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Exchange rate pass-through: What has changed since the crisis?[1]

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Abstract

We study how exchange rate pass-through to CPI inflation has changed since the global financial crisis. We have three main findings. First, exchange rate pass-through in emerging economies decreased after the financial crisis, while exchange rate pass-through in advanced economies has remained relatively low and stable over time. Second, we show that the declining pass-through in emerging markets is related to declining inflation. Third, we show that it is important to control for non-linearities when estimating exchange rate pass-through. These results hold for both short-run and long-run pass-through and remain robust to extensive changes in the specifications.

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Keywords: Exchange rate pass-through, inflation.

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1. Introduction

Exchange rate pass-through is again at the centre of economic policy and central bank thinking (Forbes, 2014 and 2015). We have to understand how the observed large exchange rate movements translate to consumer price inflation, especially as inflation remains well below central bank targets in many advanced economies. From the perspective of some emerging market economies (EMEs) another question arises on how large exchange rate movements affect inflation, especially when it is already above target. In addition, as Plantin and Shin (2016) find, exchange rate pass-through can affect the financial risk-taking channel of monetary policy.

In this paper we aim to provide an overall picture of how exchange rate pass-through has evolved for both advanced and emerging market economies. We find that exchange rate pass-through in emerging economies on average decreased after the financial crisis, and that this decline in pass-through is linked to declining inflation. By contrast, in advanced economies, where inflation has tended to be consistently low, exchange rate pass-through has also remained low. Yet, in spite of the recent decline in emerging economies, pass-through estimates are still lower in advanced than in emerging economies. The results are consistent with the implications of the menu cost theory of price setting: when inflation is higher, exchange rate changes are passed through more quickly and to a larger extent because firms have to adjust prices frequently anyway (see further Taylor (2000) for a sticky price setup).

We also confirm that the results hold robustly. The pattern of declining pass-through in EMEs and low pass-through in advanced economies holds similarly for contemporaneous (quarterly), yearly and long-run pass-through estimates. This pattern also does not depend on the length of rolling window estimates: 3, 4, 5, 6 and 8-year rolling windows all show the same pattern. The results are also not dependent on the econometric methodology: while our main methodology uses an Arellano and Bover (1995) and Blundell and Bond (1998) type of system GMM panel estimates, the pattern remains under difference GMM and within group estimators. While we control for time fixed effects to ensure that common global shocks do not affect the estimates, the results also hold when dropping these fixed effects and explicitly controlling for the global business cycle or oil prices.

We also find that controlling for non-linear effects of exchange rate movements can be crucial when estimating exchange rate pass-through: as one would expect based on the menu cost theory, larger exchange rate movements have a stronger chance to overcome the menu cost of price changes and thereby are more likely to be passed-through to consumer prices. Hence, naive linear estimates of pass-through would show an increase in emerging markets after the taper tantrum when exchange rate volatility increased sharply. However, we show that this increase disappears when one properly controls for non-linearities.

The contribution of our paper to the literature is threefold. First, we document the overall pattern of more than 20 years of exchange rate pass-through development for a large group of economies. We report that the pass-through has been low and stable in advanced economies, and higher but declining in emerging economies. The advanced economy results extends the link found earlier, for instance, by Engel (2002) and Devereux and Yetman (2008), between low pass-through and low-inflation in advanced economies in the post-crisis dataset. As for the EMEs, our results on declining pass-through extend the earlier finding in Mihaljek and Klau (2008), Aleem and Lahiani (2014) and Lopez-Villavicencio and Mignon (2016) to a more recent period and/or to a larger set of economies. Our finding of a recent decline in linear pass-through slightly contrasts with De Gregorio (2016), who finds that pass-through for large depreciations in the 2008–2015 period was lower than in the 1970s but comparable to the 1990s.[5] These results might be reconciled by the fact that we consider linear pass-through when controlling for non-linearities, while De Gregorio (2016) considers the full effects of large depreciations.

Second, we provide solid empirical evidence for a causal link between lower inflation and lower pass-through in emerging market data, as was proposed in Calvo and Reinhart (2002) and Choudhri and Hakura (2006). Our results can also be seen as extending the analysis of the low inflation – low pass-through link from advanced economies in the 1990s of Takhtamanova (2010) to emerging markets in the 2000s.

