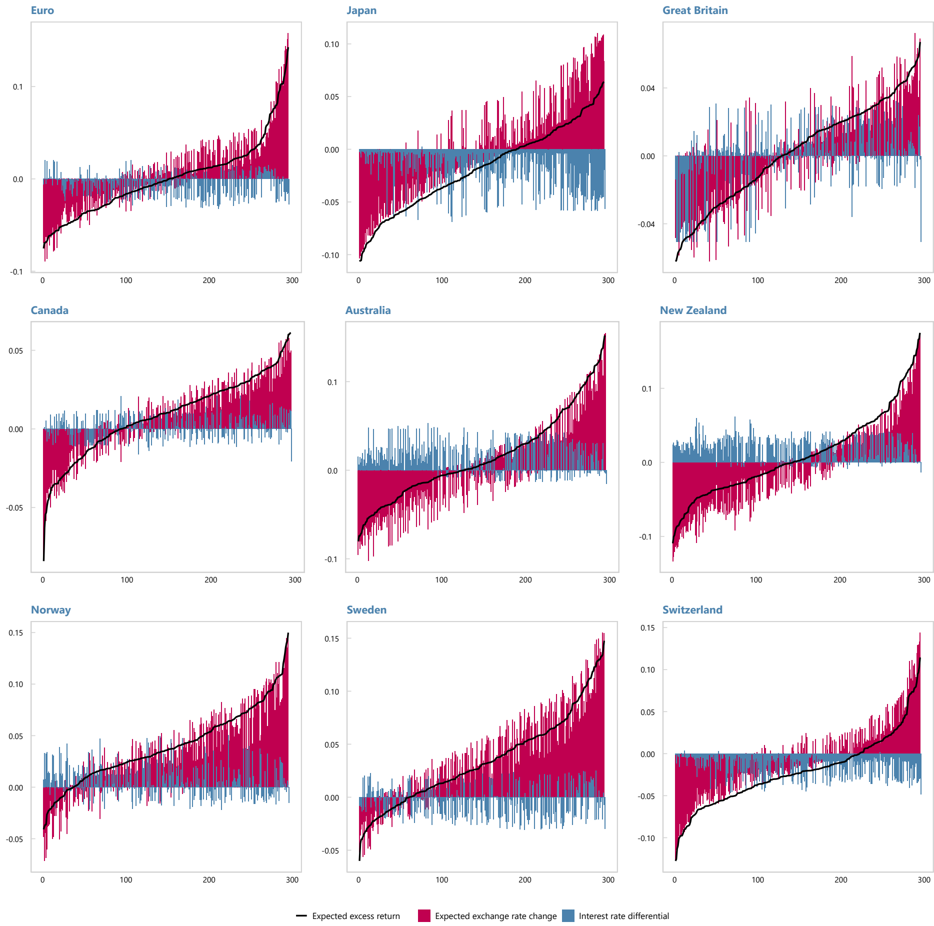


**Figure 2.2. Expected 12-months excess returns, expected 12-months exchange rate changes and 12-months interest rate differentials, 2000-22**

(Monthly data)




Expected excess returns have been sorted from low to high.

**Figure 2.3. Autocorrelation of Expected Excess Returns, 2000-24**
(Monthly data, lag = 60)

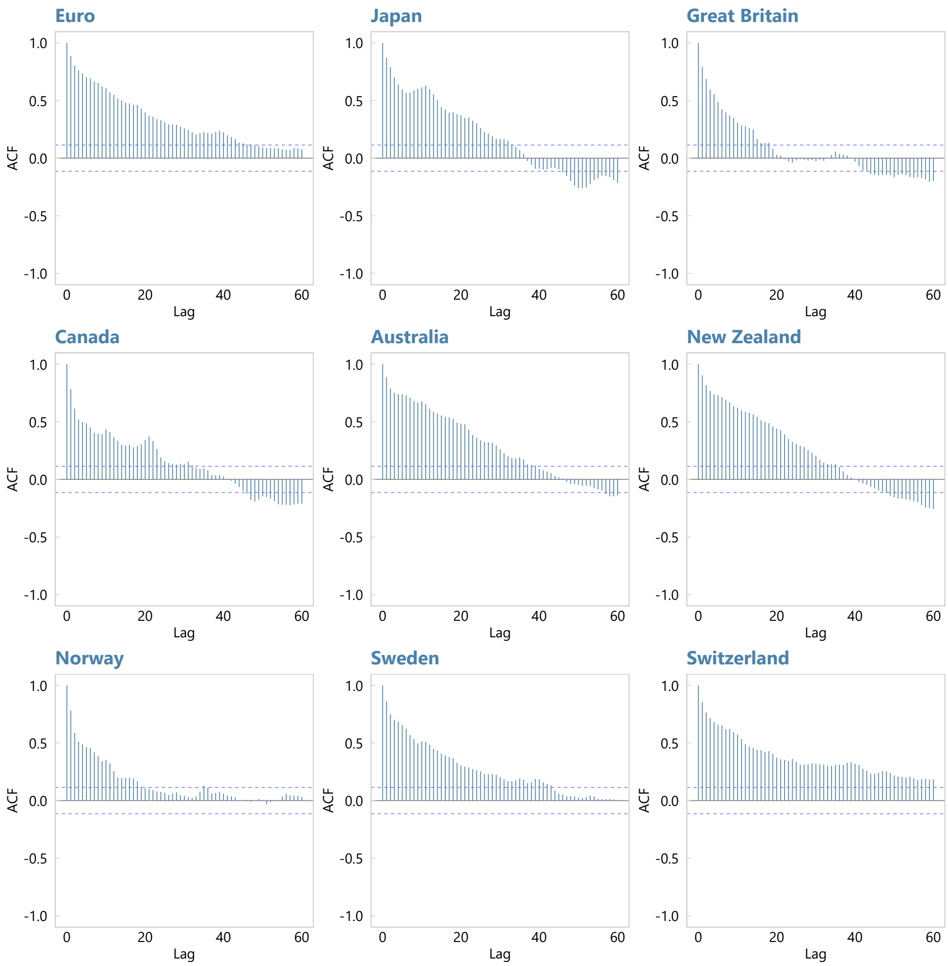


Figure 2.4. Autocorrelation of VIX, 2000-24

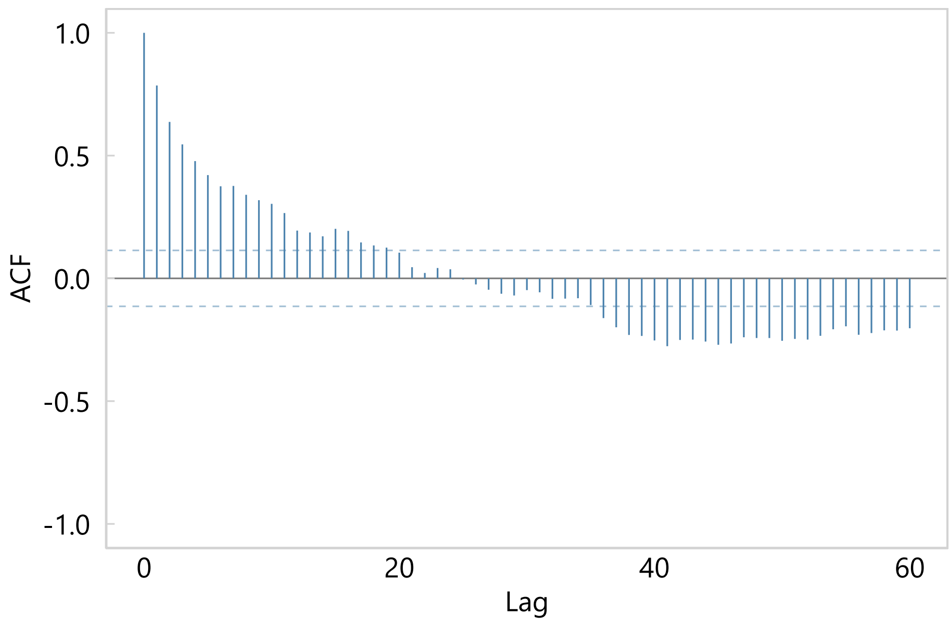
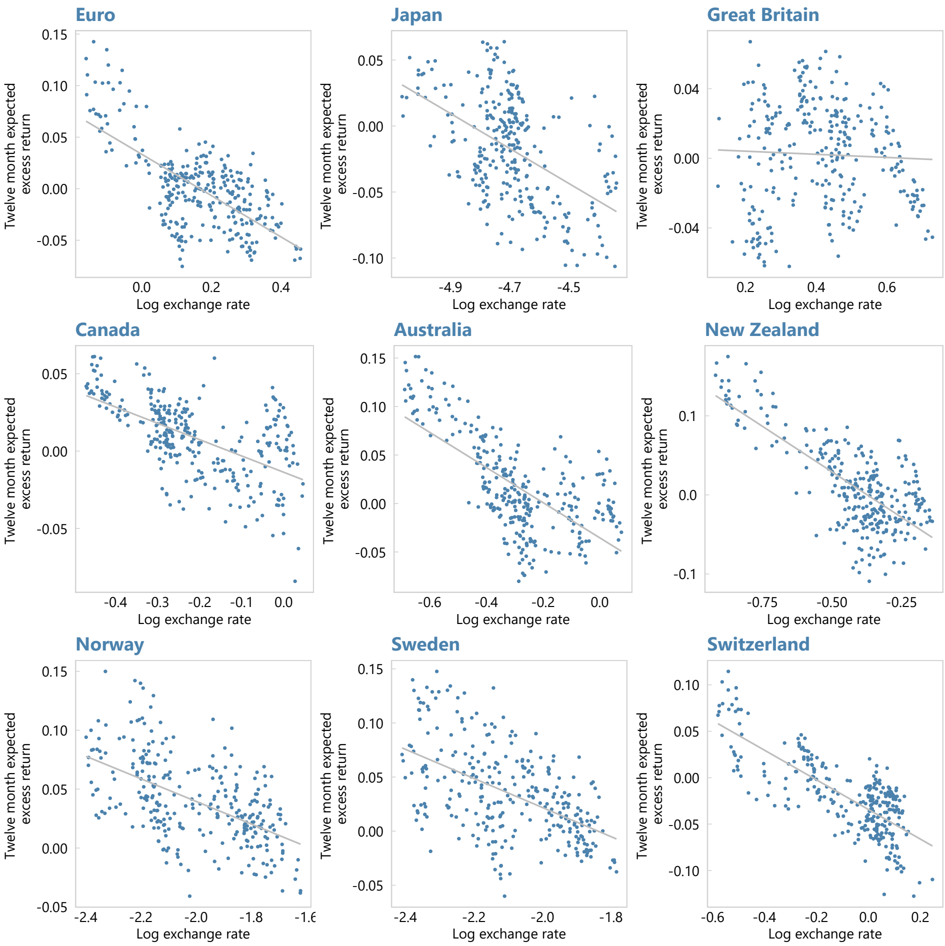


**Figure 2.5. Exchange rate level and One-year Expected Excess Return, 2000-24**
(Monthly data)



# 3 Literature review

## 3.1 Relationship between exchange rate levels and excess returns

Most exchange rate literature on excess returns has focused on the link between interest rate differentials and excess returns. Fama (1984) made a seminal contribution by documenting the forward premium puzzle. Fama found that the forward premium (approximately equal to the interest rate differential) was negatively correlated with future exchange rate changes, contradicting the predictions of uncovered interest parity (UIP).

