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PART II

MEASURING FINANCIAL INTEGRATION

2. Measuring financial integration: more data, more countries, more expectations

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1 INTRODUCTION

The signs of financial globalization are everywhere. Cross-border financial capital flows grow decade by decade, as do stocks of cross-border financial assets. Interest rates seem to move in near lockstep, and increasingly it is perceived that few countries enjoy financial autonomy.

Yet, at the same time, there is ample anecdotal evidence that flows of financial capital have not driven the returns expressed in common currency terms to equality. Some of this can be attributed to the fact that de facto impediments to arbitrage still exist. Or it could also be that arbitrageurs are not able to access sufficient amounts of capital in order to drive expected profits to zero. This last interpretation appears to be consistent with the large practitioner literature focused on the "carry trade".

In this study, we first survey the recent literature regarding the extent to which covered, uncovered, and real interest parity holds. In doing so, we can quantitatively assess the extent to which one particular – price-based – aspect of financial globalization has progressed.

In the second part of the chapter, we examine the literature on how real interest rates – which arguably are more relevant to real economic activity like investment and consumption – comove in such a way that real interest deviations are either eliminated or not.

While there is a tendency to view the interest rate parity area as a thoroughly mined research topic, we believe that examining the data from different perspectives, and with different data, will yield fruitful insights. Indeed, in recent years have seen a resurgence of interest in the area, including the distinction between short and long horizon results (Chinn and Meredith, 2004), and the differences between the developed country and emerging market experience (Bansal and Dahlquist, 2000; Frankel and Poonawala, 2006), and relaxation of the assumption of rational expectations (Bussiere et al., 2022; Kalemli-Özcan and Varela, 2021).

We conclude our chapter by examining the determinants of real interest deviations. We treat the deviations and absolute deviations as being determined by macroeconomic, institutional and regulatory factors, including impediments to capital flows. However, since the equalization of real interest rates also depends on the pace at which purchasing power parity is established, we include determinants of price adjustment. In so doing, we are able to track the process of real and financial integration across countries and time.

2 A FRAMEWORK OF ANALYSIS

Consider a two-country framework, wherein bonds of same maturity are default risk free. Then financial and real integration assessed using bond markets occurs when real interest rates are equalized.

To see this, consider the nominal interest differential can be decomposed into:

$$\underbrace{\left(i_t^k - i_t^{k*}\right)}_{\text{Interest diff.}} = \underbrace{\left[\left(i_t^k - i_t^{k*}\right) - \left(f_{t,t+k} - s_t\right)\right]}_{\substack{\text{Covered interest differential} \\ \text{"Political risk"}}} + \underbrace{\left\langle\left(f_{t,t+k} - s_t\right) - \Delta s_{t,t+k}^e\right\rangle}_{\text{Exchange risk}} + \underbrace{\Delta s_{t,t+k}^e}_{\text{Expected depreciation}} \tag{1}$$

where $f_{t,t+k}$ is the k-period forward rate, the term in the first square brackets is called covered interest differential, the term in angle brackets $\left\langle\left(f_{t,t+k} - s_t\right) - \Delta s_{t,t+k}^e\right\rangle$ is called the exchange risk premium (remember, we have assumed away default risk), and the last term is expected exchange rate depreciation.

Subtracting the expected inflation differential from both sides leads to:

$$\begin{aligned}\left(i_t^k - i_t^{k*}\right) - \left(\pi_{t,t+k}^e - \pi_{t,t+k}^{e*}\right) &= \left[\left(i_t^k - i_t^{k*}\right) - \left(f_{t,t+k} - s_t\right)\right] + \left\langle\left(f_{t,t+k} - s_t\right) - \Delta s_{t,t+k}^e\right\rangle \\ &\quad + \left\{\Delta s_{t,t+k}^e - \left(\pi_{t,t+k}^e - \pi_{t,t+k}^{e*}\right)\right\}\end{aligned} \tag{2}$$

Keeping in mind the definition of the real interest rate, and the real exchange rate depreciation leads to equation (3):

$$\underbrace{\left(r_t^k - r_t^{k*}\right)}_{\text{Real interest diff.}} = \underbrace{\left[\left(i_t^k - i_t^{k*}\right) - \left(f_{t,t+k} - s_t\right)\right]}_{\text{Covered interest differential}} + \underbrace{\left\langle\left(f_{t,t+k} - s_t\right) - \Delta s_{t,t+k}^e\right\rangle}_{\text{Exchange risk premium}} + \underbrace{\left\{\Delta\, q_{t,t+k}^e\right\}}_{\substack{\text{Expected} \\ \text{real depreciation}}} \tag{3}$$

Equation (3)[1] highlights the fact that the real interest differential will equal zero if the covered interest differential, the exchange risk premium, and expected real exchange rate depreciation all equal zero, viz:

$$\left[\left(i_t^k - i_t^{k*}\right) - \left(f_{t,t+k} - s_t\right)\right] = 0 \tag{4}$$

$$\left\langle\left(f_{t,t+k} - s_t\right) - \Delta s_{t,t+k}^e\right\rangle = 0 \tag{5}$$

$$\left\{\Delta q_{t,t+k}^e\right\} = 0 \tag{6}$$

If equations (4), (5) and (6) hold, then the real interest differential equals zero.

What does it mean for the covered interest differential in equation (4) to equal zero? In the terminology associated with Frankel (1982), capital is perfectly mobile. This terminology is appropriate in the context of a world where there are no certain nominal arbitrage profits available by rearranging assets. This would be true if no capital controls impeded

[1] Frankel and MacArthur (1988) introduce this decomposition. For industrial countries, they find the majority of real interest differentials are not accounted for by political risk.

the movement of financial capital; or if there was no risk of the imposition of such restrictions, and there were no other frictions (such as capital requirements) that drove a wedge between returns; hence the term "political risk".

Equation (5) holding, i.e., the exchange risk premium equal to zero, means investors are risk-neutral, or the underlying bonds are perfect substitutes. Frankel (1982) defines instances of uncovered interest parity holding as perfect substitutability – that is financial assets of equal default risk are treated as perfect substitutes. Then, the expected exchange rate change equals the current interest differential.

The earlier literature on why government bonds, for instance, are not treated as perfect substitutes (even if of equal default risk) is related to how bond returns comove with wealth (as in a mean-variance optimization framework), or with the marginal utility of consumption (as in the international consumption capital asset pricing model).[2]

Recent research on why bonds are not treated as perfect substitutes has focused on liquidity or convenience yields. For instance, Engel (2016) argues that US bonds in particular enjoy a price premium due to the large and liquid market that makes holding such assets particularly attractive.[3]

Equation (6) states that expected real depreciation equals zero, or equivalently, if ex ante purchasing power parity. This would require frictionless adjustment of prices so as to make goods arbitrage profits zero in expectation.

This last point highlights that real interest parity relies upon (1) the absence of impediments to capital flows (covered interest parity), (2) perfect substitutability of bonds or risk neutrality (uncovered interest parity) and (3) ex ante relative purchasing power parity, an attribute of behavior in the real side of the economy.

3 NOMINAL FINANCIAL INTEGRATION

In this portion, we survey the empirical evidence regarding whether equations 4 (covered interest parity) and 5 (uncovered interest parity).

3.1 Covered interest rate parity

Historically, it's been accepted that for developed economies, after the dismantling of capital controls, covered interest parity holds fairly well. Most tests were conducted using offshore rates, in which equation (6) is sometimes termed "closed interest parity", although covered interest parity is often used as a term encompassing this concept.

Early tests conducted by Frenkel and Levich (1975) found that, after accounting for transactions costs, covered interest parity held for three-month horizons. Offshore rates

[2] For explanations in the mean-variance framework, see Frankel (1984) and Frankel and Engel (1984). For the CCAPM approach, see Mark (1985), and discussion in Engel (1996) of the literature.

[3] See among others Del Negro et al. (2019) and Valchev (2020) for theory. For estimates of the premium, see Du et al. (2018).

sometimes diverge from onshore rates, so that the findings of covered interest parity are somewhat weaker.[4]

In many emerging markets today, covered interest parity is unlikely to hold. In other words, covered interest differentials could be interpreted as political risk, associated with the possibility of governmental authorities placing restrictions on deposits located in different jurisdictions (clearly this is something that is not relevant when all the deposits are offshore). Aliber (1973) is credited with this interpretation, while Dooley and Isard (1980) provided empirical estimates for the DM/dollar rate, in the period before the removal of German capital controls.

While the assumption of covered interest parity holding has been used historically for developed country currencies, recent work has documented the fact that covered interest differentials have increased in recent years (Borio et al., 2016; Du et al., 2018). During the global financial crisis, the appearance of measured covered interest differentials was attributed to the rise in counterparty risk and illiquidity (see Coffey et al. (2009), and Baba and Packer (2009)). As this risk dissipated, the deviations shrank, until they reappeared. Du et al. (2018) argue that enhanced bank regulation (leverage ratios, weighted bank capital requirements) has introduced costs to arbitrage that then drive covered interest deviations.

One could interpret these capital requirements as impediments to capital mobility. Hence, capital mobility has clearly declined for advanced country currencies. On the other hand, gradual removal of explicit capital controls in emerging market and developing countries has likely reduced covered interest differentials for many countries.

Cerutti et al. (2021) document the persistence of the covered interest differentials for major currencies, and attributes those differentials to financial frictions associated with banking regulations. Recent evidence for emerging markets and developing countries is rarer, although studies have been conducted for large emerging markets like China and India (Figure 2.1).

3.2 Uncovered interest parity

If covered interest parity holds, then uncovered interest parity is given by:

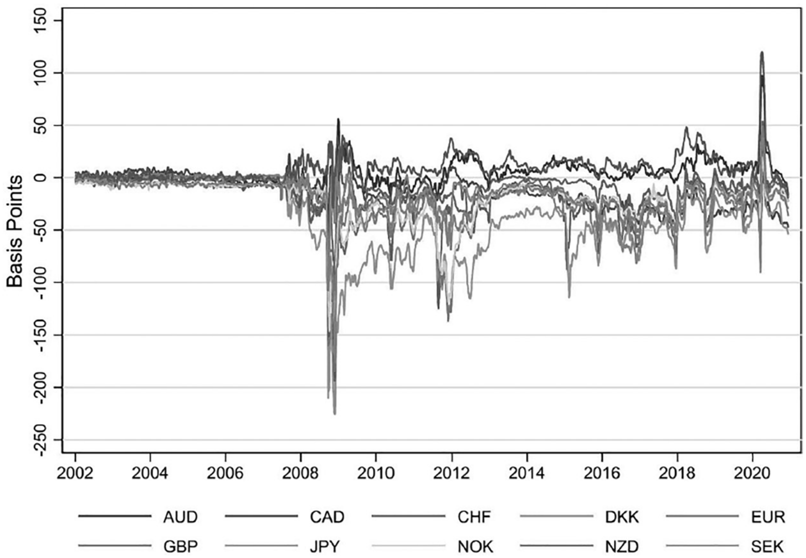
$$\left(i_t^k - i_t^{k*}\right) = \Delta s_{t,t+k}^e \tag{7}$$

When covered interest parity holds, then one can say that the uncovered interest parity (UIP) differential is driven by the existence of exchange risk premium that is defined as:

$$f_{t,t+k} = s_{t,t+k}^e + \eta_{t+k} \tag{8}$$

Substituting equation (8) into (7) then allows the expected change in the exchange rate from period t to period t + k to be expressed as a function of the interest differential and the risk premium,

4 Popper (1993) concludes that covered interest differentials at long maturities are not appreciably greater than those for short (up to one year) maturities. This is a surprising result given that there are likely a number of regulatory impediments that would tend to introduce frictions into the arbitrage process.



Source: Cerutti et al. (2021).

Figure 2.1 Covered interest differentials

$$\Delta s^{e}_{t,t+k} = \left(i^{k}_{t} - i^{k*}_{t}\right) - \eta_{t,t+k} \tag{9}$$

Narrowly defined, UIP refers to the proposition embodied in equation (9) when the risk premium is zero.

3.2.1 The joint hypothesis of uncovered interest parity and rational expectations

Equation (9) is not directly testable, however, in the absence of observations on market expectations of future exchange rate movements. Hence, most tests conducted in the 1970s–1990s were joint tests incorporating the assumption of rational expectations. Future realizations of s_{t+k} will equal the value expected at time t plus a white noise error term $\hat{\imath}_{t,t+k}$ that is uncorrelated with all information known at t, including the interest differential and the spot exchange rate, then one obtains what is commonly, if somewhat misleadingly, known as the UIP regression,

$$\Delta s_{t,t+k} = \left(i^{k}_{t} - i^{k*}_{t}\right) - \eta_{t,t+k} + \xi_{t+k} \tag{10}$$

where the left-hand side of equation (10) is the realized change in the exchange rate from t to $t + k$.

According to the unbiasedness hypothesis, the last two terms in equation (10) are assumed to be orthogonal to the interest differential. Thus, in a regression context, the estimated parameter on the interest differential will have a probability limit of unity in the following regression:

$$\Delta s_{t,t+k} = \beta_0 + \beta_1\left(i^{k}_{t} - i^{k*}_{t}\right) + \varepsilon_{t+k} \tag{11}$$

This specification is sometimes termed the 'Fama' regression (where covered interest parity is typically assumed, so that equation (6) is used to substitute the forward discount for the interest differential).

The joint null hypothesis of no risk premium in equation (11) (i.e. that UIP holds) and rational expectations is sometimes termed the 'risk-neutral efficient-markets hypothesis' (RNEMH). In this case, the disturbance in equation (11) becomes simply the rational expectations forecast error ε_{t+k}, which by definition is orthogonal to all information known at time t, including the interest differential.

Unbiasedness is a weaker condition than RNEMH. All that is required is that any risk premium and/or non-rational expectations error be uncorrelated with the interest differential, while the RNEMH requires in addition that no other regressors known at time t should have explanatory power.

The empirical literature testing whether equation (12) holds is vast, starting with Fama (1984) and Tryon (1979), where the forward premium is treated as being equivalent to the interest differential. Estimates of equation (11) for horizons that range up to one year typically reject the unbiasedness restriction on the slope parameter. For instance, the early survey by Froot and Thaler (1990) finds an average estimate for β of −0.88. A meta-analysis (Zigraiova et al., 2021) finds that correcting for biases, point estimates are positive but less than one for advanced country currencies, and not statistically distinguishable from one for emerging and developing country currencies.

In this section, we recount the results of Chinn and Frankel (2020), which uses data from 1985 to 2018. Tables 2.1 to 2.3 report the results from estimating the regression from Fama (1984) and Tryon (1979). Under the maintained hypothesis, the errors should be serially uncorrelated at the one-month horizon.

Tables 2.1 to 2.3 present the estimates for equation 11, for three-month horizons (1.1–3) and 12-month horizons (1.4–6), for full sample, pre-crisis sample (ends 2008M08) and post-crisis sample (begins 2008M09).[5] For the euro, the sample begins at 1999M01 and ends at 2018M05 (for three months) and 2017M08 (for one year). Slightly over half the point estimates are negative. One can reject the null of a coefficient of unity about three quarters of the time. In the other cases, the samples are too short and the standard errors too large.[6]

The bias is not clearly evident for the newest currency in the data set – the euro. For the full sample starting in 1999, the coefficient is positive, and the standard errors are sufficiently large at the three-month and 12-month horizon that one cannot reject the null of a coefficient of unity.

For the full sample, the results are similar to those reported elsewhere in the literature – the slope coefficients are almost always below one. Interestingly, the finding of a unit coefficient is to be found for some currencies that would seem to be unlikely candidates for the unbiasedness proposition: the Chinese yuan, the Indian Rupee, the Philippine peso and the Singapore dollar. It hardly seems likely that the government debt of these

[5] Euro legacy currency results are not reported here (see Chinn and Frankel, 2020).

[6] In earlier studies, the Fama coefficients were typically almost uniformly less than zero. Estimates incorporating the sharp exchange rate movements surrounding the EMS crises of the early 1990s evidence fewer of these negative coefficients; this pattern is consistent with the findings of Flood and Rose (2002).

Table 2.1 *Unbiasedness regressions, three month horizon, full sample*

$\Delta_{s_{t,t+k}} = \beta_0 + \beta_1(f_{t,t+k} - s_t) + \varepsilon_{t+k}$.

	(1) AUS	(2) CAN	(3) DNK	(4) JPN	(5) NZL	(6) NOR	(7) SWE	(8) CHE	(9) GBR
fs3	-1.078^{***}	-0.121^{*}	-0.417^{**}	-1.141^{**}	−0.153	−0.126	0.544	-1.118^{***}	−0.498
	(0.791)	(0.649)	(0.619)	(0.962)	(2.844)	(0.691)	(1.107)	(0.737)	(1.073)
Constant	−0.004	0.001	0.003	0.010	0.005	0.001	0.003	0.010^{**}	−0.001
	(0.007)	(0.004)	(0.004)	(0.008)	(0.018)	(0.005)	(0.005)	(0.005)	(0.004)
N	367	367	367	367	256	330	367	367	367
adj.Rsq	0.010	−0.003	0.000	0.009	−0.004	−0.003	0.002	0.009	0.000
p-value	0.009	0.085	0.023	0.027	0.686	0.104	0.681	0.004	0.164
DW	0.590	0.719	0.593	0.548	0.577	0.561	0.605	0.671	0.572

	(10) EUR	(11) CZE	(12) HUN	(13) POL	(14) RUS	(15) TUR	(16) MEX	(17) ZAF
fs3	0.610	0.870	-1.118^{***}	1.119	0.906	-0.516^{***}	−0.652	-4.602^{***}
	(2.597)	(1.820)	(0.715)	(1.024)	(0.258)	(0.226)	(1.319)	(1.771)
Constant	0.006	0.009	−0.007	0.011	0.006	-0.029^{***}	−0.017	-0.073^{***}
	(0.007)	(0.007)	(0.011)	(0.008)	(0.008)	(0.010)	(0.015)	(0.027)
N	192	192	192	192	182	192	192	192
adj.Rsq	−0.004	−0.002	0.011	0.003	0.030	0.036	−0.002	0.090
p-value	0.881	0.943	0.003	0.908	0.716	0.000	0.212	0.002
DW	0.627	0.613	0.668	0.582	0.588	0.666	0.672	0.812

Table 2.1 *(continued)*

$\Delta_{s_{t,t+k}} = \beta_0 + \beta_1(f_{t,t+k} - s_t) + \varepsilon_{t+k}$.

	(18) CHN	(19) HKG	(20) IND	(21) IDN	(22) KOR	(23) PHL	(24) SGP	(25) TWN	(26) THA
fs3	1.129	-0.213^{***}	1.160	-1.749^{***}	0.555	1.038	1.163	−0.154	-0.073^{*}
	(0.246)	(0.183)	(0.631)	(1.034)	(1.135)	(1.175)	(1.218)	(0.873)	(0.580)
Constant	0.005^{***}	0.000	0.009	-0.033^{**}	−0.001	0.007	0.003	0.002	0.005
	(0.002)	(0.000)	(0.011)	(0.014)	(0.008)	(0.009)	(0.004)	(0.005)	(0.004)
N	138	192	138	139	139	138	192	138	192
adj.Rsq	0.231	0.007	0.019	0.040	−0.006	0.016	0.004	−0.007	−0.005
p-value	0.600	0.000	0.800	0.009	0.696	0.974	0.893	0.188	0.066
DW	0.525	0.794	0.694	0.629	0.745	0.660	0.656	0.592	0.590

Note: OLS regression estimates; Newey-West standard errors. Columns 1–7: 1986M08–1998M09, column 8: 1999M01–2018M05, columns 9–16: 1986M08–2018M05, column 17: 1989M01–2018M05. $^{*}(^{**})[^{***}]$ 10% (5%) [1%] level, for null hypothesis of $\beta = 1$.

Source: Chinn and Frankel (2020).

Table 2.2 Unbiasedness regressions, three month horizon, pre-crisis sample

$\Delta_{S_{t,t+k}} = \beta_0 + \beta_1(f_{t,t+k} - s_t) + \varepsilon_{t+k}$.

	(1) AUS	(2) CAN	(3) DNK	(4) JPN	(5) NZL	(6) NOR	(7) SWE	(8) CHE	(9) GBR
fs3	-1.390^{***}	-0.445^{**}	-0.540^{**}	-2.259^{***}	-2.908^{**}	-0.225^{*}	0.491	-1.243^{***}	−0.425
	(0.792)	(0.667)	(0.713)	(0.848)	(1.589)	(0.699)	(1.218)	(0.839)	(1.183)
Constant	−0.004	0.003	0.006	0.023^{***}	−0.010	0.005	0.005	0.012^{**}	0.003
	(0.007)	(0.004)	(0.005)	(0.005)	(0.011)	(0.006)	(0.006)	(0.006)	(0.006)
N	255	255	255	255	144	218	255	255	255
adj.Rsq	0.035	0.000	0.002	0.041	0.050	−0.003	0.001	0.014	−0.002
p-value	0.003	0.031	0.032	0.000	0.015	0.081	0.677	0.008	0.230
DW	0.654	0.617	0.595	0.601	0.533	0.558	0.577	0.658	0.642

	(10) EUR	(11) CZE	(12) HUN	(13) POL	(14) RUS	(15) TUR	(16) MEX	(17) ZAF
fs3	-1.888^{*}	-0.978^{*}	-0.717^{**}	1.076	0.622	-0.183^{***}	−0.268	-4.673^{***}
	(1.667)	(1.162)	(0.798)	(0.763)	(0.324)	(0.267)	(0.766)	(1.045)
Constant	0.021^{***}	0.032^{***}	0.013	0.032^{***}	0.014^{***}	0.003	−0.007	-0.061^{***}
	(0.007)	(0.007)	(0.018)	(0.010)	(0.004)	(0.015)	(0.010)	(0.016)
N	80	80	80	80	70	80	80	80
adj.Rsq	0.010	−0.004	0.000	0.015	0.104	−0.006	−0.011	0.177
p-value	0.087	0.093	0.035	0.921	0.248	0.000	0.102	0.000
DW	0.783	0.836	0.924	0.765	0.679	0.645	0.727	1.001

Table 2.2 (continued)

$\Delta_{S_{t,t+k}} = \beta_0 + \beta_1(f_{t,t+k} - s_t) + \varepsilon_{t+k}.$

	(18) CHN	(19) HKG	(20) IND	(21) IDN	(22) KOR	(23) PHL	(24) SGP	(25) TWN	(26) THA
fs3	1.329	−0.327***	−3.035***	0.368	3.194	2.772***	2.571	−1.295	−0.673***
	(0.367)	(0.205)	(0.820)	(0.504)	(1.858)	(0.572)	(1.137)	(2.089)	(0.505)
Constant	0.005	0.000	−0.008	0.003	−0.018	0.035***	0.002	0.013	0.008
	(0.005)	(0.000)	(0.014)	(0.007)	(0.013)	(0.009)	(0.003)	(0.018)	(0.006)
N	26	80	26	27	27	26	80	26	80
adj.Rsq	0.344	0.024	0.059	−0.032	0.025	0.241	0.046	−0.021	−0.001
p-value	0.378	0.000	0.000	0.222	0.249	0.005	0.171	0.283	0.001
DW	0.874	0.796	0.491	1.517	0.626	0.531	0.612	0.652	0.599

Note: OLS regression estimates; Newey-West standard errors. Columns 1–7: 1986M08–1998M09, column 8: 1999M01–2018M05, columns 9–16: 1986M08–2018M05, column 17: 1989M01–2018M05. *(**)[***] 10% (5%) [1%] level, for null hypothesis of β = 1.

Source: Chinn and Frankel (2020).

Table 2.3 Unbiasedness regressions, three month horizon, post-crisis sample

$\Delta_{s_{t,t+k}} = \beta_0 + \beta_1(f_{t,t+k} - s_t) + \varepsilon_{t+k}$.

	(1) AUS	(2) CAN	(3) DNK	(4) JPN	(5) NZL	(6) NOR	(7) SWE	(8) CHE	(9) GBR
fs3	−1.020	10.301**	2.666	6.363	8.138	2.749	1.215	−1.467	2.889
	(1.698)	(3.600)	(2.377)	(5.891)	(5.610)	(1.661)	(1.239)	(2.360)	(7.880)
Constant	−0.002	0.011	−0.003	−0.012	0.058	0.004	0.000	0.009	−0.004
	(0.018)	(0.007)	(0.007)	(0.013)	(0.040)	(0.010)	(0.008)	(0.011)	(0.007)
N	109	109	109	109	109	109	109	109	109
adj.Rsq	−0.007	0.082	0.011	0.027	0.054	0.002	−0.005	−0.006	−0.002
p-value	0.237	0.011	0.485	0.365	0.206	0.295	0.863	0.298	0.811
DW	0.668	0.925	0.651	0.511	0.777	0.719	0.783	0.745	0.530

	(10) EUR	(11) CZE	(12) HUN	(13) POL	(14) RUS	(15) TUR	(16) MEX	(17) ZAF
fs3	3.606	2.744	−0.718	2.627	0.851	−0.418	−2.029	−9.611***
	(1.853)	(2.458)	(1.537)	(2.511)	(0.464)	(1.198)	(1.993)	(3.208)
Constant	−0.004	−0.004	−0.010	0.010	0.002	−0.032	−0.030	−0.154***
	(0.006)	(0.008)	(0.014)	(0.015)	(0.018)	(0.028)	(0.021)	(0.045)
N	109	109	109	109	109	109	109	109
adj.Rsq	0.015	0.009	−0.005	0.006	0.012	−0.008	0.010	0.114
p-value	0.163	0.480	0.266	0.518	0.749	0.239	0.132	0.001
DW	0.666	0.654	0.651	0.593	0.599	0.756	0.736	0.829

Table 2.3 (continued)

$\Delta_{S_{t,t+k}} = \beta_0 + \beta_1(f_{t,t+k} - s_t) + \varepsilon_{t+k}.$

	(18) CHN	(19) HKG	(20) IND	(21) IDN	(22) KOR	(23) PHL	(24) SGP	(25) TWN	(26) THA
fs3	0.637	−0.290***	1.637	−2.819***	1.461	−2.159***	−0.751	0.344	1.555
	(0.602)	(0.451)	(0.843)	(1.118)	(1.753)	(0.857)	(1.529)	(2.436)	(1.288)
Constant	0.003	0.000	0.018	−0.050***	0.010	−0.010*	0.003	0.002	0.008
	(0.003)	(0.000)	(0.013)	(0.016)	(0.008)	(0.005)	(0.005)	(0.006)	(0.006)
N	109	109	109	109	109	109	109	109	109
adj.Rsq	0.015	0.000	0.029	0.110	0.002	0.071	−0.008	−0.009	0.018
p-value	0.548	0.005	0.452	0.001	0.793	0.000	0.255	0.788	0.667
DW	0.508	0.973	0.850	0.554	1.033	1.055	0.747	0.648	0.725

Note: OLS regression estimates; Newey-West standard errors. Columns 1–7: 1986M08–1998M09, column 8: 1999M01–2018M05, columns 9–16: 1986M08–2018M05, column 17: 1989M01–2018M05. *(**)[***] 10% (5%) [1%] level, for null hypothesis of $\beta = 1$.

Source: Chinn and Frankel (2020).

countries would be perceived as perfect substitutes for US Treasurys *and* their currencies determined by rational expectations.

Pre-crisis, the negative coefficient is more pronounced than over the full sample. The euro, for example, exhibits a negative coefficient of −1.9, significantly different from a value of one. It is in the post-crisis sample (for both three- and 12-month horizons) that the results diverge substantially from what is known in the literature. Then for the major currencies – aside from the Australian dollar and Swiss franc – the coefficients are now large and positive. The rest of the emerging market currencies have mixed coefficients.

This finding of forward rate bias with a negative or below-unit coefficient pre-crisis for many currencies, and forward rate bias with a very large (albeit usually insignificant) coefficient in the post-crisis period mirrors that found in Bussiere et al. (2022). However, here we find this pattern over a wider set of currencies

It is interesting that the emerging country currencies do not exhibit such consistent pattern in the switches in the coefficient. At the three-month horizon, several continue to evidence a positive correlation, such as PLN, CNY, KRW, while others switch from positive to negative (IDN, PHL, SGP). In other words, it does not appear that integration measured by adherence to the unbiasedness proposition is increasing with time.

What about longer horizons? Chinn and Meredith (2004) and Alexius (2001) documented the fact that the unbiasedness hypothesis seemed to hold much better at long horizons than at short. In Chinn and Quayyum (2012), some of the results are attenuated, especially with the inclusion of data from the era of rates at the effective lower bound.

3.2.2 Uncovered interest parity using survey data

An alternative means of assessing uncovered interest parity is to proxy expected depreciation using survey data. Hence. One estimates:

$$\Delta\widehat{s^e_{t,t+k}} = \beta_0 + \beta_1\left(i_t^k - i_t^{k*}\right) + u_{t+k} \tag{12}$$

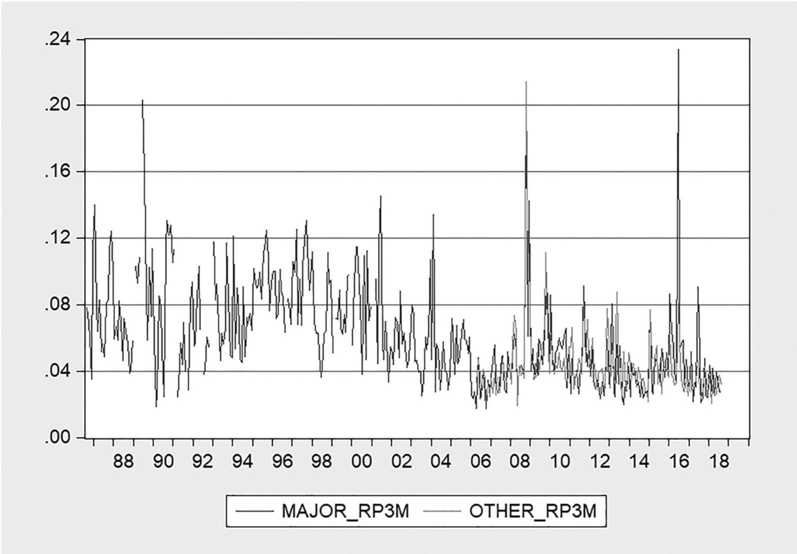
Where $\Delta\widehat{s^e_{t,t+k}}$ is the expected depreciation inferred from survey data.

The absolute value of the uncovered interest differential is shown in Figure 2.2, for a set of advanced economy currencies over the entire 1986–2018 period, and for a set of emerging economy currencies over the 2006–18 period.

Early contributions in this vein were Dominguez (1986), Frankel and Froot (1987), Froot and Frankel (1989), and Ito (1990). More recently, Chinn and Frankel (2020) examine uncovered interest parity in a data set spanning nearly a third of a century.[7] These results are found in Tables 2.4 to 2.6.

They find that the forward discount does positively correlate with expected depreciation as measured by survey data, in a manner consistent with uncovered interest parity. These results are consistent with systematic errors in exchange rate expectations. We show that for many cases (particularly where the results differ substantially between regressions using the actual ex post realized changes and ex ante expected changes) the bias in expectations is significant.

[7] See also Kalemli-Özcan et al. (2021).



Source: Chinn and Frankel (2020).

Figure 2.2 Average absolute uncovered interest differential for advanced economy currencies (dark grey), for emerging market currencies (light grey), annualized. Calculated using survey data

Similar findings are obtained in Bussiere, Chinn, Ferrara and Heipertz (2022), for eight currencies against the US dollar. UIP basically holds, and using a decomposition of the beta coefficient in the Fama regression, they find deviations from the unbiasedness hypothesis comes mostly from biased expectations, as opposed to an exchange risk premium, or covered interest differentials.

Chinn and Frankel show the exchange risk premium identified using survey data (rather than assumed rational expectations) provide evidence of exchange risk premiums. In other words, certain currencies have to provide additional returns in order to induce investors to hold assets denominated in those currencies, as opposed to the US dollar. Reassuringly, the evidence suggests negative risk premiums for the Japanese yen and Swiss franc (relative to the US dollar), both of which are widely considered "safe haven" currencies.

This means that the survey-based literature finds both greater evidence for financial integration, but also more definition of what the exchange risk premium looks like. In other words, perfect substitutability of government bonds seldom applies.

4 REAL INTEREST PARITY

Real interest parity is more closely linked to real capital mobility, to the extent that in a default risk free world, physical capital will accumulate until the marginal productivity of capital equals the real interest rate. In other words, in a world without credit constraints or financial accelerator, real interest parity denotes capital market integration.

Table 2.4 Uncovered interest parity regressions, three-month horizon

$\Delta\hat{s}^e_{t,t+k} = \beta'_0 + \beta'_1(f_{t,t+k} - s_t) + \tilde{\varepsilon}_{t+k}$

	(1) AUS	(2) CAN	(3) DNK	(4) JPN	(5) NZL	(6) NOR	(7) SWE	(8) CHE	(9) GBR
fs3	1.688**	0.802	0.576	−0.247**	0.731	0.201*	0.885	1.191	0.023
	(0.281)	(0.201)	(0.503)	(0.576)	(1.118)	(0.478)	(0.448)	(0.619)	(0.776)
Constant	0.011***	0.003**	−0.003	−0.004	0.009	0.003	0.002	−0.007*	−0.005
	(0.003)	(0.001)	(0.004)	(0.003)	(0.009)	(0.003)	(0.003)	(0.004)	(0.003)
N	367	367	367	367	256	330	367	367	367
adj.Rsq	0.257	0.076	0.030	0.002	0.014	0.002	0.076	0.073	−0.003
p-value	0.015	0.326	0.399	0.031	0.810	0.095	0.798	0.758	0.209
DW	1.000	1.562	0.644	0.577	0.937	0.619	0.613	0.585	0.782

	(10) EUR	(11) CZE	(12) HUN	(13) POL	(14) RUS	(15) TUR	(16) MEX	(17) ZAF
fs3	0.558	−0.208**	−0.446***	0.033***	0.390***	0.457***	0.102	0.473
	(0.766)	(0.494)	(0.162)	(0.349)	(0.153)	(0.162)	(0.695)	(0.447)
Constant	−0.001	−0.004*	−0.009***	−0.003	0.001	0.003	0.002	−0.004
	(0.003)	(0.002)	(0.003)	(0.004)	(0.002)	(0.005)	(0.007)	(0.005)
N	223	192	192	192	182	192	192	192
adj.Rsq	0.007	−0.002	0.048	−0.005	0.149	0.249	−0.004	0.015
p-value	0.073	0.015	0.000	0.006	0.000	0.001	0.198	0.240
DW	1.033	1.265	1.670	1.459	1.732	1.118	1.320	1.508

Table 2.4 (continued)

$\Delta\hat{s}^{e}_{t,t+k} = \beta'_0 + \beta'_1(f_{t,t+k} - s_t) + \tilde{\varepsilon}_{t+k}$

	(18) CHN	(19) HKG	(20) IND	(21) IDN	(22) KOR	(23) PHL	(24) SGP	(25) TWN	(26) THA
fs3	0.530***	0.283**	0.132***	0.583*	0.060*	0.474*	1.292	0.786	0.672
	(0.176)	(0.339)	(0.169)	(0.237)	(0.524)	(0.303)	(0.525)	(0.370)	(0.214)
Constant	0.003**	−0.000	0.003	0.009**	0.003	0.004	0.000	−0.001	0.001
	(0.002)	(0.000)	(0.003)	(0.004)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
N	138	192	138	139	139	138	192	138	192
adj.Rsq	0.205	0.007	−0.002	0.061	−0.007	0.038	0.099	0.069	0.084
p-value	0.009	0.036	0.000	0.080	0.075	0.085	0.579	0.563	0.127
DW	0.641	1.322	1.354	1.572	1.819	1.140	1.474	1.245	1.224

Note: OLS regression estimates; Newey-West standard errors. Columns 1–7: 1986M08–1998M09, column 8: 1999M01–2018M08, columns 9–16: 1986M08–2018M08, column 17: 1989M01–2018M08. *(**)[***] 10% (5%) [1%] level, for null hypothesis of $\beta = 1$.

Source: Chinn and Frankel (2020).

Table 2.5 Uncovered interest parity regressions, three month horizon, pre-crisis sample

$\Delta\hat{s}^{e}_{t,t+k} = \beta'_0 + \beta'_1(f_{t,t+k} - s_t) + \tilde{\varepsilon}_{t+k}$

	(1) AUS	(2) CAN	(3) DNK	(4) JPN	(5) NZL	(6) NOR	(7) SWE	(8) CHE	(9) GBR
fs3	1.833**	0.783	0.837	−0.736***	1.125	0.232	1.003	1.138	0.376
	(0.283)	(0.197)	(0.493)	(0.625)	(0.713)	(0.484)	(0.435)	(0.671)	(0.883)
Constant	0.014***	0.003***	0.000	0.002	0.020***	0.003	0.003	−0.006	−0.003
	(0.003)	(0.001)	(0.005)	(0.005)	(0.007)	(0.004)	(0.005)	(0.006)	(0.006)
N	255	255	255	255	144	218	255	255	255
adj.Rsq	0.383	0.137	0.071	0.027	0.074	0.003	0.094	0.071	−0.004
p-value	0.003	0.272	0.742	0.006	0.861	0.114	0.995	0.837	0.480
DW	0.910	1.459	0.498	0.430	1.017	0.508	0.512	0.417	0.428

	(10) EUR	(11) CZE	(12) HUN	(13) POL	(14) RUS	(15) TUR	(16) MEX	(17) ZAF
fs3	0.742	0.076***	0.075***	0.392***	0.762***	0.590**	0.284***	0.762
	(0.557)	(0.238)	(0.134)	(0.161)	(0.088)	(0.202)	(0.220)	(0.201)
Constant	0.007***	0.002**	0.002	0.006**	0.006***	0.014	−0.003	−0.003
	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.009)	(0.002)	(0.002)
N	111	80	80	80	70	80	80	80
adj.Rsq	0.033	−0.012	0.011	−0.050	0.564	0.299	−0.019	0.093
p-value	0.066	0.000	0.000	0.000	0.008	0.046	0.002	0.240
DW	1.606	1.483	1.780	1.622	1.458	1.108	1.591	1.341

Table 2.5 (continued)

$\Delta\hat{s}^{e}_{t,t+k} = \beta'_0 + \beta'_1 (f_{t,t+k} - s_t) + \tilde{\varepsilon}_{t+k}$

	(18) CHN	(19) HKG	(20) IND	(21) IDN	(22) KOR	(23) PHL	(24) SGP	(25) TWN	(26) THA
fs3	0.030***	0.376	1.545**	0.412	1.494**	0.839***	0.531	1.524	0.909
	(0.072)	(0.401)	(0.234)	(0.454)	(0.193)	(0.056)	(0.508)	(0.383)	(0.192)
Constant	0.008***	–0.001*	0.006**	0.012***	0.000	0.008***	0.003	–0.006*	0.005**
	(0.001)	(0.001)	(0.003)	(0.004)	(0.002)	(0.001)	(0.002)	(0.003)	(0.002)
N	26	80	26	27	27	26	80	26	80
adj.Rsq	0.040	0.043	–0.295	0.033	–0.135	0.513	0.009	0.238	0.205
p-value	0.000	0.124	0.029	0.208	0.017	0.008	0.359	0.184	0.637
DW	1.606	0.521	1.547	1.682	1.321	1.512	1.622	2.335	1.577

Note: OLS regression estimates; Newey-West standard errors. Columns 1–7: 1986M08–1998M09, column 8: 1999M01–2018M08, columns 9–16: 1986M08–2018M08, column 17: 1989M01–2018M08. *(**)[***] 10% (5%) [1%] level, for null hypothesis of β = 1. Source: Chinn and Frankel (2020).

Source: Chinn and Frankel (2020).

Table 2.6 Uncovered interest parity regressions, three month horizon, post-crisis sample

$\Delta\hat{s}^{e}_{t,t+k} = \beta'_0 + \beta'_1(f_{t,t+k} - s_t) + \tilde{\varepsilon}_{t+k}$

	(1) AUS	(2) CAN	(3) DNK	(4) JPN	(5) NZL	(6) NOR	(7) SWE	(8) CHE	(9) GBR
fs3	0.029	1.739	−1.595***	0.496	−1.439	−1.135***	−0.707***	0.647	−5.611**
	(0.631)	(1.448)	(0.843)	(0.973)	(1.551)	(0.727)	(0.340)	(0.765)	(2.565)
Constant	−0.007	0.003	−0.008***	−0.010***	−0.015*	−0.000	0.002	−0.009***	−0.008***
	(0.005)	(0.003)	(0.002)	(0.002)	(0.008)	(0.003)	(0.002)	(0.003)	(0.002)
N	109	109	109	109	109	109	109	109	109
adj.Rsq	−0.009	0.021	0.064	−0.005	0.018	0.037	0.031	−0.003	0.229
p-value	0.127	0.611	0.003	0.606	0.119	0.004	0.000	0.646	0.011
DW	1.423	1.604	1.847	2.286	1.549	1.596	1.824	1.774	1.932

	(10) EUR	(11) CZE	(12) HUN	(13) POL	(14) RUS	(15) TUR	(16) MEX	(17) ZAF
fs3	−1.075**	−0.644**	−0.535***	−0.731***	0.219***	0.270	−0.809**	−1.583**
	(0.960)	(0.809)	(0.296)	(0.637)	(0.102)	(0.584)	(0.820)	(0.997)
Constant	−0.008***	−0.009***	−0.012***	−0.012***	−0.004*	−0.004	−0.002	−0.033**
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.011)	(0.007)	(0.015)
N	109	109	109	109	109	109	109	109
adj.Rsq	0.013	0.011	0.045	0.016	0.033	0.004	0.032	0.042
p-value	0.033	0.044	0.000	0.008	0.000	0.214	0.030	0.011
DW	1.817	1.548	1.769	1.752	1.924	1.337	1.644	1.848

Table 2.6 (continued)

$\Delta\hat{s}^{e}_{t,t+k} = \beta'_0 + \beta'_1(f_{t,t+k} - s_t) + \tilde{\varepsilon}_{t+k}$									
	(18) CHN	(19) HKG	(20) IND	(21) IDN	(22) KOR	(23) PHL	(24) SGP	(25) TWN	(26) THA
fs3	0.769	1.584	0.389***	0.421**	−0.174	−0.105**	2.112	0.202	−0.206***
	(0.379)	(0.767)	(0.195)	(0.272)	(0.855)	(0.477)	(0.816)	(0.859)	(0.364)
Constant	0.004**	−0.000	0.008**	0.006	0.002	0.001	0.000	0.000	−0.004
	(0.002)	(0.001)	(0.004)	(0.005)	(0.004)	(0.004)	(0.002)	(0.003)	(0.002)
N	109	109	109	109	109	109	109	109	109
adj.Rsq	0.125	0.069	0.019	0.021	−0.008	−0.008	0.056	−0.008	−0.004
p-value	0.543	0.448	0.002	0.036	0.173	0.022	0.176	0.355	0.001
DW	0.502	1.870	1.507	1.646	1.848	1.108	1.497	1.104	1.102

Note: OLS regression estimates; Newey-West standard errors. Columns 1–7: 1986M08–1998M09, column 8: 1999M01–2018M08, columns 9–16: 1986M08–2018M08, column 17: 1989M01–2018M08. *(**)[***] 10% (5%) [1%] level, for null hypothesis of $\beta = 1$.

Source: Chinn and Frankel (2020).

One can test the real interest parity condition is to test whether the differentials are exactly equal to zero. If one is interested in real interest parity up to a constant, one can regress one real rate on another. In the early studies of real interest parity, the hypothesis was resoundingly rejected (Cumby and Obstfeld, 1984; Mishkin, 1984; Mark, 1985; Cumby and Mishkin, 1986).

Fujii and Chinn (2001) test the real interest differentials for G-7 currencies (against the US) for a longer sample. They confirm the rejection of the hypothesis that real interest rates comove with unit coefficient. However, they also find that in general, real interest parity holds better for longer term maturities than shorter term maturities.

Recall that real interest parity requires covered interest parity, uncovered interest parity, and ex ante purchasing power parity. In a world with sticky prices, there is no reason to believe this last point would be the case. Then in general, the real interest differential equals the expected rate of real exchange rate depreciation:

$$r_t - r_t^* = \Delta q_{t,t+k}^e \tag{13}$$

Under rational expectations, the expected and the ex post rate of depreciation should be on average the same. Hence the degree to which real interest parity – a measure of financial integration – holds depends the rate at which prices revert to their long run values. In the Dornbusch (1976) monetary model of exchange rates, for instance, real interest parity does not hold in the short run. If it holds in the long run, then the "stickier" prices are, the longer it takes for real interest parity to be established (at least in simple models).[8]

Obviously, the entire literature on reversion to purchasing power parity is then relevant. Unfortunately, this vast body of work comes to various conclusions, including the fact that for some cases, there is never reversion to purchasing power parity. That might occur if relative price of nontradables versus tradables differs across countries, as in the models of Balassa (1964) and Samuelson (1964). Relative prices may also be affected by demand side factors. In the long run, the rising preference for services, which are largely nontradable, may induce a trend rise in the relative price of nontradables. Over shorter horizons, government spending on public services may also induce changes in relative prices (DeGregorio and Wolf (1994) and Chinn (1999)).[9]

In recent decades, the advent of more powerful statistical techniques, larger and longer data sets, and allowing for nonlinearities has led to the general conclusion that purchasing power parity (PPP) in levels holds.[10] The question is then what determines the rate of

[8] A direct mapping is not clear in more complicated New Keynesian models with alternative approaches to modelling sticky prices; see Engel (2019).

[9] Early work on PPP relied upon Classical regression techniques, and addressed the question of whether PPP held on a period-by-period basis. That literature concluded that absolute PPP did not hold for broad price indices, in the short run. One important exception was that identified by Frenkel (1976) who found that during the German hyperinflation of the 1920s, PPP did hold. Hence the conclusion that PPP held only when nominal (monetary) shocks were large relative to real shocks.

[10] Oh (1996) investigates G-6 currencies using panel unit root tests, while MacDonald (1996) and Wu (1996) examine up to 23 OECD currencies. In all three cases, greater evidence in favour of PPP is found than in time series approaches, even when only examining the post-Bretton Woods period. Frankel and Rose (1996) used annual data over the entire post-war period, and

reversion. In a recent survey, Curran and Velic (2019) find that faster rates of reversion are associated with higher inflation, higher nominal exchange rate volatility, as in emerging market and developing countries. On the other hand, the deviations of PPP tend to be larger for emerging markets. Hence, it's not clear what the implications of differential rates of real exchange rate reversion are for the degree of financial integration.

Given the fact that relative PPP is unlikely to hold instantaneously, short-term real interest rate parity is likely too strong a proposition. This suggests using cointegration techniques to evaluate long run relationships. Goodwin and Grennes (1994) assess ten advanced country currencies, and finds evidence for cointegration. Chinn and Frankel (1994) evaluate real linkages in the Pacific Basin.

Ferreira and León-Ledesma (2007) examine real interest differentials for a set of developed economies and developing economies from late 1970s to around 2003, and find that these differentials do not always appear to be stationary. However, after accounting for structural breaks, they find that reversion of real interest differentials to zero (for developed economies) and to a constant (for emerging market and developing economies) is fairly rapid.

In the most recent cross-country analysis, Bahmani-Oskooee et al. (2019) examine a large set of countries' real interest differentials through 2016, using more powerful unit root tests (allowing for structural breaks and asymmetries), and find that unit roots are rejected in 18 out of 21 OECD countries, and four out of five BRICS. The authors take that as a real interest parity holding, although it should be noted that, aside from the constant that exists, breaks in the real parity condition can be taken as real interest parity holding, even if the real interest differentials are not strictly speaking unit root processes.

One could conjecture that some of the results are driven by the particular special circumstances affecting a given country during the sample period. Instead, going case by case, we use a different approach, systematically analyzing the relationship between ex post uncovered interest parity deviations on one hand, and observable institutional and macroeconomic factors on the other. This exercise is undertaken in the next section.

5 CROSS-COUNTRY DETERMINANTS OF REAL INTEREST PARITY DEVIATIONS

We do not observe directly the (ex ante) real interest differential. We take the expedient of examining the annual average of monthly ex post real interest rate as a proxy for the ex ante, and relating that differential to a number of variables that have been found to be of important in determining differentials.

$$\tilde{r}_t^k \equiv i_t^k - \pi_{t,t+k} \tag{14}$$

Where $\pi_{t,t+k}$ is the realized inflation rate from period t to t+k.

found confirmation of PPP. Papell (1997) found the evidence for PPP is stronger for wider panels, monthly data and non-US-based exchanged exchange rates. The advent of panel cointegration techniques allowed for a different approach to testing for PPP.

Figure 2.3 shows the evolution of the average real interest differential in advanced and emerging/developing economies, from the mid-1980s to 2020.

The interest differentials are expressed relative to the US, and at any given time, some rates might be above and some might be below the US rate. What is of interest is to see how large deviations abstracting from sign are. Figure 2.4 shows the absolute real interest differentials.

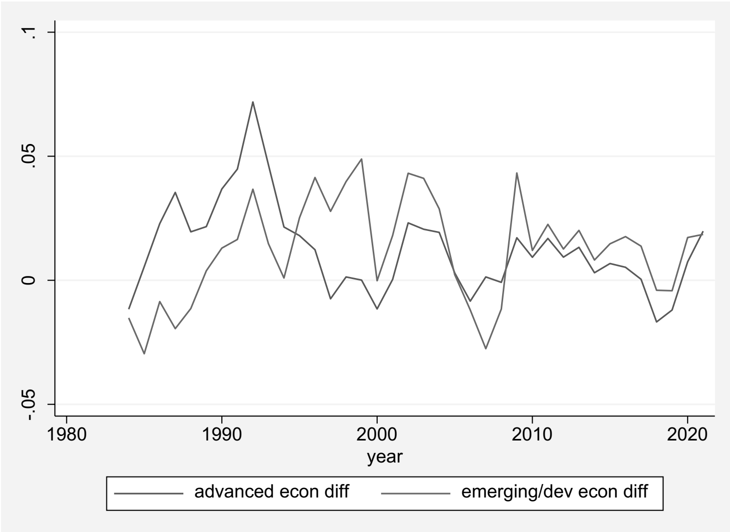


Figure 2.3 Average real interest differentials

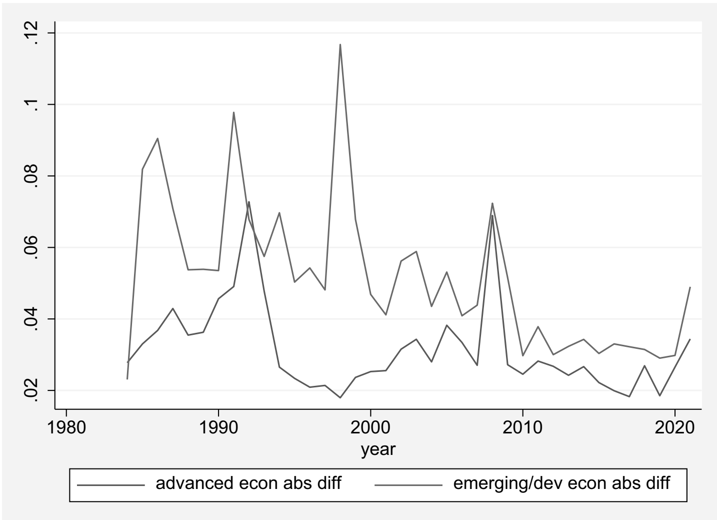


Figure 2.4 Average absolute real interest differentials

Looking at ex post real interest differentials across industrial and non-industrial countries, we note that real interest differentials (relative to the US level) for short maturities have declined, as have the absolute values of differentials. For the period before 2000, mean (std dev) real interest differentials were 2.3% (4.3%); after that they were less than 1% (2.8%). More relevant are mean (std dev) absolute real differentials, for which the corresponding figures were 4.6% (4.1%), and 3.5% (2.1%), respectively.

In order to identify the determinants of the changes in real interest differentials, we return to the decomposition of differentials.

5.1 A framework for analysis

Rewriting (4), one obtains:

$$\underbrace{\left(\tilde{r}_t^k - \tilde{r}_t^{k*}\right)}_{\substack{\text{Real interest}\\ \text{differential}}} = \underbrace{\left[\left(i_t^k - i_t^{k*}\right) - \left(f_{t,t+k} - s_t\right)\right]}_{\text{Covered interest differential}} + \underbrace{\left\langle\left(f_{t,t+k} - s_t\right) - \Delta s^e_{t,t+k}\right\rangle}_{\text{Exchange risk premium}} + \underbrace{\left\{\Delta\, q^e_{t,t+k}\right\}}_{\substack{\text{Expected}\\ \text{real depr.}}} + f'cast\ error \tag{15}$$

Note that we held default risk constant in our discussion. Obviously, in the real world, default risk is not constant, and varies over time. Hence, we need to add measures to proxy for default risk.[11]

Since we are interested in the variables that induce deviation from real interest parity, we examine the absolute value the real interest differential. We then relate that variable to factors that we believe affect the magnitude of the covered interest differential, the exchange risk premium, expected real depreciation, or the forecast error.

We index these variables by currency (relative to the US), and generate annual variables as averages of the quarterly data.

The regressions are estimated in a panel time series context, using annual data and including time fixed effects. All the variables are expressed relative to US.

$$\underbrace{\left(\tilde{r}_t^k - \tilde{r}_t^{k*}\right)}_{\substack{\text{Real interest}\\ \text{differential}}} = f(\underbrace{KAOPEN,\ LEGAL}_{\text{Political risk}}\ \underbrace{SUR,\ FINDEV}_{\substack{\text{Exchange risk}\\ \text{premium}}}\ \underbrace{OPEN,\ INFL}_{\substack{\text{Expected real}\\ \text{depreciation}}}\ \underbrace{SUR,\ CUR,\ BANKING,\ DEBT}_{\text{Default risk}}\ \underbrace{FIX,\ INFL,\ INFLVOL}_{\text{Forecast errors}}) \tag{16}$$

Note that those factors affecting forecast errors do not directly inform the question of whether financial and real markets are integrated, even though they affect the ex post real interest differential.

We control for per capita income in all the regressions because it seems to proxy for many factors. Exclusion of per capita income does not change the results in any substantive way. The use of the other variables is motivated below.

[11] We would want to use sovereign debt for short-term rates, in which case the wedge would be driven by sovereign default risk. In practice we use interbank rates in most cases; to that extent, we have overall default risk in our differentials.

Variables affecting:

The covered interest differential

- Financial openness (KAOPEN). The covered interest differential (for a given constant default risk) is attributed to explicit or implicit barriers to capital flows. These include measures explicitly aimed at restricting flows, as well as other regulations that have the effect of impeding flows, such as macroprudential regulations. In order to maximize coverage, use the Chinn and Ito (2006) financial openness index, which is the first standardized principal component of the variables that indicates the presence of multiple exchange rates, restrictions on current account transactions, on capital account transactions and the requirement of the surrender of export proceeds. Higher values of this index indicate that a country is more open to cross-border capital transactions.
- Institutions (LEGAL). We posit that capital controls are more likely to be imposed in countries with low levels of institutional development. LEGAL is the first standardized principal component of corruption, law and order, and bureaucratic quality indices drawn from the International Credit Risk Guide.

The exchange risk premium

- Government budget surplus (GSUR). The exchange risk premium depends on the riskiness of bonds in terms of covariability with wealth or consumption, and the amount of those bonds outstanding. In a static portfolio balance model, the greater the stock of government debt, the greater the premium needed to induce holding of the additional supply. In the absence of accurate cross-country data on government bond supplies over a long period, we rely upon the budget surplus data.
- Financial development (FD). The more financially developed a country is, the more likely the bonds are to be easily traded. This will tend to shrink differentials, given the US – with the greatest convenience yields associated with their bonds – is the reference country. The index, FD, measures the development of financial markets and financial institutions, as described in Sahay et al. (2015).

The size of real depreciation

- Trade openness (OPEN). The greater the extent of openness, measured by the sum of exports and imports to GDP, the larger the portion of the economy tied to arbitrage forces. Curran and Velic (2019) show that in a cross-country context, greater openness is associated with faster real exchange rate reversion.
- Inflation (INFL). In simple sticky-price models (e.g., Dornbusch, 1976), the rate of reversion is associated with the degree of price stickiness. In general, price stickiness is less when inflation is higher.

Default risk

- Government budget surplus (SUR). When the government is in surplus, the less likely debt is approaching levels that would trigger default.
- Currency crisis (CURRENCY). A large currency depreciation can lead to an increase of foreign currency denominated debt, leading to insolvency. Even if the

debt is held by private firms, higher sovereign default risk due to contingent liabilities. This is a dummy variable from the World Bank.

- Banking crisis (BANKING). A banking crisis might lead to the government's assumption of liabilities that would increase the government's debt load, thereby increasing default risk. This is a dummy variable from the World Bank.
- Debt crisis (DEBT). A debt crisis directly leads to higher sovereign default risk. This is a dummy variable drawn from the World Bank.

<u>Forecast errors (for exchange rates, inflation rates)</u>

- Exchange rate regime (FIX). For fixed exchange rate regimes, exchange rate forecast errors are typically much smaller than for other regimes, except when devaluations occur.
- Inflation (INFL). Higher inflation is partly associated with larger monetary shocks, as shown in Bansal and Dahlquist (2000). Unbiasedness is more likely to hold, likely because exchange rate forecast errors are smaller.
- Inflation volatility (INFLVOL). The greater the volatility of inflation, the larger the inflation forecast errors (Bansal and Dahlquist, 2000).

5.2 Empirical results

We conduct the investigation in two steps. First, we examine the determinants of the level of the deviations. Second, we assess the factors that are important to the behavior of the absolute value of the deviations (the USA is always defined as the foreign country). In all the analyses, we include time fixed effects to control for global factors; however, because we want to explain not only deviations from average country differentials, but the actual deviations from real interest parity (defined as real interest differential equaling zero), we do not include country fixed effects.

The sample period is 1986–2021, and includes 43 total countries, with the number of countries examined sometimes dropping to 41 or 40. Of the 43 countries, 20 are classified as emerging/developed (see the Data Appendix). It is important to note that the panel is not balanced, nor is the sample size constant over specifications. In the latter case, this outcome is due to the fact that some of the variables have differing coverage.

Table 2.7 reports the results of the regression specifications described above, for the full set. Table 2.8 reports the results for the industrial country currencies, while Table 2.9 reports those results pertaining to the non-industrial countries.

The coefficient estimates in the panels indicate that the deviations do depend upon income per capita. Bansal and Dahlquist (2000) document that countries with higher per capita income are more likely to deviate from UIP. However, as a home country's per capita income rises, the gap between the home country and the USA shrinks, which can result in smaller exchange risk premiums; that is, smaller interest parity deviations. Ito and Chinn (2009) showed mixed evidence in favor of this argument; however, they as more regressors are included, so does the sample size shrink, so the opposite correlation shows up. In the real interest differential regression, the effect shrinks and becomes statistically insignificant.

Augmenting the specification with two inflation variables – the level and the volatility of inflation –improves the goodness of fit. Higher inflation may indicate stronger

Table 2.7 Pooled OLS, FULL

	FULL (1)	FULL (2)	FULL (3)	FULL (4)	FULL (5)	FULL (6)	FULL (7)	FULL (8)	FULL (9)	FULL (10)	FULL (11)
per capita income	–0.010	–0.015	–0.005	–0.008	–0.002	–0.004	–0.004	–0.005	–0.005	–0.006	–0.004
	(0.002)***	(0.002)***	(0.003)*	(0.003)***	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)*	(0.003)
Inflation rate		0.011	–0.004	–0.255	–0.282	–0.278	–0.280	–0.268	–0.269	–0.273	–0.263
		(0.052)	(0.055)	(0.053)***	(0.053)***	(0.054)***	(0.054)***	(0.048)***	(0.048)***	(0.048)***	(0.048)***
Inflation volatility		–0.238	–0.226	–0.031	0.003	0.003	0.003	–0.066	–0.066	–0.062	–0.076
		(0.082)***	(0.087)***	(0.059)	(0.062)	(0.062)	(0.062)	(0.068)	(0.068)	(0.068)	(0.068)
Fin. develop. index			–0.011	–0.011	–0.028	–0.030	–0.026	–0.026	–0.026	–0.025	–0.026
			(0.005)**	(0.005)**	(0.006)***	(0.006)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***
Chinn-Ito index			–0.022	–0.028	–0.027	–0.028	–0.025	–0.025	–0.025	–0.026	–0.022
			(0.005)***	(0.004)***	(0.004)***	(0.004)***	(0.004)***	(0.004)***	(0.004)***	(0.004)***	(0.004)***
Gov't budget surplus				0.018	0.005	–0.001	–0.016	–0.010	–0.009	–0.004	–0.026
				(0.020)	(0.020)	(0.020)	(0.020)	(0.021)	(0.021)	(0.021)	(0.021)
Trade openness					–0.014	–0.014	–0.010	–0.009	–0.009	–0.009	–0.007
					(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***
legal						0.002	0.001	0.001	0.001	0.001	0.001
						(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Fixed ERR							–0.010	–0.011	–0.011	–0.014	–0.008
							(0.001)***	(0.001)***	(0.001)***	(0.002)***	(0.002)***
Currency crisis								0.012	0.012	0.011	0.011
								(0.014)	(0.014)	(0.013)	(0.014)
Banking crisis								0.017	0.017	0.016	0.017
								(0.007)**	(0.007)**	(0.007)**	(0.007)**
Debt crisis								0.066	0.067	0.066	0.069
								(0.064)	(0.064)	(0.064)	(0.063)
CPTPP members									0.008	0.009	0.006
									(0.004)*	(0.004)**	(0.004)
Euro area										0.005	
										(0.002)**	
European Union											–0.007
											(0.002)***

Table 2.7 (continued)

	FULL (1)	FULL (2)	FULL (3)	FULL (4)	FULL (5)	FULL (6)	FULL (7)	FULL (8)	FULL (9)	FULL (10)	FULL (11)
N	1,298	1,297	1,221	1,142	1,142	1,140	1,134	1,134	1,134	1,134	1,134
Adj. R2	0.20	0.31	0.33	0.48	0.50	0.50	0.52	0.53	0.53	0.54	0.54
# of countries	43	43	42	41	41	41	41	41	41	41	41

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Annual fixed effects are included but not reported in the table. CPTPP stands for the Comprehensive and Progressive Agreement for Trans-Pacific Partnership which is a free trade agreement (FTA) between Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, Peru, New Zealand, Singapore and Vietnam. Australia, Canada, Japan, Mexico, New Zealand and Singapore ratified in 2018, Vietnam in 2019 and Peru in 2021.

Table 2.8 Pooled OLS, IDC

	IDC (1)	IDC (2)	IDC (3)	IDC (4)	IDC (5)	IDC (6)	IDC (7)	IDC (8)	IDC (9)	IDC (10)	IDC (11)
per capita income	–0.006	–0.007	–0.003	–0.013	–0.006	–0.014	–0.016	–0.016	–0.016	–0.016	–0.017
	(0.003)**	(0.002)***	(0.003)	(0.004)***	(0.004)	(0.005)***	(0.004)***	(0.004)***	(0.004)***	(0.004)***	(0.004)***
Inflation rate		–0.033	–0.154	–0.163	–0.176	–0.175	–0.201	–0.198	–0.198	–0.196	–0.193
		(0.076)	(0.080)*	(0.087)*	(0.089)**	(0.087)**	(0.092)**	(0.094)**	(0.094)**	(0.095)**	(0.093)**
Inflation volatility		–0.120	–0.094	–0.074	–0.040	–0.055	-0.029	–0.030	–0.030	–0.030	–0.044
		(0.071)*	(0.070)	(0.072)	(0.075)	(0.075)	(0.078)	(0.077)	(0.077)	(0.077)	(0.077)
Fin. develop. index			–0.017	–0.011	–0.016	–0.013	–0.023	–0.023	–0.024	–0.024	–0.023
			(0.005)***	(0.005)***	(0.006)***	(0.006)**	(0.006)***	(0.006)***	(0.006)***	(0.006)***	(0.006)***
Chinn-Ito index			–0.036	–0.037	–0.036	–0.037	–0.031	–0.030	–0.030	–0.029	–0.029
			(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***
Gov't budget surplus				0.076	0.061	0.039	0.025	0.028	0.029	0.029	0.024
				(0.018)***	(0.019)***	(0.019)**	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Trade openness					–0.007	–0.007	–0.001	–0.001	–0.001	–0.001	0.000
					(0.002)***	(0.002)***	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
legal						0.005	0.003	0.003	0.003	0.002	0.002
						(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)**	(0.001)**
Fixed ERR							–0.010	–0.010	–0.010	–0.009	–0.009
							(0.001)***	(0.001)***	(0.001)***	(0.002)***	(0.002)***
Currency crisis								0.003	0.003	0.003	0.001
								(0.011)	(0.011)	(0.011)	(0.011)
Banking crisis								0.014	0.014	0.014	0.014
								(0.004)***	(0.004)***	(0.004)***	(0.004)***
Debt crisis								0.005	0.005	0.005	0.005
								(0.003)*	(0.003)	(0.003)	(0.003)
CPTPP members									0.003	0.003	0.001
									(0.003)	(0.003)	(0.003)
Euro area										–0.002	
										(0.002)	
European Union											–0.004
											(0.002)**

Table 2.8 (continued)

	IDC (1)	IDC (2)	IDC (3)	IDC (4)	IDC (5)	IDC (6)	IDC (7)	IDC (8)	IDC (9)	IDC (10)	IDC (11)
N	761	760	717	689	689	689	689	689	689	689	689
Adj. R2	0.49	0.51	0.58	0.59	0.59	0.61	0.63	0.64	0.63	0.63	0.64
# of countries	22	22	21	21	21	21	21	21	21	21	21

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Annual fixed effects are included but not reported in the table. CPTPP stands for the Comprehensive and Progressive Agreement for Trans-Pacific Partnership which is a free trade agreement (FTA) between Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, Peru, New Zealand, Singapore and Vietnam. Australia, Canada, Japan, Mexico, New Zealand and Singapore ratified in 2018, Vietnam in 2019 and Peru in 2021.

Table 2.9 Pooled OLS, EMDE

	EMDE (1)	EMDE (2)	EMDE (3)	EMDE (4)	EMDE (5)	EMDE (6)	EMDE (7)	EMDE (8)	EMDE (9)	EMDE (10)	EMDE (11)
per capita income	–0.014	–0.017	–0.014	–0.019	–0.002	0.000	–0.003	–0.002	–0.002	–0.005	–0.002
	(0.003)***	(0.003)***	(0.005)***	(0.005)***	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Inflation rate		0.029	0.047	–0.298	–0.355	–0.396	–0.435	–0.405	–0.402	–0.409	–0.403
		(0.051)	(0.054)	(0.072)***	(0.068)***	(0.072)***	(0.071)***	(0.059)***	(0.058)***	(0.059)***	(0.059)***
Inflation volatility		–0.285	–0.306	–0.045	0.014	0.035	0.073	–0.048	–0.051	–0.044	–0.050
		(0.086)***	(0.088)***	(0.071)	(0.067)	(0.068)	(0.068)	(0.067)	(0.067)	(0.066)	(0.068)
Fin. develop. index			0.010	0.013	–0.019	–0.007	–0.016	–0.018	–0.019	–0.011	–0.017
			(0.011)	(0.009)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.012)
Chinn-Ito index			–0.006	–0.001	0.003	0.010	0.004	0.001	0.000	0.002	0.000
			(0.010)	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Gov't budget surplus				–0.137	–0.161	–0.190	–0.134	–0.149	–0.150	–0.151	–0.149
				(0.050)***	(0.049)***	(0.048)***	(0.048)***	(0.047)***	(0.047)***	(0.047)***	(0.047)***
Trade openness					–0.031	–0.027	–0.018	–0.018	–0.019	–0.020	–0.020
					(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.006)***
Legal						–0.008	–0.008	–0.007	–0.007	–0.007	–0.007
						(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***
Fixed ERR							–0.019	–0.018	–0.017	–0.028	–0.017
							(0.004)***	(0.003)***	(0.003)***	(0.007)***	(0.003)***
Currency crisis								0.012	0.013	0.012	0.013
								(0.020)	(0.020)	(0.019)	(0.020)
Banking crisis								–0.001	–0.001	–0.000	–0.001
								(0.013)	(0.014)	(0.013)	(0.014)
Debt crisis								0.129	0.130	0.127	0.129
								(0.033)***	(0.033)***	(0.032)***	(0.034)***
CPTPP members									0.021	0.022	0.022
									(0.007)***	(0.007)***	(0.007)***
Euro area										0.017	
										(0.008)**	
European Union											0.002
											(0.004)

Table 2.9 *(continued)*

	EMDE (1)	EMDE (2)	EMDE (3)	EMDE (4)	EMDE (5)	EMDE (6)	EMDE (7)	EMDE (8)	EMDE (9)	EMDE (10)	EMDE (11)
N	537	537	504	453	453	451	445	445	445	445	445
Adj. R2	0.16	0.32	0.34	0.55	0.60	0.62	0.64	0.66	0.66	0.67	0.66
# of countries	21	21	21	20	20	20	20	20	20	20	20

Note: * p<0.1; ** p<0.05; *** p<0.01. Annual fixed effects are included but not reported in the table. CPTPP stands for the Comprehensive and Progressive Agreement for Trans-Pacific Partnership which is a free trade agreement (FTA) between Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, Peru, New Zealand, Singapore and Vietnam. Australia, Canada, Japan, Mexico, New Zealand and Singapore ratified in 2018, Vietnam in 2019 and Peru in 2021.

monetary shocks and, therefore, would make it easier for UIP to hold, that is, it should result in smaller deviations. But no such correlation is found on the estimated coefficients of the inflation level. Higher inflation volatility, on the other hand, means higher inflation uncertainty and, therefore, should cause more deviation from UIP. We find the real interest differential shrinks the real interest parity deviation; however, this outcome is not robust to inclusion of other variables, such as the inclusion of financial development and financial openness.

Financial development seems to reduce the deviation, as does greater financial openness, with statistical significance. Now inflation reduces the real interest differential, while volatility no longer has a significant impact. The estimated effects of financial development and financial openness are not sensitive to the inclusion of other variables, such as the government budget surplus, or trade openness.

One interesting aspect is an increase in our measure of institutional – or legal – development has little effect. To the extent that one would expect this index to have some correlation with political risk, this is surprising (although institutional development is probably measured with a very large degree of measurement error).

Interestingly, we find a statistically significant role for exchange rate regimes; a fixed regime is associated with a smaller real interest differential.

What about crises? Currency crises and debt crises do not register a statistically significant impact. However, debt crisis does have a relatively large coefficient, even if not statistically significant. Banking crises on the other hand have a clear and positive impact on real interest rates.

Dummies for preferential trading arrangements and monetary unions – Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), European Union and Eurozone – have significant impacts but are not robust to the set of groupings included. More likely, they represent special characteristics of the groups.

Moving to the industrial country results, we obtain results that, while the proportion of variance explained rises for the full specifications, look remarkably similar to those for the full sample, in terms of what variables show up as significant.

The effect of inflation rates tends to increase the size of deviations, with largely double the size. The effect is fairly pronounced and seems to be relatively constant across specifications (about 0.4, implying that each one percentage point increase in inflation relative to US inflation induces a 0.4 percentage point decrease in the real deviation). Financial openness, exchange rate regime and banking crises have approximately the same effect. The financial development index has an opposite sign, and is significant albeit with small coefficient.

Turning to the emerging and developing country grouping, we again find inflation has a large and negative impact on the real interest differential. So too does a fixed exchange rate regime. But those are two of the few similarities to the full sample or industrial country results. Financial development and financial openness no longer evidence any statistical significance. The budget surplus, trade openness, and institutional development show up as significantly shrinking the real interest differential; with most countries in this grouping having interest rates higher than the US, this means that real interest rates are brought closer to US levels by higher levels of these variables.

Finally, only debt crises have a statistically significant impact on the real differential.

With respect to the absolute value of the deviations (results reported in Tables 2.10, 2.11 and 2.12), we find somewhat different results, with the fact many of the variables are

Table 2.10 Absolute deviations, pooled OLS, FULL

	FULL (1)	FULL (2)	FULL (3)	FULL (4)	FULL (5)	FULL (6)	FULL (7)	FULL (8)	FULL (9)	FULL (10)	FULL (11)
per capita income	–0.020	–0.011	–0.006	–0.006	–0.003	–0.001	–0.002	–0.003	–0.003	–0.003	–0.002
	(0.002)***	(0.001)***	(0.002)**	(0.003)**	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Inflation rate		0.035	0.027	0.014	–0.000	–0.005	–0.005	–0.001	–0.001	–0.003	0.001
		(0.030)	(0.031)	(0.040)	(0.041)	(0.041)	(0.041)	(0.034)	(0.034)	(0.034)	(0.034)
Inflation volatility		0.274	0.283	0.312	0.330	0.334	0.333	0.265	0.265	0.267	0.262
		(0.040)***	(0.043)***	(0.046)***	(0.049)***	(0.049)***	(0.048)***	(0.053)***	(0.053)***	(0.053)***	(0.054)***
Fin. develop. index			–0.009	–0.009	–0.018	–0.017	–0.015	–0.015	–0.015	–0.015	–0.015
			(0.004)***	(0.004)**	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***
Chinn-Ito index			-0.009	–0.006	–0.006	–0.005	–0.004	–0.004	–0.004	–0.005	-0.004
			(0.004)**	(0.004)*	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Gov't budget surplus				0.000	–0.007	–0.004	–0.011	–0.003	–0.003	–0.000	–0.007
				(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Trade openness					–0.007	–0.008	–0.006	–0.005	–0.005	–0.005	–0.005
					(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***
legal						–0.001	–0.001	–0.001	–0.001	–0.001	–0.001
						(0.001)	(0.001)*	(0.001)	(0.001)	(0.001)	(0.001)*
Fixed ERR							–0.005	–0.005	–0.005	–0.007	–0.004
							(0.001)***	(0.001)***	(0.001)***	(0.002)***	(0.001)***
Currency crisis								0.030	0.030	0.030	0.030
								(0.015)**	(0.015)**	(0.015)**	(0.015)**
Banking crisis								0.005	0.005	0.005	0.005
								(0.005)	(0.005)	(0.005)	(0.005)
Debt crisis								0.064	0.064	0.064	0.065
								(0.055)	(0.055)	(0.054)	(0.055)
CPTPP members									–0.001	–0.000	–0.001
									(0.003)	(0.003)	(0.003)
Euro area										0.003	
										(0.002)*	
European Union											–0.001
											(0.001)

N	1,298	1,297	1,221	1,142	1,142	1,140	1,134	1,134	1,134	1,134	1,134
Adj. R2	0.28	0.57	0.58	0.59	0.60	0.60	0.60	0.62	0.62	0.62	0.62
# of countries	43	43	42	41	41	41	41	41	41	41	41

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Annual fixed effects are included but not reported in the table. CPTPP stands for the Comprehensive and Progressive Agreement for Trans-Pacific Partnership which is a free trade agreement (FTA) between Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, Peru, New Zealand, Singapore and Vietnam. Australia, Canada, Japan, Mexico, New Zealand and Singapore ratified in 2018, Vietnam in 2019 and Peru in 2021.

Table 2.11 Absolute deviations, pooled OLS, IDC

	IDC (1)	IDC (2)	IDC (3)	IDC (4)	IDC (5)	IDC (6)	IDC (7)	IDC (8)	IDC (9)	IDC (10)	IDC (11)
per capita income	–0.011	–0.009	–0.008	–0.011	–0.008	–0.009	–0.010	–0.010	–0.011	–0.010	–0.011
	(0.002)***	(0.002)***	(0.003)***	(0.003)***	(0.003)**	(0.004)**	(0.004)***	(0.004)***	(0.004)***	(0.004)***	(0.004)***
Inflation rate		0.173	0.122	0.131	0.124	0.124	0.117	0.111	0.111	0.108	0.113
		(0.042)***	(0.042)***	(0.046)***	(0.046)***	(0.046)***	(0.047)**	(0.050)**	(0.050)**	(0.050)**	(0.049)**
Inflation volatility		0.176	0.197	0.183	0.202	0.199	0.206	0.203	0.203	0.203	0.198
		(0.050)***	(0.052)***	(0.056)***	(0.057)***	(0.058)***	(0.058)***	(0.058)***	(0.058)***	(0.058)***	(0.058)***
Fin. develop. index			–0.000	0.002	–0.001	–0.000	–0.003	–0.003	–0.002	–0.001	–0.002
			(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Chinn-Ito index			–0.017	–0.017	–0.016	–0.016	–0.014	–0.013	–0.013	–0.014	–0.013
			(0.004)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***
Gov't budget surplus				0.031	0.023	0.018	0.014	0.021	0.019	0.019	0.018
				(0.015)**	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Trade openness					–0.004	–0.004	–0.002	–0.002	–0.002	–0.003	–0.002
					(0.001)***	(0.001)***	(0.002)	(0.002)	(0.002)	(0.002)*	(0.002)
legal						0.001	0.000	0.000	0.000	0.001	0.000
						(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Fixed ERR							–0.003	–0.003	–0.003	–0.004	–0.003
							(0.001)**	(0.001)***	(0.001)***	(0.001)***	(0.001)**
Currency crisis								0.015	0.015	0.015	0.015
								(0.005)***	(0.005)***	(0.005)***	(0.004)***
Banking crisis								0.011	0.011	0.010	0.011
								(0.005)**	(0.005)**	(0.005)**	(0.005)**
Debt crisis								0.009	0.009	0.010	0.009
								(0.003)***	(0.003)***	(0.003)***	(0.003)***
CPTPP members									–0.007	–0.006	–0.008
									(0.003)***	(0.003)**	(0.003)***
Euro area										0.002	
										(0.001)	
European Union											–0.001
											(0.001)

N	761	760	717	689	689	689	689	689	689	689	689
Adj. R2	0.43	0.53	0.56	0.55	0.56	0.56	0.56	0.57	0.57	0.57	0.57
# of countries	22	22	21	21	21	21	21	21	21	21	21

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Annual fixed effects are included but not reported in the table. CPTPP stands for the Comprehensive and Progressive Agreement for Trans-Pacific Partnership which is a free trade agreement (FTA) between Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, Peru, New Zealand, Singapore and Vietnam. Australia, Canada, Japan, Mexico, New Zealand and Singapore ratified in 2018, Vietnam in 2019 and Peru in 2021.

Table 2.12 Absolute deviations, pooled OLS, EMDE

	EMDE (1)	EMDE (2)	EMDE (3)	EMDE (4)	EMDE (5)	EMDE (6)	EMDE (7)	EMDE (8)	EMDE (9)	EMDE (10)	EMDE (11)
per capita income	–0.015	–0.010	–0.008	–0.011	–0.004	–0.002	–0.003	–0.002	–0.002	–0.000	–0.002
	(0.003)***	(0.002)***	(0.004)*	(0.004)**	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)	(0.004)
Inflation rate		0.038	0.039	–0.008	–0.033	–0.071	–0.079	–0.058	–0.058	–0.055	–0.059
		(0.030)	(0.033)	(0.061)	(0.064)	(0.063)	(0.066)	(0.054)	(0.054)	(0.054)	(0.054)
Inflation volatility		0.254	0.254	0.314	0.339	0.357	0.364	0.264	0.264	0.261	0.266
		(0.041)***	(0.044)***	(0.063)***	(0.066)***	(0.063)***	(0.065)***	(0.066)***	(0.066)***	(0.067)***	(0.067)***
Fin. develop. index			–0.006	–0.007	–0.021	–0.009	–0.012	–0.015	–0.015	–0.019	–0.014
			(0.008)	(0.008)	(0.010)**	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.010)
Chinn-Ito index			-0.002	0.004	0.006	0.013	0.011	0.009	0.009	0.008	0.009
			(0.008)	(0.007)	(0.007)	(0.007)*	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)
Gov't budget surplus				0.001	–0.010	–0.035	–0.018	–0.030	–0.030	–0.029	–0.029
				(0.039)	(0.039)	(0.036)	(0.037)	(0.036)	(0.036)	(0.036)	(0.036)
Trade openness					–0.013	–0.009	–0.007	–0.008	–0.008	–0.007	–0.009
					(0.004)***	(0.004)**	(0.005)	(0.004)*	(0.004)*	(0.004)*	(0.006)
legal						–0.008	–0.008	–0.007	–0.007	–0.007	–0.007
						(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***
Fixed ERR							–0.005	–0.003	–0.003	0.002	–0.004
							(0.003)	(0.003)	(0.003)	(0.005)	(0.003)
Currency crisis								0.027	0.027	0.027	0.027
								(0.023)	(0.023)	(0.023)	(0.023)
Banking crisis								–0.016	–0.016	–0.016	–0.016
								(0.010)*	(0.010)*	(0.010)*	(0.010)*
Debt crisis								0.106	0.106	0.107	0.105
								(0.044)**	(0.044)**	(0.045)**	(0.045)**
CPTPP members									0.001	0.001	0.002
									(0.007)	(0.007)	(0.007)
Euro area										-0.008	
										(0.006)	
European Union											0.002
											(0.004)

N	537	537	504	453	453	451	445	445	445	445	445
Adj. R2	0.26	0.59	0.59	0.61	0.63	0.65	0.66	0.68	0.68	0.68	0.68
# of countries	21	21	21	20	20	20	20	20	20	20	20

Note: * p<0.1; ** p<0.05; *** p<0.01. Annual fixed effects are included but not reported in the table. CPTPP stands for the Comprehensive and Progressive Agreement for Trans-Pacific Partnership which is a free trade agreement (FTA) between Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, Peru, New Zealand, Singapore and Vietnam. Australia, Canada, Japan, Mexico, New Zealand and Singapore ratified in 2018, Vietnam in 2019 and Peru in 2021.

probably operating on the components of the differential in offsetting directions. The results are quite different between the industrial country and emerging and developing country groups, so we focus on the individual group results.

In the industrial country grouping, inflation and inflation volatility positively affect absolute deviations. A fixed exchange rate regime reduces the absolute deviation as well. While financial development has no significant effect (likely because the industrial countries are at roughly the same level), financial openness does; a higher degree of de jure financial openness reduces the deviation.

Crises of all types significantly increase absolute deviations, in line with expectations.

In contrast to the results for the industrial country grouping, inflation volatility does increase deviations in the less developed country grouping (using robust regression, inflation would also reduce absolute deviations). Legal development reduces absolute differentials, in contrast to the results for industrial countries. Trade openness also shrinks absolute differentials, although the results are sensitive to the inclusion of exchange rate regime and economic groupings.

Finally, banking and debt crises have significant impacts on absolute differentials. While the debt crisis coefficient has the anticipated sign (positive), banking crises have negative effects.

5.3 Interpretation

The cross-country analysis demonstrates that different factors affect the real interest differential, and hence the degree of real and financial integration. The deviations from ex post real interest parity depend in part on inflation and inflation volatility; however, to the extent that these factors affect forecast errors rather than the degree of integration directly.

We confirm for the industrial country grouping a role for financial openness and fixed exchange rate regime, working through the political risk and forecast error channels, respectively. For the non-industrial grouping, we find that one common reason for real interest deviations is from the inflation volatility, presumably working through the forecast error channel. Interestingly, higher institutional development is consistent factor that decreases deviations, presumably through the political risk channel. Finally, as expected debt crises have the anticipated effect of raising deviations, through increasing default risk.

6 CONCLUSION

This survey has only covered integration measured via bond markets. Several key distinctions in the recent literature have cast older results in a new light, even as new data has enabled us to evaluate integration in the new century.

Key insights include the following:

1. Covered interest parity which was previously thought to hold, up to transactions costs, no longer holds post global financial crisis. At one juncture, part of this is due to default risk (so that measured yields no longer relate to assets of same default

risk), and more recently to the change in the regulatory regime that now makes hedging costly.

2. Uncovered interest rate parity needs to be distinguished from the unbiasedness hypothesis – i.e., the joint hypothesis of uncovered interest parity and unbiased expectations. Once this is done, the evidence in favor of uncovered interest parity (and hence perfect capital substitutability) is much greater.
3. Government bonds are not only differentiated by the degree to which their yields covary with wealth or consumption, but also by their convenience yield. Given this, it is unsurprising that nominal financial integration has been incomplete.
4. Ex post short-term real returns have shrunk over time, but are still far from being equalized.

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LIST OF COUNTRIES FOR REAL INTEREST PARITY ANALYSIS

	ISO	Country	IDC		ISO	Country	IDC
1	193	Australia	1	23	136	Italy	1
2	122	Austria	1	24	158	Japan	1
3	124	Belgium	1	25	542	Korea, Rep.	0
4	156	Canada	1	26	941	Latvia	0
5	228	Chile	0	27	946	Lithuania	0
6	924	China	0	28	137	Luxembourg	1
7	233	Colombia	0	9	273	Mexico	0
8	238	Costa Rica	0	30	138	Netherlands	1
9	935	Czech Republic	0	31	196	New Zealand	1
10	128	Denmark	1	32	142	Norway	1
11	939	Estonia	0	33	964	Poland	0
12	163	Euro_Area	1	34	182	Portugal	1
13	172	Finland	1	35	922	Russian Federation	0
14	132	France	1	36	936	Slovak Republic	0
15	134	Germany	1	37	961	Slovenia	0
16	174	Greece	1	38	199	South Africa	0
17	944	Hungary	0	39	184	Spain	1
18	176	Iceland	1	40	144	Sweden	1
19	534	India	0	41	146	Switzerland	1
20	536	Indonesia	0	42	528	Taiwan	0
21	178	Ireland	1	43	112	United Kingdom	1
22	436	Israel	0				

DATA APPENDIX

Interest rate (i): three-month interbank rate or treasury bill yields, extracted from the OECD Database.

Exchange rate (s): the value of the dollar in terms of local currency, extracted from the IMF International Financial Statistics. Originally quarterly.

Inflation rate (π): annualized rate of quarter-to-quarter change in consumer price index (OECD Database).

Financial openness ($KAOPEN$): measure of capital account openness, data from Chinn and Ito (2006, 2008). $KAOPEN$ is the first standardized principal component of the variables that indicates the presence of multiple exchange rates, restrictions on current account transactions, on capital account transactions and the requirement of the surrender of export proceeds. Higher values of this index indicate that a country is more open to cross-border capital transactions.

Legal and institutional development (LEGAL): the first standardized principal component of corruption, law and order, and bureaucratic quality indices drawn from the International Credit Risk Guide.

Government budget surplus (GSUR): central government surplus as a share of GDP. The data is from the IMF World Economic Outlook Database as of October 2022.

Financial development (FD): measures the development of financial markets and financial institutions, as described in Sahay et al. (2015). The index tries to capture not only the size and depth of financial markets, but also the quality of financial markets with higher levels of diversity (breadth), liquidity and efficiency. For more details, refer to https://data.imf.org/?sk=F8032E80-B36C-43B1-AC26-493C5B1CD33B.

Trade openness (OPEN): measured by the sum of exports and imports to GDP. The data is available from the World Bank Global Development Indicators.

Currency, banking, and debt crisis. Originally from Laeven and Valencia (2008, 2012).

Dummy for Fixed Exchange Rate Regime (FIX). This is based on the exchange rate stability (ERS) index in the “trilemma index” introduced by Aizenman et al. (2010). A value of one is assigned when ERS is equal to or above 0.66.

Dummy for Euro member states (EURO): takes the value of one when a country becomes a member of the euro arrangement.

Dummy for EU states (EU): takes the value of one when a country becomes a member of the European Union.

Dummy for CPTPP (CPTPP): stands for the Comprehensive and Progressive Agreement for Trans-Pacific Partnership which is a free trade agreement (FTA) between Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, Peru, New Zealand, Singapore and Vietnam. Australia, Canada, Japan, Mexico, New Zealand and Singapore ratified in 2018, Vietnam in 2019 and Peru in 2021.