Third, we provide evidence that larger exchange rate movements lead to disproportionally larger price changes. Therefore, it is useful to control for non-linearities when estimating pass-through, especially when exchange rate volatility is changing in the sample period. One crucial example is the post taper-tantrum period when exchange rate volatility increased – and the inclusion of such periods in a naïve linear setup can misleadingly suggest an increase in pass-through. This result confirms the findings in Bussière (2013), Cheikh and Rault (2015) and Alvarez et al. (2016) of the relevance of non-linearity and provides additional support to control for non-linearities to exclude the possibility that linear pass-through estimates pick up changes in exchange rate volatility. This result is also consistent with evidence in Kohlscheen (2010) and Campa and Goldberg (2005) that pass-through to consumer prices and import prices, respectively, is higher for countries with greater nominal exchange rate volatilities.

Furthermore, the results also have policy relevance when thinking about changing global conditions for monetary and economic policy setting. The average low pass-through levels today imply that central banks in general should have less "fear of floating", at least from an inflation perspective. Yet, the lower pass-through in emerging markets also implies that the exchange rate channel of monetary policy might be less effective to affect inflation than before the financial crisis. Finally, the results further reinforce the importance of price stability by showing that lower inflation also reduces pass-through. In fact, there might be a positive feedback loop: lower pass-through could in turn further contribute to price stability.

However, the results should be read with appropriate caveats. Importantly, our results apply only for groups of countries, and not for individual economies. Hence, our results do not offer direct implications for individual countries Furthermore, our setup is necessarily limited to macroeconomic factors and only captures time invariant microeconomic factors, such as pricing power, through country fixed effects. Finally, our approach does not distinguish between exogenous and endogenous exchange rate shocks – and this distinction might matter as Forbes et al. (2015) and Shambaugh (2008) show. However, we mitigate this problem by consistently controlling for global shocks through time fixed effects.

The remainder of the paper is organised as follows. The second section introduces the data. The third section outlines the method and discusses the results. The fourth section presents robustness checks. Finally, the fifth section concludes.

[5] Importantly, we do not exclude the possibility that the link between lower pass-through and lower inflation works through more credible monetary policy, as Gagnon and Ihrig (2004) and Bailliu and Fujii (2004) argued for advanced economies.

2. Data

We analyse quarterly time-series data for 22 emerging[6] and 11 advanced[7] economies over the period 1994 Q1 – 2015 Q4.

We focus on exchange rate pass-through (ERPT) to consumer price inflation. To do so, we use log differences in quarterly seasonally adjusted consumer price indices (CPI) as our dependent variable.

We use several explanatory variables. The exchange rate series are chosen as the BIS nominal effective exchange rate (NEER) broad indices available from 1994 with 2010 as the indices' base year. In the regression analysis we use log differences in the average quarterly NEER indices. In our definition, an increase in the NEER implies an appreciation of the local exchange rate. Later, we also use log differences in average quarterly bilateral US dollar exchange rates.

We also control for the business cycle by including measures of the output gap. The underlying real GDP series are taken from national sources. The output gap is calculated by employing the standard univariate Hodrick-Prescott filtering method with the smoothing parameter λ set to 1600 for all available quarterly GDP data. For the analysis, we use the data starting in 1994 Q1 or later depending on their availability.[8]

In addition, we use control variables for some global factors, namely oil prices and the global output gap. For oil prices we use average quarterly West Texas Intermediate (WTI) crude oil spot prices in US dollars transformed into quarterly log changes. The global output gap is calculated according to the same methodology as the domestic output gap, and is computed from IMF IFS data.

In some specifications, we also include inflation expectations to evaluate the pass-through according to a New-Keynesian Phillips curve setup. The end-year inflation expectations are taken from Consensus Economics. We estimate the expectation series with a quarterly frequency by subtracting realized quarterly inflation from the forecasts (Q2 and Q3), using end-year figures (Q4) or linearly interpolating end-year's estimates (Q1).

Appendix A provides a detailed description of the data including additional information on data availability.

3. Method and results

Benchmark model

We estimate exchange rate pass-through from the following dynamic panel regression with system GMM:

[6] Argentina, Brazil, Chile, China, Colombia, the Czech Republic, Hong Kong SAR, Hungary, India, Indonesia, Israel, Korea, Mexico, Malaysia, Peru, the Philippines, Poland, Russia, Singapore, South Africa, Thailand and Turkey.

[7] Australia, Canada, Denmark, the euro area, Japan, New Zealand, Norway, