What Flows Around Comes Around: A Story of Mean Reversion and Portfolio Flows

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34. Workshop Austrian Working Group on Banking and Finance

November 22, 2019

Motivation

- Stationarity of long-run PPP is a common an assumption, but does it hold in reality?
- If real (effective) exchange rates are stationary, do mean-reversion speeds vary?
- Do portfolio flows influence the speed of mean reversion?

Motivation

- Real effective exchange rates are often used as a measure of a currency's intrinsic value and a country's competitiveness. They are not sensitive to the choice of numeraire (no dollar dependency). ▸ definition
- Many studies in the post-Bretton-Woods era failed to find stationarity in real exchange rates (RER) due to limitations in data and statistical methods. (Adler and Lehman 1983, Taylor and Taylor 2004)
- Dornbusch (1976): PPP is a long-run relationship, in the short run there can be overshooting.
- Combes et al. (2012) show that a 1 percentage point increase in the ratio of portfolio flows to GDP is associated with a 7.8% appreciation of the REER (p.a.).

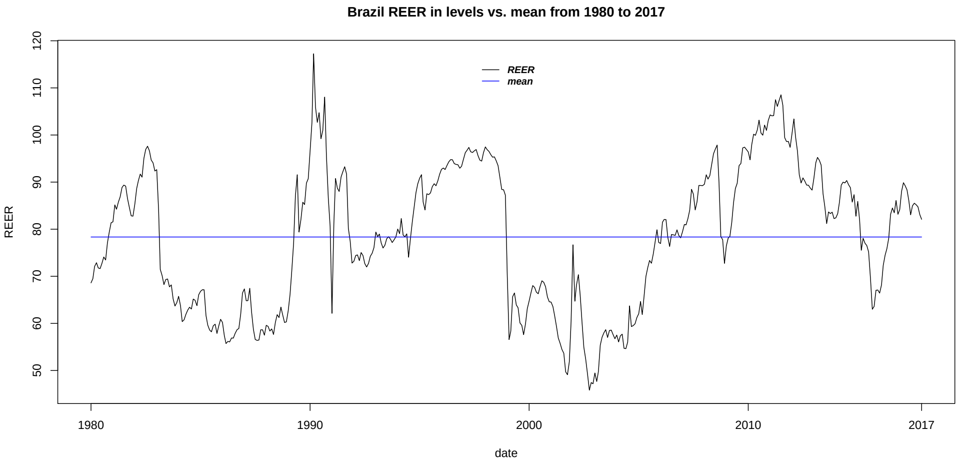
Recap: What exactly is the purchasing power parity puzzle?

- **PPP Puzzle I:** Does the real exchange rate revert to some equilibrium level (implied by the purchasing power parity) or a is it a non-stationary process? (see Taylor et. al 2001 and Taylor and Taylor 2004)
- **PPP Puzzle II:** How to reconcile the extremely high short-term volatility of the real exchange rate with the glacial rate at which deviations to the PPP die out? (1996)

The evolution of testing for stationarity in RER

1. Standard unit root tests, but longer samples (Cheung and Lai 1993, Lothian and Taylor 1996)
2. Longer samples, but panel unit root tests (Taylor and Sarno 1998, Frankel and Rose 1996, Papell and Theodoridis 1998) - still assuming constant dynamics
3. Parametric unit root test with regime switching models, allowing for different speeds of adjustment
4. Non-linear unit root tests using Threshold Autoregressive (TAR) or Smooth Transition Autoregressive (STAR) models, accounting for a "band of inaction"
5. Quantile Autoregression (Koenker et. al. 1994, Koenker and Xiao 2004): allows non-linear mean reversion and asymmetric behavior

Example: Brazil - the REER looks mean reverting



Dataset

- Monthly data on REERs from the IMF's International Financial Statistics (IFS) database including 29 countries from January 1980 to December 2017
- Monthly data on portfolio flows from the Institute of International Finance (IIF) and local central bank statistics (BoP) including 18 countries from January 1995 to December 2017
- Data on control variables like US interest rate, inflation and others from the IMF, FRED St. Louis database, Bloomberg and Global Financial Data

Autoregression

Assuming the log-demeaned REER y_t follows an AR(1) process:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \epsilon_t \tag{1}$$

we get 3 cases

1. if $\alpha_1 > 1$, y_t is explosive
2. if $\alpha_1 = 1$, y_t follows a unit root process
3. if $|\alpha_1| < 1$, y_t is mean reverting

$$\text{deviation half-life:} \quad T_{1/2} = \frac{log\,(0.5)}{|\alpha_1|} \tag{2}$$

Quantile autoregression

We chose the lag-lengths for our QAR models to be equal to one for all countries, since the partial autocorrelation functions cut off after the first lag for practically all countries and comparative reasons. Additionally, computing half-lives in case of a QAR(1) is straightforward. Hence, our estimated model is:

$$\widehat{Q}_{y_t}(\tau|\mathcal{F}_{t-1}) = \widehat{\alpha_0}(\tau) + \widehat{\alpha_1}(\tau)y_{t-1} \tag{3}$$

Testing for stationarity (again)

Koenker and Xiao (2006) suggest the following t_n statistic to investigate y_t at different quantiles τ and for constructing the Quantile Kolmogorov-Smirnov (QKS) test. The formula gives, for any fixed τ, the **quantile regression counterpart of the ADF t-ratio test** for a unit root.

$$t_n^*(\tau) = \frac{f(\widehat{F^{-1}(\tau)})}{\sqrt{\tau(1-\tau)}} \left(Y_{-1}^{*\top} P_X^* Y_{-1}^*\right)^{1/2} \left(\widehat{\alpha_1^*}(\tau) - 1\right) \tag{4}$$

where $f(\widehat{F^{-1}(\tau})$ is a consistent estimator of $f(F^{-1}(\tau)$, f is the density and F the cumulative density function of u_t in (**??**). $Y_{-1}^{*\top}$ is a vector of lagged dependent variables (y_{t-1}) and P_X^* is the projection matrix onto the space orthogonal to $X = (1, \Delta y_{t-1}, \ldots, \Delta y_{t-q})$.

Testing for stationarity - QKS test

To check the unit root hypothesis over a range of quantiles, Koenker and Xiao propose a quantile based Kolmogorov-Smirnov (QKS) test statistic for $\tau \in \mathcal{T}$, given by:

$$QKS_t = \sup_{\tau \in \mathcal{T}} |t_n(\tau)| \tag{5}$$

- limiting distribution of $t_n(\tau)$ and QKS tests are nonstandard
- we apply a bootstrap procedure to get critical values bootstrap

Advantages of the QAR-approach

- This method allows us to check if REER processes are locally and globally mean reverting by comparing the original t_n and QKS test statistics to their bootstrapped distributions.
- We can investigate the corresponding deviation half-lives of equation (2) in a quantile setting by:

$$T_{1/2}(\tau) = \frac{log\,(0.5)}{|\alpha_1(\tau)|} \tag{6}$$

Panel model

Goal: estimate the effect of equity and debt flows on REER changes, depending on the deviation size

$$\Delta REER_{i,t} = \beta_0 + \beta_1 PFE_{i,t} + \beta_2 PFD_{i,t} + \boldsymbol{\Psi} PFE_{i,t} \times QD_{\tau,t,i} + \boldsymbol{\Phi} PFD_{i,t} \times QD_{\tau,t,i} + QD_{\tau,t,i} + \boldsymbol{\delta} X_{i,t} + \alpha_t + \gamma_i + \epsilon_{i,t} \quad (7)$$

with the following additional specifications:

- $\Delta REER_{i,t}$: monthly log changes in country i's REER from time $t-1$ to time t
- $PFE_{i,t}$: The net non-resident equity portfolio flows of country i at time t.
- $PFD_{i,t}$: The net non-resident debt portfolio flows of country i at time t.
- $QD_{\tau,t,i}$: vector of dummies for quintiles. $\tau \in \{0.2, 0.4, 0.6, 0.8\}$

Panel mode - controls and FEs

- $X_{i,t}$: vector of control variables including
  - a CBOE Volatility Index (VIX) at time t
  - c steepness of the US-Yield Curve measured as the difference between the 10-year US-Treasury Bond yield and the 3-month US-Treasury Bill yield
  - d MoM change in consumer price index (CPI) of country i at time t
  - f difference of the 3-month Treasury Bill yield of country i at time t to the 3-month US-Treasury Bill yield at time t
- α_t: time fixed effects for every t
- γ_i: country fixed effects for every i

QAR results for Brazil

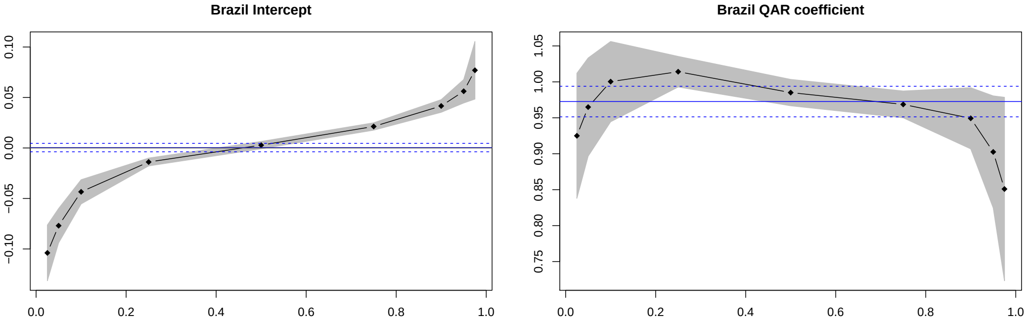


Figure 1: The blue lines show OLS estimates and confidence bands. The shaded grey areas indicate 95% confidence bands obtained by a paired bootstrap with 10.000 replications. $\tau = \{0.025, 0.05, 0.10, 0.25, 0.5, 0.75, 0.90, 0.95, 0.975\}$

QAR results for Brazil (cont'd)

τ	**0.025**	**0.05**	**0.10**	**0.25**	**0.50**	**0.75**	**0.90**	**0.95**	**0.975**
$\alpha_0(\tau)$	-0.1039	-0.0770	-0.0434	-0.0139	0.0028	0.0213	0.0416	0.0562	0.0770
p-value	0.0041***	0.0009***	0.0100**	0.0926*	0.5504	0.0000***	0.0000***	0.0000***	0.0125**
$\alpha_1(\tau)$	0.9250	0.9649	1.0003	1.0141	0.9851	0.9686	0.9493	0.9025	0.8509
p-value	0.1024	0.2665	0.8054	0.9986	0.0523*	0.0063***	0.0095***	0.0015***	0.0132**
Half-life	8.8913	19.4007	∞	∞	46.1128	21.7491	13.3215	6.7593	4.294
QKS/*p*-value	3.7067/0.0198**								

Note: All *p*-values in this table are computed from the first bootstrap block using 10.000 replications. For $\alpha_0(\tau)$ we test the null hypothesis that the intercept equals zero with a student-t test. For $\alpha_1(\tau)$ we test for the null of a unit root with the Koenker-Xiao test using the t_n statistic. The Quantile Kolmogorov-Smirnov (QKS) test result equals the highest value of t_n over all quantiles. Its *p*-value is obtained from the empirical distribution function of QKS values. The symbols $*$, $**$ and $***$ denote rejection of the null at the 10%, 5% and 1% significance levels, respectively.

QAR block bootstrap results for several countries

Country	Block	QKS	p-value	5% crit. value	10% crit. value	$H_0 : \alpha_{1,t} = 1$
Belgium	6	3.4985	0.0340	3.1882	2.6386	reject at 5%
	8	3.4985	0.0326	3.1220	2.5838	reject at 5%
	10	3.4985	0.0285	3.0686	2.5101	reject at 5%
Brazil	6	3.7067	0.0198	2.9539	2.4203	reject at 5%
	8	3.7067	0.0206	3.0453	2.4783	reject at 5%
	10	3.7067	0.0251	3.1297	2.5753	reject at 5%
Bulgaria	6	8.8751	0.0527	9.0636	7.0122	reject at 10%
	8	8.8751	0.0616	9.4874	7.2912	reject at 10%
	10	8.8751	0.0813	10.9558	8.0596	reject at 10%
Canada	6	2.1896	0.3779	4.6803	3.8493	do not reject at 10%
	8	2.1896	0.3857	4.7878	3.8999	do not reject at 10%
	10	2.1896	0.3698	4.6618	3.8137	do not reject at 10%
Chile	6	4.3294	0.0829	5.0038	4.0642	reject at 10%
	8	4.3294	0.0946	5.2271	4.2644	reject at 10%
	10	4.3294	0.1046	5.4731	4.3988	do not reject at 10%

Note: All *p*-values are computed using a block bootstrap algorithm with 10.000 replications. The same holds for p-values, 5% and 10% critical values. For $\alpha_1(\tau)$ we test for the null of a unit root with the t_n statistic. The Quantile Kolmogorov-Smirnov (QKS) test result equals the highest value of t_n over all quantiles. Its *p*-value is obtained from the empirical distribution function of QKS values. The symbols $*$, $**$ and $***$ denote rejection of the null at the 10%, 5% and 1% significance levels, respectively.

QAR interim results

Our quantile autoregression analysis suggests the following:

- 13 out of the 29 countries show mean reversion at least at the 10% significance level.
- mean reversion speed differs with REER shock size.
- in the extreme quantiles half lives are as short as a few months.
- several countries show asymmetries in the mean reversion process.
- countries that show no mean reversion are often part of a currency union, or have been known to show persistent deviations for several years (e.g. Japan).

Table 7.2 equity and debt flows and the REER changes

	Dependent variable: $\ln(REER_t) - \ln(REER_{t-1})$			
	All countries		Low-income countries	
	(3)	(4)	(7)	(8)
Equity PF	-0.069	0.881	-0.148	2.490
	(0.18)	(1.11)	(0.24)	(1.92)*
Equity PF × Q20%		-0.996		-3.927
		(1.29)		(2.09)*
Equity PF × Q40%		-1.443		-2.455
		(1.50)		(2.00)*
Equity PF × Q80%		-0.644		-1.950
		(0.98)		(1.63)
Equity PF × Q100%		-0.912		-2.923
		(1.07)		(1.99)*
Debt PF	0.095	0.223	0.336	0.053
	(1.04)	(0.64)	(1.70)	(0.07)
Debt PF × Q20%		-0.138		1.728
		(0.39)		(1.63)
Debt PF × Q40%		-0.100		0.191
		(0.23)		(0.21)
Debt PF × Q80%		-0.345		0.011
		(1.02)		(0.02)
Debt PF × Q100%		-0.137		-0.275
		0.31		(0.31)
Q20%		-0.006		-0.012
		(2.14)**		(3.82)***
Q40%		-0.003		-0.005
		(1.67)		(1.89)*
Q80%		0.001		0.004
		(0.81)		(1.71)
Q100%		0.004		0.007
		(2.43)**		(3.06)**
Inflation	0.415	0.450	0.326	0.430
	(4.48)***	(4.76)***	(3.08)**	(3.30)***
T-Bill yield	0.023	0.011	0.096	0.115
	(1.13)	(0.50)	(1.98)*	(1.89)*
US yield curve	-37.108	-35.397	-0.818	-2.704
	(1.55)	(1.46)	(0.49)	(1.40)
Volatility index	0.025	0.024	-0.049	-0.050
	(1.60)	(1.51)	(1.09)	(1.06)
Time fixed effects	*incl.*	*incl.*	*incl.*	*incl.*
Country fixed effects	*incl.*	*incl.*	*incl.*	*incl.*
Observations	2,739	2,739	1,512	1,512
R^2	0.155	0.159	0.288	0.303

Panel - interim results

- Portfolio flows have a significant negative effect on the deviation of the REER from its long run equilibrium
- In the lowest quintile a 1% increase in debt flows leads to an increase of about 1.78% in monthly REER changes.
- The effect of equity portfolio flows on the REER deviation is not significant.
- When a shock happens to the REER that deviates from its long run equilibrium, international investors buy debt securities and the REER reverts back to its long run equilibrium.

Conclusion (I/II)

Concerning the mean reversion effects, we find that:

- 13 out of 29 countries show mean reversion at least at the 10%-level, while traditional tests fail to provide evidence for stationarity (ADF, DF-GLS)
- mean reversion speed differs with REER shock size
- in the extreme quantiles half lives are as short as a few months
- several countries show asymmetries in the mean reversion process
- countries that show no mean reversion are often part of a currency union or have been known to show persistent deviations (Japan)

Conclusion (II/II)

Regarding the effect of portfolio flows (equity & debt flows) we find that:

- portfolio flows have a statistically significant effect on REER changes in low-income countries (but not in developed countries)
- a negative shock on top of a large deviation leads to high portfolio inflows which in turn lead to an appreciation in REER
- while equity flows do not matter, debt flows do have a significant effect on REER changes

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Journal of Banking & Finance

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How are real effective exchange rates constructed?

$$REER_i = NEER_i \times \prod_{j=1}^{n} \left(\frac{CPI_i}{CPI_j} \right)^{w_j} \text{ with : } \quad NEER_i = \prod_{j=1}^{n} (NBER)^{w_j} \qquad (8)$$

- $REER_i$, $NEER_i$ and $NBER_i$ represent the real effective, nominal effective and nominal bilateral exchange rate, quoted indirectly, of country i with respect to the currencies of countries $j \in \{1, \ldots, n \mid j \neq i\}$.
- CPI_i and CPI_j are the consumer price indices of country i and j
- w_j denotes trade weight of country j.
- The conditions $w_j > 0$ and $\sum_{j=1}^{n} w_j = 1$ have to hold.

back

Appendix: REER summary statistics

Country	N	Mean	Min.	Max.	Std. Dev.	Skew	Kurt.	JB.	p-val
Belgium	456	98.179	88.7	113.081	4.257	0.2	3.421	6.421**	0.04033
Brazil	456	78.338	45.834	117.242	14.793	-0.082	1.997	19.626***	0.00005
Bulgaria	300	81.254	34.917	105.343	19.779	-0.522	2.036	25.229***	0.00000
Canada	456	90.419	69.647	108.02	10.497	-0.231	1.869	28.353***	0.00000
Chile	456	102.13	75.386	192.255	22.702	2.236	7.99	853.198***	0.00000
China	456	118.521	65.38	277.129	48.476	1.741	4.955	303.06***	0.00000
Colombia	456	93.211	61.262	159.409	24.368	1.115	3.426	97.993***	0.00000
Cote d'Ivoire	456	104.272	66.694	137.116	14.196	0.582	2.58	29.117***	0.00000
Czech Republic	336	76.175	36.246	109.361	19.421	-0.235	1.768	24.349***	0.00001
France	456	101.103	91.04	115.773	4.772	0.253	3.267	6.203**	0.04499
Germany	456	102.823	91.98	119.564	5.546	0.604	3.171	28.262***	0.00000
Hungary	327	82.871	51.348	112.932	14.679	-0.212	1.705	25.303***	0.00000
Italy	456	99.353	79.254	119.135	6.727	0.739	3.634	49.093***	0.00000
Japan	456	96.977	65.616	146.891	17.227	0.159	2.362	9.653***	0.00801
Malaysia	456	115.806	84.414	184.727	26.362	1.093	3.08	90.957***	0.00000

Appendix: REER summary statistics (cont'd)

Country	N	Mean	Min.	Max.	Std. Dev.	Skew	Kurt.	JB.	p-val
Mexico	456	98.73	61.439	140.566	15.218	-0.111	3.031	0.957	0.61983
Netherlands	456	97.36	87.425	106.079	3.592	-0.233	2.511	8.663**	0.01315
Nigeria	456	153.514	43.56	600.469	121.302	1.716	5.231	318.488***	0.00000
Philippines	456	100.39	72.956	134.7	13.833	0.218	2.373	11.091***	0.00390
Poland	327	86.731	40.499	119.451	14.91	-0.788	3.023	33.852***	0.00000
Singapore	456	99.402	81.81	114.907	8.194	-0.083	2.091	16.203***	0.00030
South Africa	456	104.797	61.07	171.058	24.32	0.887	3.36	62.195***	0.00000
Sweden	456	114.432	88.549	148.228	14.628	0.524	2.414	27.392***	0.00000
Switzerland	456	94.456	78.015	120.921	8.243	0.746	2.963	42.339***	0.00000
Ukraine	301	101.786	45.155	235.356	24.475	2.195	11.821	1217.383***	0.00000
United Kingdom	456	116.1	92.572	148.36	10.848	0.082	2.608	3.44	0.17904
United States	456	111.358	92.521	157.199	12.546	1.211	4.338	145.414***	0.00000
Uruguay	456	83.076	48.552	130.26	20.279	0.235	2.246	14.997***	0.00055
Zambia	360	74.848	36.576	120.22	21.521	0.216	1.599	32.236***	0.00000

Obtaining critical values using resampling in 4 Steps

1. Let $w_t = \Delta y_t, t = (2, \ldots, n)$, fit the q-th order autoregression by OLS: $w_t = \sum_{j=1}^{q} \hat{\beta} w_{t-j} + \hat{u}_t, t = q+1, \ldots, n$, and obtain $\hat{\beta}_1, \ldots, \hat{\beta}_q$ and the residuals $\hat{u}_t$.
2. Draw i.i.d. variables $\{u_t^\star\}_{t=q+1}^{n}$ from the centered residuals $\hat{u}_t - \frac{1}{n-q} \sum_{j=q+1}^{n} \hat{u}_j$ and generate a new process $w_t^\star$ from $u_t^\star$ using the fitted autoregression from step 1:

$$w_t^\star = \sum_{j=1}^{n} \hat{\beta}_j w_{t-j}^\star + u_t^\star$$

back

Obtaining critical values using resampling (cont'd)

3. Generate $y_t^\star$ under the null restriction of a unit root, such that $y_t^\star = y_{t-1}^\star + w_t^\star$ with starting point $y_1^\star = y_1$
4. Estimate the p-th order QAR(p) model:

$$y_t^\star = \alpha_0 + \alpha_1 y_{t-1}^\star + \sum_{j=1}^{q} \alpha_{j+1} \Delta y_{t-j}^\star + u_t$$

set $\alpha_1(\tau)$ to $\hat{\alpha}_1^\star(\tau)$ and construct $t_n^\star(\tau)$ as in (4). The limiting null distribution is then obtained by repeating steps 2 to 4 many times.

Table 5.1 Portfolio flows and REER deviations

	Dependent variable: ln(REER) - ln($REER_{MA60m}$)			
	All countries		Low-income countries	
	(1)	(2)	(5)	(6)
Portfolio Flows (PF)	-0.109	-1.710	0.430	-2.949
	(0.30)	(1.08)	(0.75)	(2.54)**
PF × Q20%		1.822		3.903
		(1.18)		(3.04)**
PF × Q40%		1.076		4.163
		(0.65)		(2.70)**
PF × Q80%		0.099		2.972
		(0.08)		(1.98)*
PF × Q100%		-0.312		2.280
		(0.15)		(1.12)
Q20%		-0.131		-0.220
		(4.53)***		(8.08)***
Q40%		-0.061		-0.090
		(2.33)**		(2.76)**
Q80%		0.024		0.056
		(2.04)*		(2.66)**
Q100%		0.113		0.130
		(5.18)***		(9.16)***
Inflation	-2.997	-2.089	-3.519	-2.024
	(3.70)***	(3.36)***	(3.87)***	(2.93)**
T-Bill yield	0.171	-0.105	-0.319	0.150
	(0.46)	(0.59)	(0.57)	(0.55)
US yield curve	-15.645	19.375	35.888	-6.594
	(0.55)	(0.63)	(1.86)*	(0.51)
Volatility index	0.008	-0.012	-0.083	-0.016
	(0.41)	(0.60)	(1.62)	(0.46)
Time fixed effects	*incl.*	*incl.*	*incl.*	*incl.*
Country fixed effects	*incl.*	*incl.*	*incl.*	*incl.*
Observations	2,739	2,739	1,512	1,512
R^2	0.261	0.485	0.421	0.554

Table 5.2 Equity and debt flows and REER deviations

	Dependent variable: ln(REER) - ln($REER_{MA60m}$)			
	All countries		Low-income countries	
	(3)	(4)	(7)	(8)
Equity PF	-0.119	0.198	1.379	-1.010
	(0.08)	(0.12)	(0.72)	(0.29)
Equity PF × Q20%		-0.106		0.280
		(0.07)		(0.07)
Equity PF × Q40%		0.261		6.115
		(0.10)		(1.18)
Equity PF × Q80%		1.695		1.711
		(0.44)		(1.76)
Equity PF × Q100%		-2.817		-3.230
		(0.74)		(0.70)
Debt PF	-0.108	-2.052	0.299	-3.223
	(0.37)	(1.15)	(0.50)	(2.52)**
Debt PF × Q20%		2.165		5.019
		(1.26)		(3.00)**
Debt PF × Q40%		1.307		3.904
		(0.71)		(1.95)*
Debt PF × Q80%		0.0244		2.477
		(0.02)		(1.49)
Debt PF × Q100%		0.103		2.786
		0.04		(1.26)
Q20%		-0.131		-0.218
		(4.58)***		(8.05)***
Q40%		-0.062		-0.091
		(2.38)**		(2.83)**
Q80%		0.024		0.052
		(2.11)**		(2.46)**
Q100%		0.113		0.131
		(5.18)***		(8.94)***
Inflation	-2.996	-2.09	-3.516	-1.977
	(3.67)***	(3.31)***	(3.87)***	(2.90)**
T-Bill yield	0.171	-0.107	-0.315	0.135
	(0.46)	(0.61)	(0.56)	(0.50)
US yield curve	-15.716	22.413	35.919	-7.073
	(0.59)	(0.74)	(1.86)*	(0.55)
Volatility index	0.008	-0.014	-0.079	-0.016
	(0.45)	(0.71)	(1.52)	(0.40)
Time fixed effects	*incl.*	*incl.*	*incl.*	*incl.*
Country fixed effects	*incl.*	*incl.*	*incl.*	*incl.*
Observations	2,739	2,739	1,512	1,512
R^2	0.261	0.486	0.421	0.558

Table 6
Wald tests of the deviation from the moving average regressions.

	All countries			Low-income countries		
	Total PF	Equity PF	Debt PF	Total PF	Equity PF	Debt PF
Q20%	0.93	0.01	1.14	4.80	0.07	4.62
	(0.414)	(0.988)	(0.343)	(0.032)**	(0.931)	(0.035)**
Q40%	0.78	0.02	0.90	3.98	0.97	3.43
	(0.476)	(0.981)	(0.423)	(0.050)**	(0.409)	(0.070)*
Q60%	1.08	0.12	1.15	2.54	0.29	2.52
	(0.295)	(0.907)	(0.267)	(0.027)**	(0.774)	(0.029)**
Q80%	1.16	0.16	1.34	3.30	3.12	3.52
	(0.336)	(0.850)	(0.288)	(0.076)*	(0.084)*	(0.066)*
Q100%	1.31	0.29	1.14	3.93	0.58	4.37
	(0.295)	(0.749)	(0.344)	(0.051)*	(0.574)	(0.040)**

Note: Numbers reported here are F-statistics of Wald tests using the regression estimates from columns (2), (4), (5) and (8) of tables 5.1 and 5.2. Numbers in parentheses are the corresponding *p*-values. The tests were conducted once for the entire sample of countries and once for the sub-sample of low-income countries only (defined as all non-G10 countries in the sample). The null hypotheses of the Wald tests are that the coefficients are simultaneously zero, i.e. portfolio flows do not differ across different REER quintiles. If the null hypothesis is rejected for a given quintile, we can conclude that significant portfolio flows occur in times of certain magnitudes in REER deviations (quintiles). Thus, the size of the current deviation matters for the size of portfolio flows. The symbols $*$, $**$ and $***$ denote rejection of the null at the 10%, 5% and 1% significance levels, respectively.

Table 7.1 Portfolio flows and REER changes

	Dependent variable: $\ln(REER_t) - \ln(REER_{t-1})$			
	All countries		Low-income countries	
	(1)	(2)	(5)	(6)
Portfolio Flows (PF)	0.081	0.325	0.277	0.411
	(1.06)	(0.97)	(2.07)*	(0.66)
PF × Q20%		-0.256		0.475
		(0.77)		(0.65)
PF × Q40%		-0.262		-0.190
		(0.70)		(0.25)
PF × Q80%		-0.402		-0.324
		(1.31)		(0.53)
PF × Q100%		-0.247		-0.624
		(0.56)		(0.83)
Q20%		-0.006		-0.014
		(2.09)*		(3.70)***
Q40%		-0.004		-0.006
		(1.57)		(1.98)*
Q80%		0.001		0.004
		(0.77)		(1.78)
Q100%		0.003		0.007
		(2.37)**		(2.63)*
Inflation	0.413	0.448	0.327	0.421
	(4.45)***	(4.76)***	(3.10)***	(3.45)***
T-Bill yield	0.023	0.011	0.097	0.126
	(1.13)	(0.50)	(1.96)*	(1.96)*
US yield curve	-36.057	-34.329	-0.804	-3.269
	(1.55)	(1.46)	(0.49)*	(1.65)
Volatility index	0.024	0.023	-0.048	-0.043
	(1.61)	(1.52)	(1.15)	(1.11)
Time fixed effects	*incl.*	*incl.*	*incl.*	*incl.*
Country fixed effects	*incl.*	*incl.*	*incl.*	*incl.*
Observations	2,739	2,739	1,512	1,512
R^2	0.155	0.158	0.286	0.292

Table 8
Wald tests of the change in REER regressions.

	All countries			Low-income countries		
	Total PF	Equity PF	Debt PF	Total PF	Equity PF	Debt PF
Q20%	0.88	0.85	0.64	9.78	2.19	3.87
	(0.431)	(0.446)	(0.538)	(0.004)***	(0.158)	(0.053)*
Q40%	0.67	1.25	0.54	0.77	2.00	0.49
	(0.524)	(0.311)	(0.590)	(0.485)	(0.182)	(0.624)
Q60%	0.97	1.11	0.64	0.66	1.92	0.07
	(0.345)	(0.284)	(0.529)	(0.524)	(0.081)*	(0.947)
Q80%	1.22	0.63	0.89	0.28	1.90	0.07
	(0.319)	(0.544)	(0.430)	(0.763)	(0.195)	(0.934)
Q100%	0.77	0.69	0.38	0.35	2.11	0.15
	(0.480)	(0.514)	(0.687)	(0.714)	(0.168)	(0.862)

Note:Numbers reported here are F-statistics of Wald tests using the regression estimates from columns (2), (4), (5) and (8) of tables 7.1 and 7.2. Numbers in parentheses are the corresponding p-values. The tests were conducted once for the entire sample of countries and once for the sub-sample of low-income countries only (defined as all non-G10 countries in the sample). The null hypotheses of the Wald tests are that the coefficients are simultaneously zero, i.e. portfolio flows do not differ across different REER quintiles. If the null hypothesis is rejected for a given quintile, we can conclude that significant portfolio flows occur in times of certain magnitudes in REER deviations (quintiles). Thus, the size of the current deviation matters for the size of portfolio flows. The symbols $*$, $**$ and $***$ denote rejection of the null at the 10%, 5% and 1% significance levels, respectively.