This finding is typically expressed through the "Fama regression":

$$s_{t+1} - s_t = \alpha + \beta(f_t - s_t) + \varepsilon_{t+1} \tag{3.1.1}$$

where UIP predicts $\beta = 1$, but Fama consistently found $\beta < 0$. This implies that high interest rate currencies tend to appreciate rather than depreciate as UIP suggests. Crucially, it also means that high interest rate currencies typically earn positive excess returns. Engel (2016) extended this analysis, finding that while high real-interest-rate currencies experience positive excess returns in the short run, cumulative excess returns over longer horizons are negative.

The negative cumulative excess returns for high interest rate currencies over longer horizons imply a negative relationship between exchange rate levels and cumulative excess returns. This is because currencies with high interest rates tend to be strong. This insight provides a bridge between the literature on interest rate differentials and excess returns, and the strand of research focusing directly on the link between exchange rate levels and future returns.

Several studies have focused specifically on the relationship between exchange rate levels and future excess returns, consistently finding a negative relationship. Jordà and Taylor (2012) demonstrate that currencies overvalued relative to their fundamental equilibrium exchange rates (FEER) tend to yield lower returns in future periods. Their approach incorporates a broad set of macroeconomic fundamentals to estimate equilibrium exchange rates, providing a comprehensive measure of currency valuation.

Menkhoff et al. (2017) investigate whether real exchange rates, as a measure of currency value, can predict currency excess returns. They construct portfolios of currencies sorted on real exchange rates and find significant profitability in strategies that involve buying undervalued and selling overvalued currencies.

Extending this line of inquiry to longer horizons, Balduzzi and Chiang (2020) provide evidence that real exchange rates have predictive power for currency returns over extended periods. They employ panel regression techniques and find that overvalued currencies consistently underperform in the long run.

### 3.2 Recent Advances in Explaining Deviations from UIP

Recent research in international macroeconomics and finance has deepened our understanding of the factors leading to deviations from the uncovered interest parity (UIP) condition. While traditional models often attribute deviations to risk premiums or expectational errors, more recent studies identify structural factors that introduce wedges between expected exchange rate changes and interest rate differentials. These wedges include convenience yields, changes in the natural rate of interest tied to the price of risk, hocks to intermediary constraints and the behavior of noise traders.

#### Convenience Yields

One wedge in the UIP condition arises from the concept of "convenience yields", which refers to the non-pecuniary benefits of holding a particular currency, often driven by its status as a safe haven.

Research by Engel (2016) and Jiang et al. (2021) shows that currencies like the U.S. dollar may offer convenience yields, leading investors to hold these currencies despite lower interest rates. This creates a persistent deviation from UIP, as investors are willing to accept lower returns on assets denominated in currencies perceived as safe havens, especially during periods of global economic uncertainty.

Convenience yields introduce an additional reason why high-interest-rate currencies may not depreciate as much as UIP would predict, as lower-yielding safe-haven currencies maintain strong demand, regardless of their interest rate differentials.

However, they may be less relevant in explaining non-zero expected returns between safe-haven currencies—such as the Swiss franc versus the US dollar.

#### Natural Rates and the Price of Risk

Kekre and Lenel (2024) propose a novel perspective on exchange rate dynamics, introducing the concept of natural rates of interest as linked to the price of risk. Their model suggests that differences in natural rates across countries, influenced by risk premia, create persistent deviations from UIP. By tying exchange rate movements to fluctuations in the natural rate of interest, which reflects the equilibrium real interest rate adjusted for risk, their framework shows how macroeconomic shocks to the price of risk can result in exchange rate fluctuations even in the absence of traditional arbitrage conditions.

The paper highlights that UIP deviations can be sustained by changes in the global price of risk, driven by shifts in investor sentiment, risk tolerance, and macroeconomic conditions. This approach aligns with recent studies that emphasize the importance of risk factors in explaining deviations from UIP. By extending the analysis to include natural rates and the role of risk premiums, Kekre and Lenel offer an important extension to the UIP literature, complementing intermediary constraints and convenience yields as key drivers of exchange rate dynamics.

### Shocks to Intermediary Constraints

Intermediary constraints have become central to understanding how financial markets, particularly foreign exchange markets, function in the presence of liquidity and capital frictions. Studies by He and Krishnamurthy (2013) and Gabaix and Maggiori (2015) demonstrate that financial intermediaries—such as banks or hedge funds—play a critical role in determining exchange rates. Intermediaries are typically the ones taking the open position in foreign exchange markets, acting as the counterparties to other market participants. For example, if there is increased demand for euro bonds, intermediaries will meet this demand by selling euro bonds, thereby taking an open short position in euros. When these intermediaries face capital or liquidity constraints, their ability to arbitrage away mispricings diminishes. This creates persistent deviations from UIP, as intermediaries are unable to fully exploit differences in interest rates across currencies. As a result, shocks to intermediary constraints serve as a source of non-fundamental exchange rate movements, driving deviations from the parity condition.

Incorporating this into the analysis of exchange rates suggests that UIP deviations may persist not due to informational inefficiencies but because intermediaries, faced with capital constraints, cannot engage in arbitrage that would bring exchange rates in line with their theoretical values. While intermediary-based models provide valuable insights into market frictions, they still leave open the question of why other market participants don't step in when profitable opportunities arise. Our portfolio adjustment costs framework addresses this by explaining why all market participants, not just intermediaries, might be slow to exploit apparent profit opportunities.

### Noise Trader Demand

The behavior of "noise traders"—who act on speculative or non-fundamental information—adds another layer of complexity to exchange rate dynamics. While De Long et al. (1990) primarily analyze the effects of noise trader risk in broader financial markets, their framework provides a conceptual foundation for understanding how speculative behavior can introduce volatility and deviations from fundamental values.

Recent work by Itskhoki and Mukhin (2021) explicitly extends this concept to exchange rates. They introduce a dynamic general equilibrium model where financial shocks, generated by noise traders, are the primary drivers of exchange rate dynamics. In their framework, segmented financial markets restrict households from directly trading foreign assets, leaving intermediaries to absorb the excess demand or supply created by noise traders. These intermediaries, being risk-averse, take positions opposite to those of noise traders to ensure market clearing and require compensation for bearing the associated exchange rate risk. This compensation takes the form of risk premia, resulting in deviations from uncovered interest parity (UIP).

Like our portfolio adjustment costs framework, their model can generate a negative link between exchange rate levels and expected excess returns. For example, exogenous demand shocks by noise traders for euro bonds drives up the euro-dollar exchange rate. Financial intermediaries, taking short positions in euro bonds to meet this demand, require compensation for the exchange rate risk in the form of positive expected excess returns. This mechanism generates a negative link between the euro-dollar exchange rate level and the expected excess return on long euro positions.

While noise trader models can generate the observed negative relationship between exchange rates and expected excess returns, they introduce an interesting and largely unexplored tension within the literature. In De Long et al. (1990), noise traders are shown to earn higher expected returns than sophisticated investors by unknowingly taking on more price risk that they themselves create. In contrast, models such as Itskhoki and Mukhin (2021) suggest that noise traders systematically incur losses as intermediaries earn positive expected excess returns from taking opposing positions. This discrepancy raises questions about the long-term sustainability of noise traders in currency markets—a tension that has not been directly addressed in the existing research. Our portfolio adjustment costs framework explains the same empirical patterns through a simpler economic mechanism that does not require either systematically losing noise traders or noise traders who consistently outperform sophisticated investors.

### Toward a Simpler Explanation for UIP Deviations

While these advances offer valuable insights into the drivers of UIP deviations, they often rely on complex mechanisms, such as intermediary constraints, noise trader behavior, or exogenous shocks, which can be difficult to observe or measure directly. By focusing on portfolio adjustment costs, this paper offers a simpler and more testable explanation for UIP deviations that closely matches observed data.

# 4 The Model

## 4.1 The basics

Bacchetta and van Wincoop (2021) derive a model in which the exchange rate depends on the lagged exchange rate and the sum of current and expected future interest rate differentials:

$$\log s_t = \alpha \log s_{t-1} + E_t \sum_{i=0}^{\infty} \rho^i \text{dif}_{t+i} \tag{4.1.1}$$

where $s_t$ is the exchange rate (US dollars per foreign currency unit), and $\text{dif}_t$ is the interest rate differential (foreign interest rate minus US interest rate). If portfolio adjustment is gradual, $0 < \alpha < 1$, otherwise $\alpha = 0$. If investors are risk-neutral, $\rho = 1$, otherwise $0 < \rho < 1$.

In line with Bacchetta and van Wincoop (2021), we assume that the interest rate differential follows a stochastic AR(1) process:

$$\text{dif}_t = \beta \text{dif}_{t-1} + \epsilon_t \tag{4.1.2}$$

This implies:

$$E_t \text{dif}_{t+i} = \beta^i \text{dif}_t \tag{4.1.3}$$

Substituting (4.1.3) in (4.1.1) we get

$$\log s_t = \alpha \log s_{t-1} + \left( \frac{\rho}{1 - \rho\beta} \right) \text{dif}_t \tag{4.1.4}$$

The exchange rate depends on the lagged exchange rate and the interest rate differential only.

Substituting (4.1.3) into (4.1.1) and solving,[1] we obtain:

[1] It follows from equation (4.1.2) that

$$(1 - \beta L)\text{dif}_t = \epsilon_t \tag{4.1.5}$$

It follows that

$$\text{dif}_t = \frac{\epsilon_t}{1 - \beta L} \tag{4.1.6}$$

Substituting (4.1.6) in (4.1.4) we get:

$$(1 - \alpha L)(1 - \beta L)s_t = \epsilon'_t \tag{4.1.7}$$

where $\epsilon'_t = \frac{\epsilon_t}{1-\beta}$. We can rewrite this as:

$$s_t = (\alpha + \beta)st - 1 - \alpha\beta st - 2 + \epsilon' t \tag{4.1.8}$$

$$\log s_t = (\alpha + \beta) \log s_{t-1} - \alpha\beta \log s_{t-2} + \epsilon'_t \tag{4.1.9}$$

where $\epsilon'_t = \frac{\epsilon_t}{1-\beta}$. Equation (4.1.9) is an AR(2) process with roots $\alpha$ and $\beta$. As long as both $\alpha < 1$ and $\beta < 1$, this process is stationary, implying mean reversion in exchange rates.

## 4.2 The link between Exchange Rate Levels and Expected Exchange Rate Changes

We assume that exchange rate forecasts are made using the autocorrelation function:

$$E_t s_{t+k} = \rho(k) s_t \tag{4.2.1}$$

where $\rho(k)$ is the autocorrelation function. We show in Annex 1 that for our exchange rate equation this is equal to

$$\rho(k) = \frac{\alpha^{1+k}(1-\beta^2) - \beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)} \tag{4.2.2}$$

The $k$ period expected exchange rate *change* therefore is:

$$E_t s_{t+k} - s_t = -(1-\rho(k))s_t = -\left(1 - \left(\frac{\alpha^{1+k}(1-\beta^2) - \beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)}\right)\right) s_t \tag{4.2.3}$$

If $\alpha = 0$ (i.e., there are no adjustment costs), this simplies to

$$E_t s_{t+k} - s_t = -(1-\beta^k)s_t \tag{4.2.4}$$

## 4.3 The link between Exchange Rate Levels and Expected excess returns

The k-period expected excess return is equal to the expected exchange rate change during these periods and the expected cumulative interest rate differentials:

$$x_{t,t+k} = s_{t+k} - s_t + E_t \sum_{i=0}^{k-1} \mathrm{dif}_{t+i} \tag{4.3.1}$$

The expected excess return given the exchange rate level is:

$$E_t x_{t,t+k} | s_t = E_t[s_{t+k} - s_t] | s_t + E_t \sum_{i=0}^{k-1} \mathrm{dif}_{t+i} | s_t \tag{4.3.2}$$

The first part we determined above. For the second part:

$$E_t \sum_{i=0}^{k-1} \mathrm{dif}_{t+i} | s_t = E_t \left( \frac{1-\beta^k}{1-\beta} \right) \mathrm{dif}_t | s_t \tag{4.3.3}$$

We show in Annex B that:

$$E_t \left( \mathrm{dif}_t \mid s_t \right) = \frac{\left( \frac{1-\beta\rho}{\rho} \right) \left( 1-\alpha^2 \right)}{1+\alpha\beta} \tag{4.3.4}$$

It follows that:

$$E_t x_{t,t+k} | s_t = \left( \frac{\alpha^{1+k} \left( 1-\beta^2 \right) - \beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)} + \frac{\left( \frac{1-\beta\rho}{\rho} \right) \left( 1-\alpha^2 \right) \left( \frac{1-\beta^k}{1-\beta} \right)}{(1+\alpha\beta)} - 1 \right) s_t \tag{4.3.5}$$

The sign of the coefficient is not clear a priori.

### 4.4 The link between expected exchange rate changes and expected excess returns

Recall that the link between exchange rate levels and expected exchange rate changes is:

$$E_t s_{t+k} - s_t = -(1-\rho(k))s_t = -\left(1 - \left(\frac{\alpha^{1+k}(1-\beta^2) - \beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)}\right)\right) s_t \tag{4.4.1}$$

The link between exchange rate levels and expected excess returns is:

$$E_t x_{t,t+k}|s_t = \left(\frac{\alpha^{1+k}\left(1-\beta^2\right) - \beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)} + \frac{\left(\frac{1-\beta\rho}{\rho}\right)\left(1-\alpha^2\right)\left(\frac{1-\beta^k}{1-\beta}\right)}{(1+\alpha\beta)} - 1\right) s_t \tag{4.4.2}$$

It follows that:

$$E_t x_{t,t+k} = \left(\frac{\left(1 - \frac{\alpha^{1+k}\left(1-\beta^2\right)-\beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)} - \frac{\left(\frac{1-\beta\rho}{\rho}\right)\left(1-\alpha^2\right)\left(\frac{1-\beta^k}{1-\beta}\right)}{(1+\alpha\beta)}\right)}{\left(1 - \left(\frac{\alpha^{1+k}(1-\beta^2)-\beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)}\right)\right)}\right) [E_t s_{t+k} - s_t] \tag{4.4.3}$$

The sign of the coefficient is not clear a priori.

# 5 Theoretical Predictions: Risk Aversion vs. Portfolio Adjustment Costs

## 5.1 Risk aversion and immediate portfolio adjustment

If there is risk aversion (i.e., $\rho < 1$) but portfolio adjustment is immediate ($\alpha = 0$), it follows from equation (4.3.5) that there is a *positive* link between exchange rate levels and expected excess returns:

$$E_t x_{t,t+k} = \left(\frac{(1-\rho)(1-\beta^k)}{\rho}\right) s_t \tag{5.1.1}$$

Similarly, it follows from equation (4.4.3) that there is a *negative* link between expected exchange rate changes and expected excess returns:

$$E_t x_{t,t+k} = \left(1 - \frac{(1-\beta\rho)}{\rho(1-\beta)}\right)[E_t s_{t+k} - s_t] = -\frac{(1-\rho)}{\rho(1-\beta)}[E_t s_{t+k} - s_t] \tag{5.1.2}$$

## 5.2 Risk neutrality and gradual portfolio adjustment

### The link between exchange rate levels and expected excess returns

If there is no risk aversion (i.e., $\rho = 1$) but portfolio adjustment is gradual ($\alpha > 0$), then:

$$E_t x_{t,t+k} | s_t = b_k s_t \tag{5.2.1}$$

where:

$$b_k = \left(\frac{\alpha^{1+k}\left(1-\beta^2\right) - \beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)} + \frac{(1-\beta)\left(1-\alpha^2\right)\left(\frac{1-\beta^k}{1-\beta}\right)}{(1+\alpha\beta)} - 1\right) \tag{5.2.2}$$

It follows that:

$$b_1 = \frac{\alpha+\beta}{1+\alpha\beta} + \frac{\left(1-\alpha^2\right)(1-\beta)}{1+\alpha\beta} - 1 > \frac{\alpha+\beta}{1+\alpha\beta} + \frac{(1-\beta)(1-\alpha)}{(1+\alpha\beta)} - 1 = 0 \tag{5.2.3}$$

There is a *positive* link between the exchange rate level and the *one period* excess return.

We demonstrate in Annex H that $b_k$ declines as $k$ increases:

$$\frac{db_k}{dk} < 0 \tag{5.2.4}$$

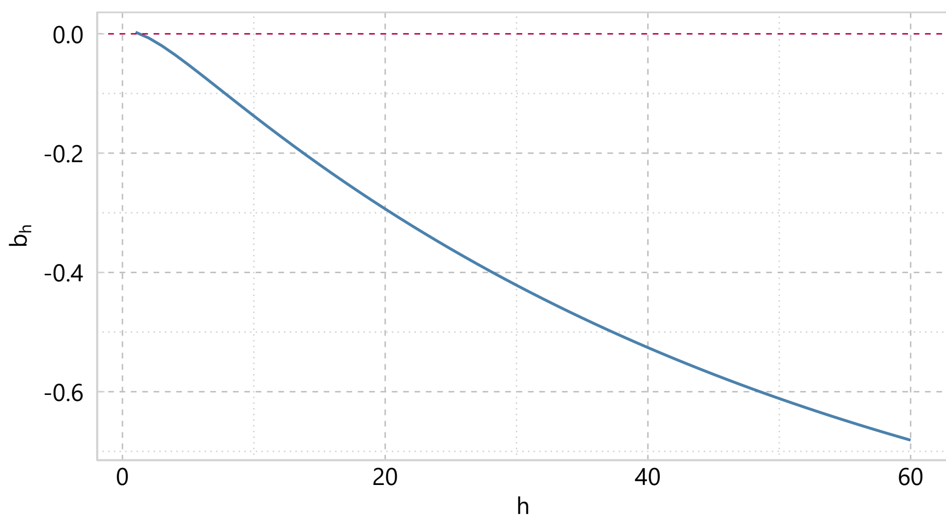
If $k$ is large enough, $b_k$ becomes negative:

$$\lim_{k\to\infty} b_k = \left(\frac{1-\alpha^2}{1+\alpha\beta}\right) - 1 < 0 \tag{5.2.5}$$

This implies that there is a *negative* link between the exchange rate level and the *long-term* excess return.

Figure 5.1 shows $b_k$ for $\alpha = 0.65$ and $\beta = 0.98$. In this case, we have $b_1 = 0.003$, and $b_k$ is negative for $k > 1$.

Figure 5.1. $b_h$ for $\alpha$ = 0.98 and $\beta$ = 0.65




### The link between expected exchange rate changes and expected excess returns

If $\rho = 1$, equation (5.2.1) becomes:

$$E_t x_{t,t+k} = c_k(E_t \log s_{t+h} - \log s_t) \tag{5.2.6}$$

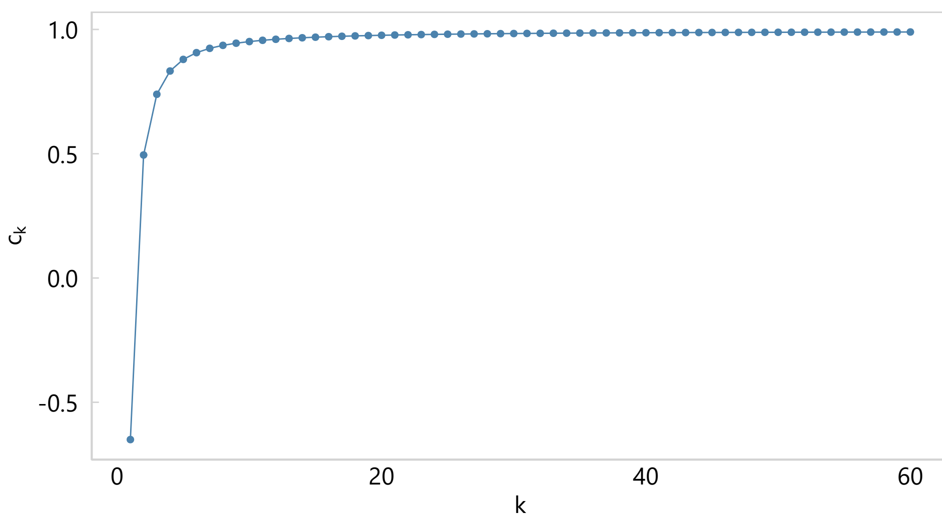
where:

$$c_k = \frac{1 - \frac{\alpha^{1+k}(1-\beta^2)-\beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)} - \frac{(1-\alpha^2)(1-\beta)}{1+\alpha\beta}}{1 - \frac{\alpha^{1+k}(1-\beta^2)-\beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)}} \tag{5.2.7}$$

It is easily shown that $c_1 > 0$, $c_{k+1} > c_k$, and $\lim_{k\to\infty} c_k > 0$. It follows that for sufficiently large $k$, $c_k$ is positive and increasing in $k$, implying a positive relationship between expected exchange rate changes and expected excess returns that strengthens with horizon.

Figure 5.2 shows the link between $k$ and $c_k$ when $\alpha = 0.98$ and $\beta = 0.98$. In this case, $b_k$ is negative for $k = 1$, positive for $k > 1$, and close to 1 for large $k$.

Figure 5.2. $c_k$ for $\alpha$ = 0.98 and $\beta$ = 0.65



# 6 Empirical Results

So far we have deduced the following predictions for the link between exchange rate levels and expected excess rerturns, and for the link between expected exchange rate changes and expected excess returns:

Table 6.1: Relationships between Exchange Rate Levels, Expected Excess Returns, and Expected Exchange Rate Changes under Different Cases

| **Case** | **Exchange Rate Levels and Expected Excess Returns** | **Expected Exchange Rate Changes and Expected Excess Returns** |
|---|---|---|
| Risk Averse, Zero Portfolio Adjustment Costs | Positive | Negative |
| Risk Neutral, Costly Portfolio Adjustment | Negative | Positive |

We will now investigate empirically which of the two models best explains reality.

## 6.1 The link between expected exchange rate changes and expected excess returns

There is a strong positive link between expected exchange rate changes and expected excess returns (Figure 6.1).

Interestingly, our data reveal no significant relationship between interest rate differentials and expected excess returns (Figure 6.2). This fundamentally challenges the logic underlying carry trade strategies. The canonical carry trade view holds that currencies with higher interest rates should deliver positive expected excess returns.

**Figure 6-1. One-Year Expected Exchange Rate Change and One-year Expected Excess Return, 2000-24**

(Monthly data)

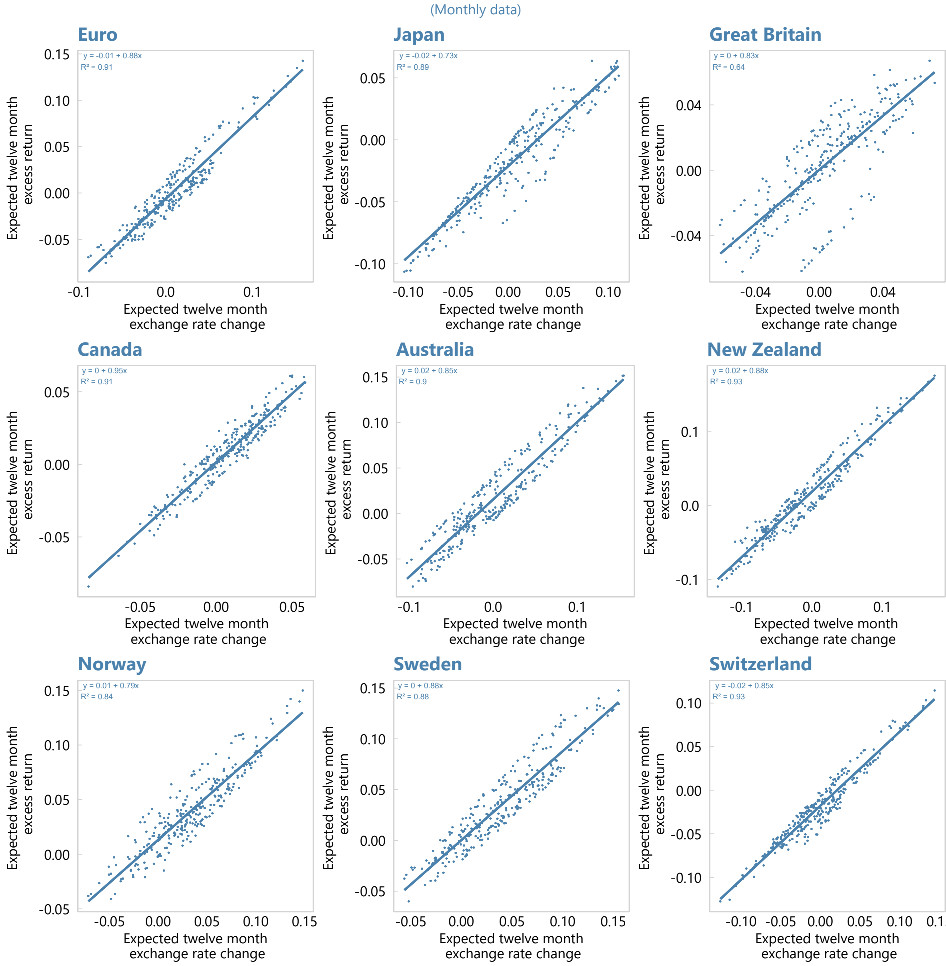
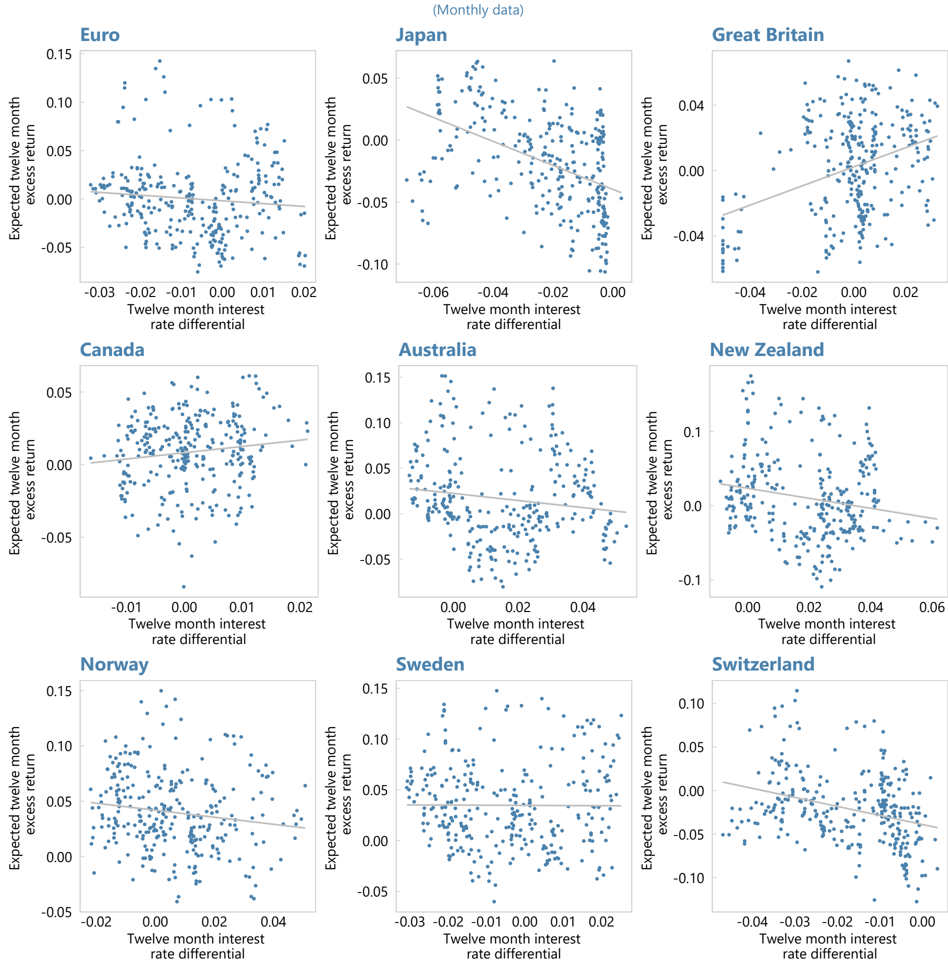


**Figure 6.2. One-Year Interest Rate Differential and One-year Expected Excess Return, 2000-24**

(Monthly data)



## 6.2 The Link Between Exchange Rate Levels and Expected Excess Returns

Empirical analysis reveals a robust negative relationship between exchange rate levels and expected excess returns for most currencies (Table 6.2).

Table 6.2: Regressions of expected excess returns on log spot rate, 2000-2024

| Country | R2 | Constant | p-value | lspot | p-value |
|---|---|---|---|---|---|
| EUR | 0.46 | 0.033 | 0.000 | -0.201 | 0.000 |
| JPN | 0.25 | -0.640 | 0.000 | -0.133 | 0.000 |
| GBR | 0.00 | 0.006 | 0.266 | -0.009 | 0.456 |
| CAN | 0.34 | -0.014 | 0.000 | -0.106 | 0.000 |
| CHE | 0.59 | -0.034 | 0.000 | -0.160 | 0.000 |
| AUS | 0.46 | -0.035 | 0.000 | -0.182 | 0.000 |
| NZL | 0.55 | -0.086 | 0.000 | -0.231 | 0.000 |
| SWE | 0.28 | -0.247 | 0.000 | -0.135 | 0.000 |
| NOR | 0.31 | -0.152 | 0.000 | -0.096 | 0.000 |

[a] Monthly data.

However, this relationship appears weaker for some currencies, particularly the British pound, where structural changes may have influenced the equilibrium exchange rate. This suggests the need to refine our framework to account for both temporary deviations and long-term structural shifts in exchange rates.

Following Bakker (2024), we decompose the exchange rate $s_t$ into two components:

- A stochastic trend $\mu_t$ capturing permanent shifts in the equilibrium exchange rate
- A stationary (cyclical) component $s_t^c$ capturing temporary deviations from this trend

Formally, the decomposition is:

$$s_t = \mu_t + s_t^c \tag{6.2.1}$$

where the stochastic trend follows a random walk:

$$\mu_t = \mu_{t-1} + \eta_t \tag{6.2.2}$$

and the stationary component retains the properties outlined in earlier sections.

As shown in Annex C, the cyclical component $s_t^c$ plays a critical role in driving predictable excess returns. Its relationship with expected excess returns, derived from the theoretical framework, reflects the gradual mean reversion of exchange rates. Portfolio adjustment costs prevent immediate rebalancing, leading to persistent deviations from the stochastic trend and generating predictable patterns in excess returns. This cyclical behavior contrasts with the stochastic trend $\mu_t$, which represents long-term equilibrium shifts and does not directly contribute to excess return predictability.

The relationship between the cyclical component and expected excess returns is given by:

$$E_t x_{t,t+k}|s_t^c = \left( \frac{\alpha^{1+k}\left(1-\beta^2\right) - \beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)} + \frac{\left(\frac{1-\beta\rho}{\rho}\right)\left(1-\alpha^2\right)\left(\frac{1-\beta^k}{1-\beta}\right)}{(1+\alpha\beta)} - 1 \right) s_t^c \tag{6.2.3}$$

This is the same equation as (5.2.1), with $s_t$ replaced by $s_t^c$.

To test this, we ran regressions of the expected excess returns on the cyclical component of the exchange rate, where the cyclical component was derived using an HP-filter.[2]

The regression results in Table 6.3 show that the cyclical component is highly significant across all countries. Even for currencies like the British pound, the cyclical component effectively captures the relationship, addressing the limitations of using raw exchange rate levels.

In conclusion, there is a negative link between exchange rate levels (or the cyclical component of the exchange rate for currencies with stronger stochastic trends) and expected excess returns. This finding further supports our theoretical model with portfolio adjustment costs, while contradicting the predictions of models based purely on risk aversion.

[2]We used $\lambda = 1e8$. As discussed in Bakker (2024), a slowly moving stochastic trend is necessary to explain the negative link between exchange rate levels and expected exchange rate changes documented in that paper.

Table 6.3: Regressions of expected excess returns on cyclical component log spot rate , 2000-2024

| Country | R2 | Constant | p-value | lspot_cycl | p-value |
|---|---|---|---|---|---|
| EUR | 0.43 | 0.000 | 0.913 | -0.195 | 0.000 |
| JPN | 0.23 | -0.018 | 0.000 | -0.131 | 0.000 |
| GBR | 0.17 | 0.002 | 0.171 | -0.115 | 0.000 |
| CAN | 0.34 | 0.009 | 0.000 | -0.106 | 0.000 |
| CHE | 0.43 | -0.021 | 0.000 | -0.259 | 0.000 |
| AUS | 0.38 | 0.016 | 0.000 | -0.170 | 0.000 |
| NZL | 0.49 | 0.010 | 0.000 | -0.240 | 0.000 |
| SWE | 0.46 | 0.035 | 0.000 | -0.182 | 0.000 |
| NOR | 0.40 | 0.040 | 0.000 | -0.124 | 0.000 |

[a] Monthly data.

# 7 Could the Negative Link Be the Result of Risk Premium Shocks?

We acknowledge that alternative models incorporating risk premium shocks might generate similar patterns, but we demonstrate that these shocks cannot fully explain our findings.

If a higher VIX is associated with both a higher expected excess return:

$$E_t x_{t,t-h} = a + b \log(\mathrm{VIX}_t), \tag{7.0.1}$$

and a more depreciated exchange rate:

$$\log s_t = c - d \log(\mathrm{VIX}_t), \tag{7.0.2}$$

it follows that there is a negative relationship between the exchange rate and the expected excess return:

$$E_t x_{t,t-h} = \left(\frac{ad - bc}{d}\right) - \left(\frac{b}{d}\right) \log s_t. \tag{7.0.3}$$

This derived negative relationship (7.0.3) demonstrates that risk premium shocks, if present, align with observed patterns. However, further empirical analysis is needed to establish whether they are sufficient to explain the link.

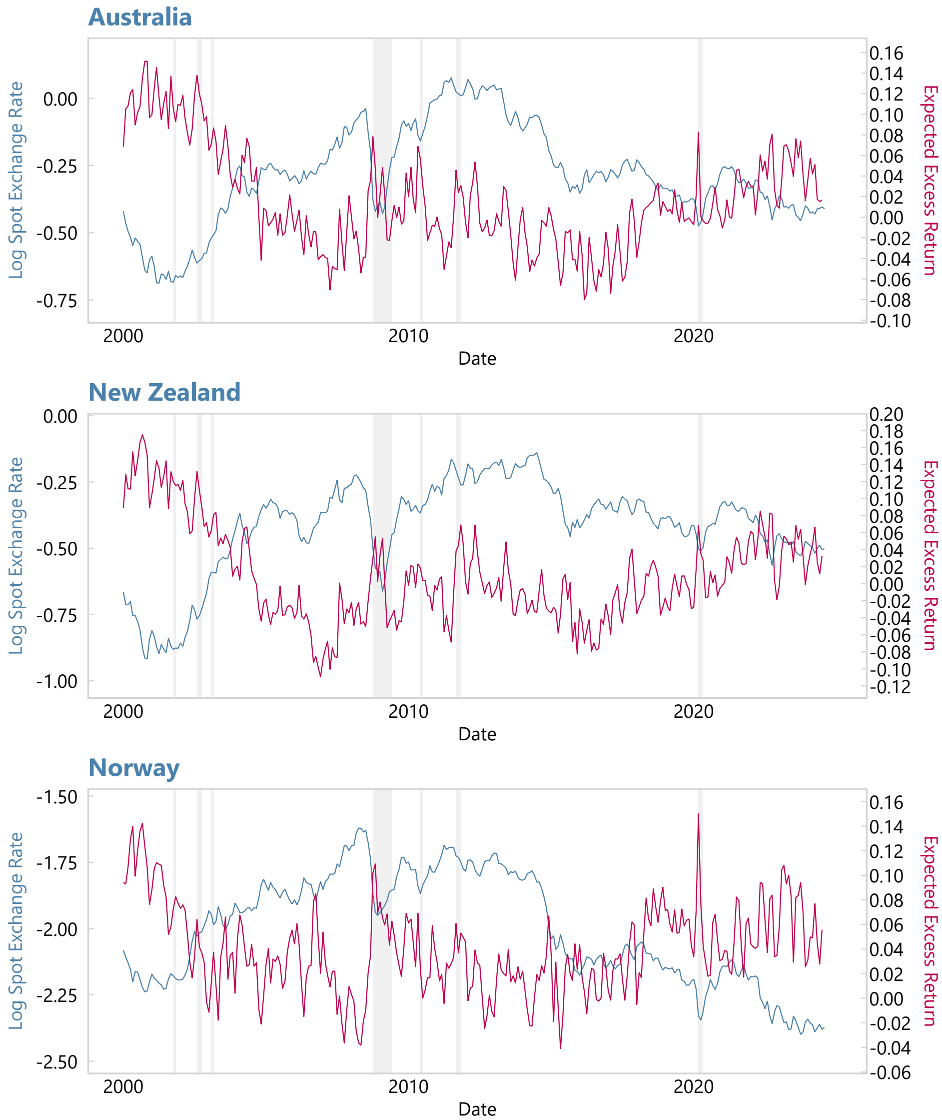
Figures 7.1a-7.1c illustrate that, for some countries, periods of extreme stress are indeed associated with both a decline in the exchange rate and an increase in expected excess returns.

**Figure 7.1a. Exchange rate level and**
**One-year Expected Excess Return, 2000-24**
(Monthly data)


Grey areas indicate months in which the VIX exceeded 30.

**Figure 7.1b. Exchange rate level and One-year Expected Excess Return, 2000-24**

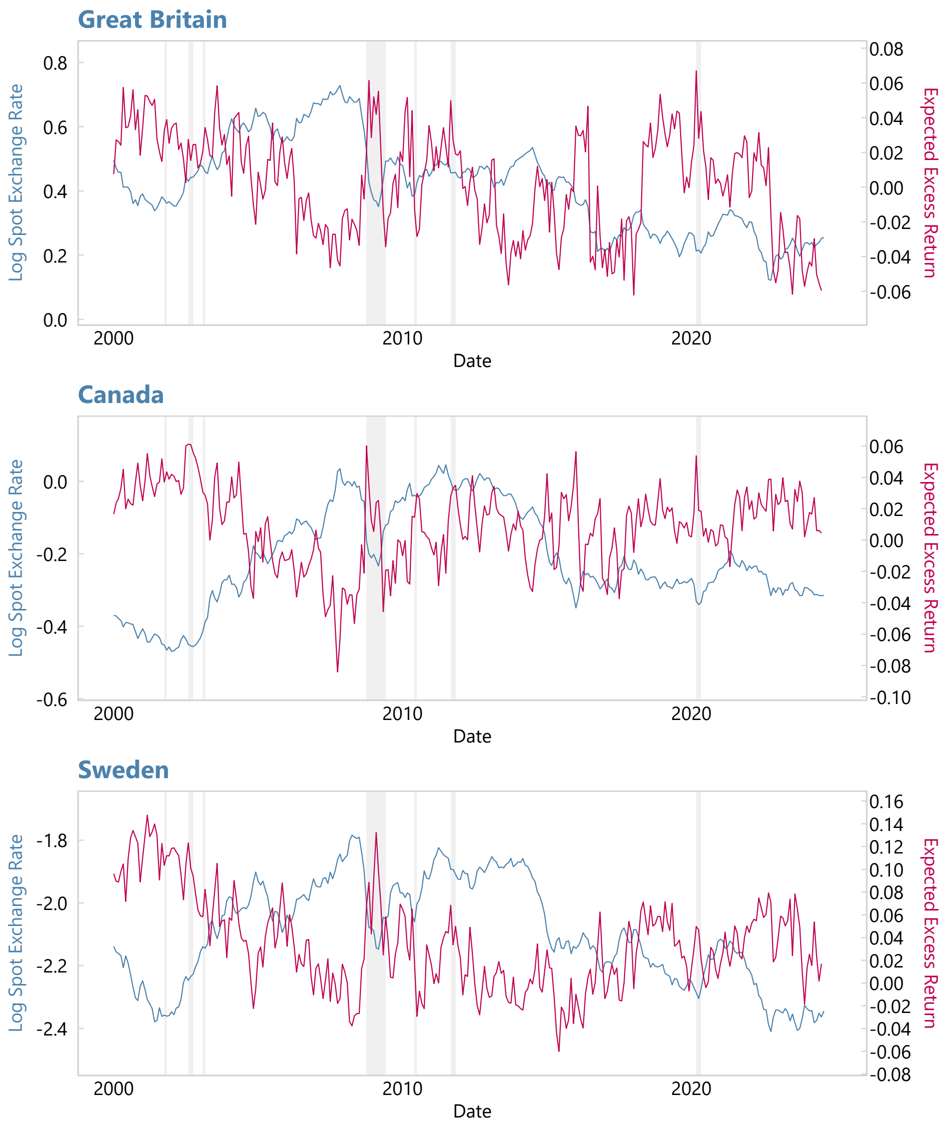
(Monthly data)




Grey areas indicate months in which the VIX exceeded 30.

**Figure 7.1c. Exchange rate level and One-year Expected Excess Return, 2000-24**

(Monthly data)




Grey areas indicate months in which the VIX exceeded 30.

However, while the VIX tends to rise during crisis periods and exchange rates often depreciate, the general relationship between the spot rate and the VIX is weak. Table 7.1 shows that, despite statistical significance, the $R^2$ values for the relationship remain near zero for most countries, underscoring the limited explanatory power of risk premium shocks.

Table 7.1: Regressions of log spot rate on log vix, 2000-2024

| country | R2 | Constant | p-value | log(vix) | p-value |
|---|---|---|---|---|---|
| EUR | 0.01 | 0.273 | 0.000 | -0.037 | 0.093 |
| JPN | 0.03 | -4.914 | 0.000 | 0.076 | 0.002 |
| GBR | 0.01 | 0.521 | 0.000 | -0.036 | 0.118 |
| CAN | 0.02 | -0.049 | 0.452 | -0.056 | 0.011 |
| CHE | 0.04 | 0.254 | 0.006 | -0.115 | 0.000 |
| AUS | 0.05 | 0.059 | 0.489 | -0.118 | 0.000 |
| NZL | 0.14 | 0.129 | 0.105 | -0.187 | 0.000 |
| SWE | 0.02 | -1.912 | 0.000 | -0.063 | 0.017 |
| NOR | 0.00 | -1.948 | 0.000 | -0.019 | 0.562 |

[a] Monthly data.

There is another reason why the link between exchange rate levels and expected excess returns is not the result of risk premium shocks: risk premium shocks are relatively rare. Since 2000, there have been only 32 months (10.6% of the time) in which the VIX exceeded 30 (Figure 7.2).

Indeed, when we regress exchange rate levels on the VIX and restrict the sample to periods when the VIX was below 30, the negative link remains strong and highly significant (Table 7.2). A similar result is obtained when using the cyclical component of the exchange rate instead of the level (Table 7.3). The link persists even when excluding periods of moderate volatility and focusing solely on low market volatility (VIX $<$ 20). Regression results in Table 7.4 confirm that the negative link remains significant even in low-volatility periods, while Table 7.5 highlights the robustness of this relationship when analyzing the cyclical component of exchange rates.

Finally, there is an additional challenge to the hypothesis that risk premium shocks drive the negative link between exchange rate levels and expected excess returns. For some currencies, such as the New Zealand dollar, the relationship is straightforward: an increase in the VIX causes a depreciation of the currency vis-à-vis the US dollar and a rise in expected excess returns. However, for safe-haven currencies like the Swiss Franc, the relationship is far more ambiguous. When the VIX rises, will the Swiss Franc appreciate or depreciate vis-à-vis the US dollar? This uncertainty further undermines the sufficiency of risk premium shocks as a universal explanation.

Taken together, these findings strongly support the conclusion that the negative link between exchange rate levels and expected excess returns cannot be attributed solely to risk premium shocks. Instead, the evidence points to alternative mechanisms, such as portfolio adjustment costs, as the primary drivers of this relationship.

**Figure 7.2. VIX, 2000-2024**

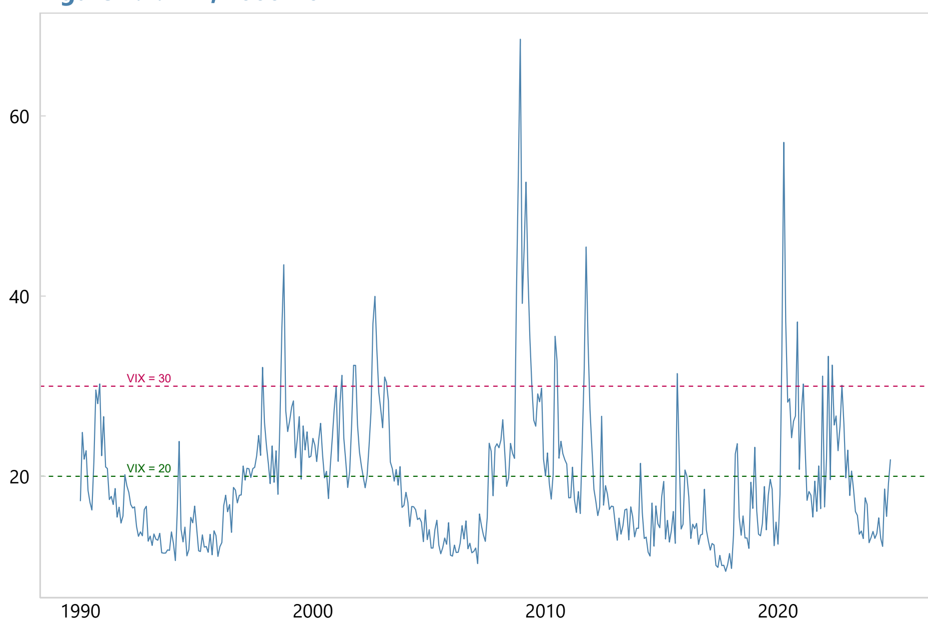


Table 7.2: Regressions of expected excess returns on log spot rate component for periods where VIX < 30, 2000-2024

| Country | R2 | Constant | p-value | lspot | p-value |
|---|---|---|---|---|---|
| EUR | 0.45 | 0.033 | 0.000 | -0.202 | 0.000 |
| JPN | 0.23 | -0.626 | 0.000 | -0.130 | 0.000 |
| GBR | 0.00 | 0.001 | 0.922 | -0.002 | 0.869 |
| CAN | 0.36 | -0.015 | 0.000 | -0.106 | 0.000 |
| CHE | 0.64 | -0.035 | 0.000 | -0.171 | 0.000 |
| AUS | 0.45 | -0.037 | 0.000 | -0.182 | 0.000 |
| NZL | 0.56 | -0.089 | 0.000 | -0.236 | 0.000 |
| SWE | 0.29 | -0.241 | 0.000 | -0.131 | 0.000 |
| NOR | 0.33 | -0.158 | 0.000 | -0.098 | 0.000 |

[a] Monthly data.

Table 7.3: Regressions of expected excess returns on cyclical component log spot rate for periods where VIX < 30, 2000-2024

| Country | R2 | Constant | p-value | lspot_cycl | p-value |
|---|---|---|---|---|---|
| EUR | 0.44 | -0.001 | 0.482 | -0.199 | 0.000 |
| JPN | 0.23 | -0.016 | 0.000 | -0.131 | 0.000 |
| GBR | 0.16 | -0.000 | 0.846 | -0.109 | 0.000 |
| CAN | 0.36 | 0.007 | 0.000 | -0.106 | 0.000 |
| CHE | 0.45 | -0.022 | 0.000 | -0.263 | 0.000 |
| AUS | 0.40 | 0.013 | 0.000 | -0.173 | 0.000 |
| NZL | 0.50 | 0.006 | 0.010 | -0.243 | 0.000 |
| SWE | 0.50 | 0.032 | 0.000 | -0.183 | 0.000 |
| NOR | 0.44 | 0.037 | 0.000 | -0.128 | 0.000 |

[a] Monthly data.

Table 7.4: Regressions of expected excess returns on log spot rate for periods where VIX < 20, 2000-2024

| Country | R2 | Constant | p-value | lspot | p-value |
|---|---|---|---|---|---|
| EUR | 0.21 | 0.017 | 0.000 | -0.146 | 0.000 |
| JPN | 0.20 | -0.585 | 0.000 | -0.122 | 0.000 |
| GBR | 0.01 | -0.012 | 0.058 | 0.016 | 0.256 |
| CAN | 0.20 | -0.013 | 0.000 | -0.085 | 0.000 |
| CHE | 0.65 | -0.035 | 0.000 | -0.198 | 0.000 |
| AUS | 0.25 | -0.034 | 0.000 | -0.132 | 0.000 |
| NZL | 0.28 | -0.076 | 0.000 | -0.189 | 0.000 |
| SWE | 0.18 | -0.161 | 0.000 | -0.089 | 0.000 |
| NOR | 0.32 | -0.146 | 0.000 | -0.090 | 0.000 |

[a] Monthly data.

Table 7.5: Regressions of expected excess returns on cyclical component log spot rate for periods where VIX < 20, 2000-2024

| Country | R2 | Constant | p-value | lspot_cycl | p-value |
|---|---|---|---|---|---|
| EUR | 0.35 | -0.009 | 0.000 | -0.202 | 0.000 |
| JPN | 0.27 | -0.009 | 0.001 | -0.153 | 0.000 |
| GBR | 0.10 | -0.005 | 0.010 | -0.113 | 0.000 |
| CAN | 0.16 | 0.004 | 0.021 | -0.080 | 0.000 |
| CHE | 0.56 | -0.028 | 0.000 | -0.281 | 0.000 |
| AUS | 0.26 | -0.001 | 0.734 | -0.139 | 0.000 |
| NZL | 0.27 | -0.008 | 0.008 | -0.188 | 0.000 |
| SWE | 0.43 | 0.023 | 0.000 | -0.181 | 0.000 |
| NOR | 0.30 | 0.033 | 0.000 | -0.125 | 0.000 |

[a] Monthly data.

## 8 The predictive power of one-year expected excess returns for multi-year excess returns

In an earlier paper Bakker (2024), we demonstrated that expected one-year exchange rate changes predict subsequent multi-year changes. We now show a parallel result for excess returns, maintaining our assumptions of risk-neutral investors and costly portfolio adjustment.

### 8.1 Theoretical Framework

The k-period expected excess return follows:

$$E_t x_{t,t+k} = -d_k \log s_t^c \tag{8.1.1}$$

where

$$d_k = 1 - \frac{\alpha^{1+k}\left(1-\beta^2\right) - \beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)} - \frac{(1-\alpha^2)(1-\beta)}{1+\alpha\beta} \tag{8.1.2}$$

The one-year expected excess return takes a similar form:

$$E_t x_{t,t+12} = -d_{12} \log s_t^c \tag{8.1.3}$$

Combining these equations reveals a striking relationship:

$$E_t x_{t,t+k} = \left(\frac{d_k}{d_{12}}\right) E_t x_{t,t+12} \tag{8.1.4}$$

Since $d_{k+1} > d_k$, this equation implies that expected multi-year excess returns are multiples of expected one-year returns, with the multiple increasing with horizon.

### 8.2 Empirical Evidence

Our empirical analysis strongly supports these theoretical predictions. Tables 8.1 and 8.2 report results from regressing realized excess returns on lagged expected excess returns across various horizons, revealing three key patterns:

1. Multi-year excess returns are indeed multiples of expected one-year returns
2. These multiples increase systematically with the forecast horizon
3. The predictive power strengthens at longer horizons, with R-squared values rising substantially

The euro provides a striking example of this long-horizon predictability. At the five-year horizon:

- The excess return is 3.34 times the lagged one-year expected return.
- The R-squared reaches 0.58, explaining 58% of return variation.
- his predictability is remarkably high for financial markets, especially at such long horizons

These findings parallel our earlier results on exchange rate changes, suggesting a unified framework for understanding long-horizon currency market dynamics.

Table 8.1: Coefficients and Standard errors of regression of x-year excess return on x-year lagged one-year expected excess return, 2005-2024

| | Coefficients | | | | | Standard errors | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 year | 2 years | 3 years | 4 years | 5 years | 1 year | 2 years | 3 years | 4 years | 5 years | Observations |
| EUR | 0.71 | 1.77 | 2.63 | 3.03 | 3.27 | 0.13 | 0.16 | 0.16 | 0.17 | 0.20 | 237 |
| JPN | -0.62 | -0.79 | -0.30 | 1.12 | 2.56 | 0.15 | 0.25 | 0.31 | 0.33 | 0.30 | 237 |
| GBR | 0.83 | 2.45 | 3.30 | 3.48 | 3.74 | 0.19 | 0.24 | 0.26 | 0.33 | 0.37 | 237 |
| CAN | 0.90 | 1.28 | 1.69 | 2.09 | 2.28 | 0.18 | 0.26 | 0.33 | 0.39 | 0.45 | 237 |
| CHE | 0.50 | 1.01 | 1.59 | 2.08 | 2.30 | 0.11 | 0.14 | 0.14 | 0.15 | 0.15 | 237 |
| AUS | 0.55 | 1.52 | 2.25 | 2.66 | 2.77 | 0.15 | 0.20 | 0.22 | 0.25 | 0.30 | 237 |
| NZL | 0.47 | 1.41 | 2.12 | 2.60 | 2.58 | 0.13 | 0.17 | 0.18 | 0.20 | 0.24 | 237 |
| SWE | 0.92 | 2.26 | 3.05 | 3.36 | 3.39 | 0.16 | 0.20 | 0.18 | 0.21 | 0.25 | 237 |
| NOR | 0.95 | 1.99 | 2.73 | 3.06 | 3.15 | 0.19 | 0.26 | 0.30 | 0.35 | 0.42 | 237 |

[a] Monthly data.

Table 8.2: R2 of regressions of x-year excess return on x-year lagged one-year expected excess return, 2005-2024

| | 1 year | 2 years | 3 years | 4 years | 5 years | Observations |
|---|---|---|---|---|---|---|
| EUR | 0.09 | 0.31 | 0.53 | 0.56 | 0.54 | 237 |
| JPN | 0.05 | 0.03 | -0.00 | 0.04 | 0.23 | 237 |
| GBR | 0.06 | 0.28 | 0.38 | 0.31 | 0.30 | 237 |
| CAN | 0.07 | 0.08 | 0.09 | 0.10 | 0.09 | 237 |
| CHE | 0.07 | 0.17 | 0.34 | 0.45 | 0.49 | 237 |
| AUS | 0.04 | 0.18 | 0.28 | 0.31 | 0.27 | 237 |
| NZL | 0.04 | 0.20 | 0.34 | 0.41 | 0.34 | 237 |
| SWE | 0.10 | 0.32 | 0.51 | 0.51 | 0.43 | 237 |
| NOR | 0.08 | 0.17 | 0.24 | 0.23 | 0.19 | 237 |

[a] Monthly data.

# 9 Extension: Both Risk Aversion and Costly Portfolio Adjustment

Thus far, we have analyzed two polar cases: costless portfolio adjustment with risk aversion and costly portfolio adjustment without risk aversion. In this section, we consider intermediate cases where both risk aversion and costly portfolio adjustment coexist.

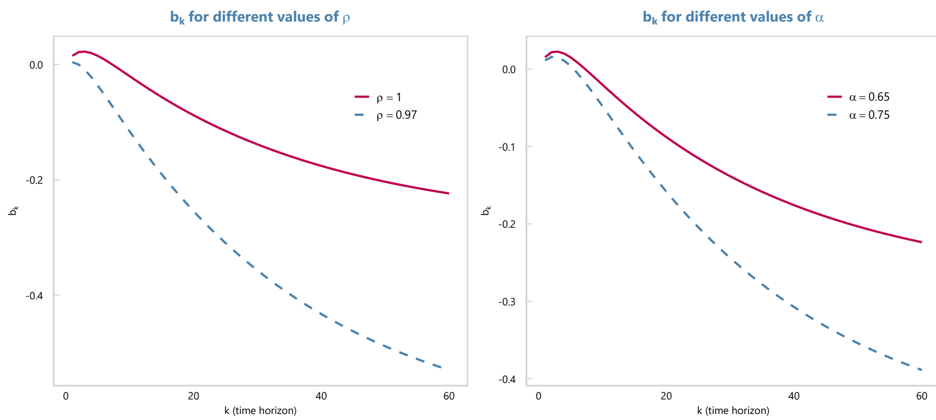
Rather than relying on analytical expressions, we present numerical examples to examine the regression coefficients of expected excess returns on the exchange rate level. Several key patterns emerge:

- For a given level of portfolio adjustment costs, greater risk aversion results in coefficients that are less negative (or more positive) (Figure 9.1, left panel).
- For a given level of risk aversion, higher portfolio adjustment costs lead to coefficients that are less positive (or more negative) (Figure 9.1, right panel).

These findings suggest that the absence of risk aversion is not a necessary condition for a negative relationship between exchange rate levels and expected excess returns; instead, the presence of portfolio adjustment costs is essential. However, the presence of portfolio adjustment costs is insufficient—they must be sufficiently high to offset the influence of risk aversion.

Similarly, the absence of portfolio adjustment costs is not a necessary condition for a positive link between exchange rate levels and expected excess returns; risk aversion is crucial. Yet, the presence of risk aversion is insufficient—it must be sufficiently strong to counteract the effects of portfolio adjustment costs.

**Figure 9.1. Expected coefficient of of regression of k-period excess return on Exchange rate level**




Unless otherwise indicated, $\beta = 0.97$, $\rho = 0.97$, $\alpha = 0.65$

## 10 Conclusion

This paper has demonstrated that portfolio adjustment costs, rather than risk aversion, may be the primary driver of systematic patterns in currency markets in advanced economies. Building on Bacchetta and van Wincoop's (2021) portfolio balance framework, we show theoretically that costly portfolio adjustment alone can generate non-zero expected excess returns, even when investors are risk-neutral. Our model yields two key predictions that sharply distinguish it from traditional risk-aversion explanations: a positive correlation between expected exchange rate changes and expected excess returns, and a negative relationship between exchange rate levels and longer-term expected excess returns.

Using survey data from nine advanced economies over 2000-2024, we find strong empirical support for these predictions. First, we document a robust positive relationship between expected exchange rate changes and expected excess returns - precisely as predicted by our portfolio adjustment costs framework, but contrary to the negative relationship implied by risk-aversion models. Second, we find a significant negative link between exchange rate levels and longer-term expected excess returns, again consistent with our framework's predictions.

Importantly, we show that these patterns cannot be explained by risk premium shocks. The relationships persist even during periods of low market stress, and exchange rates show remarkably weak correlation with standard measures of market risk like the VIX. This evidence suggests that while risk premium shocks may play a role during crisis periods, they cannot account for the systematic patterns we observe throughout the sample.

Our results suggest that adjustment costs, rather than time-varying risk aversion, may be key to understanding the behavior of expected excess returns.

Our findings also reveal substantial predictability of excess returns at longer horizons. One-year expected excess returns strongly predict subsequent multi-year returns, with the relationship strengthening at longer horizons. This predictability pattern mirrors our earlier findings on exchange rate changes Bakker (2024) and provides further support for our portfolio adjustment costs framework.

These findings provide a simpler, testable alternative to literature relying on assumptions about unobservable factors like time-varying risk premiums, intermediary constraints, or noise trader activity.

A promising direction for future research would be to examine whether similar patterns exist in other asset classes. Understanding the precise nature and source of these adjustment costs - whether they stem from institutional features, market microstructure, or behavioral factors - would also be valuable.

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# Annexes

## A The Exchange Rate Level and Expected Exchange Rate Changes

Consider the regression:

$$\log s_t = a + b_k \log s_{t-k} + \xi_t \tag{A.0.1}$$

where $b_k$ is given by:

$$b_k = \frac{\text{cov}(\log s_t, \log s_{t-k})}{\text{var}(\log s_t)} \tag{A.0.2}$$

### Autocovariance and AR(2) Process

The autocovariance function $\gamma(k) = \text{cov}(\log s_t, \log s_{t-k})$ satisfies:

$$\gamma(k) = (\alpha + \beta)\gamma(k-1) - \alpha\beta\gamma(k-2) \tag{A.0.3}$$

This difference equation has the solution:

$$\gamma(k) = A\alpha^k + B\beta^k \tag{A.0.4}$$

where $A$ and $B$ are constants determined by initial conditions.

### Solving for A and B

Given the AR(2) process:

$$\log s_t = (\alpha + \beta) \log s_{t-1} - \alpha\beta \log s_{t-2} + \epsilon'_t \tag{A.0.5}$$

The initial conditions yield:

$$\gamma(0) = \frac{(1 + \alpha\beta)\sigma^2_{\epsilon'}}{(1 - \alpha^2)(1 - \beta^2)} \quad \text{and} \quad \gamma(1) = \frac{(\alpha + \beta)\sigma^2_{\epsilon'}}{(1 - \alpha^2)(1 - \beta^2)} \tag{A.0.6}$$

With these, the constants $A$ and $B$ become:

$$A = \frac{\alpha\sigma^2_{\epsilon'}}{(1 - \alpha^2)(\alpha - \beta)(1 - \alpha\beta)} \quad \text{and} \quad B = -\frac{\beta\sigma^2_{\epsilon'}}{(1 - \beta^2)(\alpha - \beta)(1 - \alpha\beta)} \tag{A.0.7}$$

### Coefficient $b_k$ for Predictability

The coefficient for the lagged exchange rate is:

$$b_k = \frac{\alpha^{1+k}(1-\beta^2) - \beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)} \tag{A.0.8}$$

This coefficient decreases with $k$ and approaches 0 as $k \to \infty$.

## B The Exchange Rate Level and Excess Returns

### B.1 Derivation

Let $x_{t,t+k} = \log s_{t+k} - \log s_t + \sum_{i=0}^{i=k-1} \mathrm{dif}_{t+i}$. Consider a regression of excess returns on exchange rate levels:

$$x_{t,t+k} = a + b_k \log s_t \tag{B.1.1}$$

We know that

$$b_k = \frac{\mathrm{cov}(x_t^{t+k}, \log s_t)}{\mathrm{var}(\log s_t)} \tag{B.1.2}$$

It follows that:

$$b_k = \frac{\mathrm{cov}(\log s_{t+k} - \log s_t + \sum_{i=0}^{i=k-1} \mathrm{dif}_{t+i}, \log s_t)}{\mathrm{var}(\log s_t)} \tag{B.1.3}$$

This implies:

$$b_k = \frac{\mathrm{cov}(\log s_{t+k}, \log s_t)}{\mathrm{var}(\log s_t)} - \frac{\mathrm{cov}(\log s_t, \log s_t)}{\mathrm{var}(\log s_t)} + \frac{\mathrm{cov}(\sum_{i=0}^{i=k-1} \mathrm{dif}_{t+i}, \log s_t)}{\mathrm{var}(\log s_t)} \tag{B.1.4}$$

It follows that:

$$b_k = -1 + \frac{\mathrm{cov}(\log s_{t+k}, \log s_t)}{\mathrm{var}(\log s_t)} + \frac{\mathrm{cov}(\sum_{i=0}^{i=k-1} \mathrm{dif}_{t+i}, s_{t-k})}{\mathrm{var}(\log s_t)} \tag{B.1.5}$$

#### Deriving b

It is easily checked that

$$\mathrm{cov}(\sum_{i=0}^{i=k-1} \mathrm{dif}_{t+i}, \log s_t) = \sum_{i=0}^{i=k-1} \beta^i \mathrm{cov}(\mathrm{dif}_t, \log s_t) = \left(\frac{1-\beta^k}{1-\beta}\right) \mathrm{cov}(\mathrm{dif}_t, \log s_t) \tag{B.1.6}$$

We will now derive $\mathrm{cov}(\mathrm{dif}_t, \log s_t)$. Recall that

$$\log s_t = \alpha \log s_{t-1} + \left(\frac{\rho}{1-\rho\beta}\right) \mathrm{dif}_t \tag{B.1.7}$$

It follows that

$$\mathrm{cov}(\log s_t, \mathrm{dif}_t) = \left(\frac{\rho}{1-\rho\beta}\right) \sum_{i=0}^{\infty} \alpha^i \mathrm{cov}(\mathrm{dif}_{t+i}, \mathrm{dif}_t) \tag{B.1.8}$$

This implies:

$$\text{cov}(\log s_t, \text{dif}_t) = \left(\frac{\rho}{1-\rho\beta}\right)\sum_{i=0}^{\infty}(\alpha\beta)^i \text{var}(\text{dif}_t) \tag{B.1.9}$$

This can be written as:

$$\text{cov}(\log s_t, \text{dif}_t) = \left(\frac{\rho}{1-\rho\beta}\right)\left(\frac{1}{1-\alpha\beta}\right)\text{var}(\text{dif}_t) \tag{B.1.10}$$

Recall that

$$\text{dif}_t = \beta\text{dif}_{t-1} + \epsilon_t \tag{B.1.11}$$

It follows that

$$\text{var}(\text{dif}_t) = \left(\frac{1}{1-\beta^2}\right)\sigma_\epsilon^2 \tag{B.1.12}$$

Substituting (B.1.12) in (B.1.10) we get:

$$\text{cov}(\log s_t, \text{dif}_t) = \left(\frac{\rho}{1-\rho\beta}\right)\left(\frac{1}{1-\alpha\beta}\right)\left(\frac{1}{1-\beta^2}\right)\sigma_\epsilon^2 \tag{B.1.13}$$

Substitute (B.1.13) in (B.1.6):

$$\text{cov}\left(\sum_{i=0}^{i=k-1}\text{dif}_{t+i}, \log s_t\right) = \left(\frac{1-\beta^k}{1-\beta}\right)\left(\frac{\rho}{1-\rho\beta}\right)\left(\frac{1}{1-\alpha\beta}\right)\left(\frac{1}{1-\beta^2}\right)\sigma_\epsilon^2 \tag{B.1.14}$$

Recall from (A.0.6) that[3]

$$\text{var}(\log s_t) = \left(\frac{1+\alpha\beta}{1-\alpha\beta}\right)\frac{\sigma_{\epsilon'}^2}{(1-\alpha^2)(1-\beta^2)} \tag{B.1.15}$$

Note that

$$\epsilon'_t = \left(\frac{\rho}{1-\rho\beta}\right)\epsilon_t \tag{B.1.16}$$

It follows that

$$\sigma_{\epsilon'}^2 = \left(\frac{\rho}{1-\rho\beta}\right)^2\sigma_\epsilon^2 \tag{B.1.17}$$

This implies that

$$\text{var}(\log s_t) = \left(\frac{1+\alpha\beta}{1-\alpha\beta}\right)\frac{1}{(1-\alpha^2)(1-\beta^2)}\left(\frac{\rho}{1-\rho\beta}\right)^2\sigma_\epsilon^2 \tag{B.1.18}$$

[3]Note that $\text{var}(\log s_t) = \gamma(0)$

Combine (B.1.13) and (B.1.18):

$$\frac{\operatorname{cov}(\sum_{i=0}^{i=k-1} \operatorname{dif}_{t-k+i}, \log s_{t-k})}{\operatorname{var}(\log s_t)} = \frac{\left(\frac{1-\beta^k}{1-\beta}\right)\left(\frac{\rho}{1-\rho\beta}\right)\left(\frac{1}{1-\alpha\beta}\right)\left(\frac{1}{1-\beta^2}\right)\sigma_\epsilon^2}{\left(\frac{1+\alpha\beta}{1-\alpha\beta}\right)\frac{1}{(1-\alpha^2)(1-\beta^2)}\left(\frac{\rho}{1-\rho\beta}\right)^2\sigma_\epsilon^2} \tag{B.1.19}$$

This can be rewritten as:

$$\frac{\operatorname{cov}(\sum_{i=0}^{i=k-1} \operatorname{dif}_{t-k+i}, \log s_{t-k})}{\operatorname{var}(\log s_t)} = \frac{(1-\alpha^2)\left(\frac{1-\beta^k}{1-\beta}\right)}{(1+\alpha\beta)\left(\frac{\rho}{1-\rho\beta}\right)} \tag{B.1.20}$$

Recall from equation (A.0.2)and (A.0.8) that

$$\frac{\operatorname{cov}(\log s_t, \log s_{t-k})}{\operatorname{var}(\log s_t)} = \frac{\alpha^{1+k}\left(1-\beta^2\right) - \beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)} \tag{B.1.21}$$

Substitute (B.1.21) and (B.1.20) in (B.1.5):

$$b_k = \left(\frac{\alpha^{1+k}\left(1-\beta^2\right) - \beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)} + \frac{(1-\alpha^2)\left(\frac{1-\beta^k}{1-\beta}\right)}{(1+\alpha\beta)\left(\frac{\rho}{1-\rho\beta}\right)} - 1\right) \tag{B.1.22}$$

It follows that:

$$b_k = \left(\frac{\alpha^{1+k}\left(1-\beta^2\right) - \beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)} + \frac{\left(\frac{1-\beta\rho}{\rho}\right)(1-\alpha^2)\left(\frac{1-\beta^k}{1-\beta}\right)}{(1+\alpha\beta)} - 1\right) \tag{B.1.23}$$

## B.2 Derivation of $\frac{db_k}{dk}$

$$\frac{db_k}{dk} = \frac{\left(\alpha^2-1\right)\log(\beta)\beta^{k+1} - \left(\beta^2-1\right)\log(\alpha)\alpha^{k+1}}{(\alpha-\beta)(\alpha\beta+1)} + \frac{\left(\alpha^2-1\right)\log(\beta)\beta^k}{\alpha\beta+1} \tag{B.2.1}$$

It follows that:

$$\frac{db_k}{dk} = \frac{\left(\alpha^2-1\right)\log(\beta)\beta^{k+1} - \left(\beta^2-1\right)\log(\alpha)\alpha^{k+1}}{(\alpha-\beta)(\alpha\beta+1)} + \frac{\left(\alpha^2-1\right)\log(\beta)\beta^k(\alpha-\beta)}{(\alpha\beta+1)(\alpha-\beta)} \tag{B.2.2}$$

This can be rewritten as:

$$\frac{db_k}{dk} = \frac{\left(1-\beta^2\right)\log(\alpha)\alpha^{k+1}}{(\alpha-\beta)(\alpha\beta+1)} - \frac{\left(1-\alpha^2\right)\log(\beta)\beta^k\alpha}{(\alpha\beta+1)(\alpha-\beta)} \tag{B.2.3}$$

Define $b = -\log(\beta)$ and $a = -\log(\alpha)$. Note that $a > 0$ and $b > 0$.

$$\frac{db_k}{dk} = -\frac{\left(1-\beta^2\right)a\alpha^{k+1}}{(\alpha-\beta)(\alpha\beta+1)} + \frac{\left(1-\alpha^2\right)b\beta^k\alpha}{(\alpha\beta+1)(\alpha-\beta)} \tag{B.2.4}$$

First take $\alpha > \beta$. This implies $a < b$.

$$\begin{aligned}\frac{db_k}{dk} &= -\frac{\left(1-\beta^2\right)a\alpha^{k+1}}{(\alpha-\beta)(\alpha\beta+1)} + \frac{\left(1-\alpha^2\right)b\beta^k\alpha}{(\alpha\beta+1)(\alpha-\beta)} \\ &\quad -\frac{\left(1-\beta^2\right)b\alpha^{k+1}}{(\alpha-\beta)(\alpha\beta+1)} + \frac{\left(1-\alpha^2\right)b\alpha^{k+1}}{(\alpha\beta+1)(\alpha-\beta)} \\ &= \frac{\left(\beta^2-\alpha^2\right)b\alpha^{k+1}}{(\alpha\beta+1)(\alpha-\beta)} < 0\end{aligned} \tag{B.2.5}$$

The proof is similar for $\alpha < \beta$.

## C Combining the Stationary Component and a Stochastic Trend

Following Bakker (2024) the exchange rate $s_t$ is modeled as the sum of two components: a stochastic trend $\mu_t$ and a stationary component $s_t^c$:

$$s_t = \mu_t + s_t^c. \tag{C.0.1}$$

The stochastic trend evolves as a random walk:

$$\mu_t = \mu_{t-1} + \eta_t, \tag{C.0.2}$$

where $\eta_t$ is a white noise error term. This trend accounts for the long-term, persistent movements in exchange rates, reflecting their random walk nature.

The stationary component $s_t^c$, follows the AR(2) process detailed in section 4.1:

$$s_t^c = \alpha s_{t-1}^c + E_t \sum_{i=0}^{\infty} \rho^i \text{dif}_{t+i} \tag{C.0.3}$$

As before, we assume that the interest rate differential follows a stochastic AR(1) process:

$$\text{dif}_t = \beta \text{dif}_{t-1} + \epsilon_t \tag{C.0.4}$$

This implies:

$$E_t \text{dif}_{t+i} = \beta^i \text{dif}_t \tag{C.0.5}$$

Substituting (C.0.5) in (C.0.3) we get

$$s_t^c = \alpha s_{t-1}^c + \left( \frac{\rho}{1 - \rho\beta} \right) \text{dif}_t \tag{C.0.6}$$

Combining (C.0.6) and (C.0.4) we get

$$s_t^c = (\alpha + \beta) s_{t-1}^c - \alpha\beta s_{t-2}^c + \varepsilon_t, \tag{C.0.7}$$

where $\alpha$ and $\beta$ determine the degree of mean reversion.

### Cyclical component of the exchange and expected excess returns

The $k$ period expected exchange rate *change* therefore is:

$$E_t s_{t+k} - s_t = E_t s_{t+k}^c - s_t^c = -\left(1 - \left(\frac{\alpha^{1+k}(1-\beta^2) - \beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)}\right)\right) s_t^c \tag{C.0.8}$$

Instead of a relationship between the exchange rate level and the expected exchange rate change we now have a relationship between the cyclical component of the exchange rate and the expected exchange rate change.

Similarly, instead of a relationship between the exchange rate level and the expected excess return, we now have a relationship between the cyclical component of the exhcnage rate and the expected excess return:

$$E_t x_{t,t+k} | s_t^c = \left( \frac{\alpha^{1+k}\left(1-\beta^2\right) - \beta^{1+k}(1-\alpha^2)}{(\alpha-\beta)(1+\alpha\beta)} + \frac{\left(\frac{1-\beta\rho}{\rho}\right)\left(1-\alpha^2\right)\left(\frac{1-\beta^k}{1-\beta}\right)}{(1+\alpha\beta)} - 1 \right) s_t^c \tag{C.0.9}$$

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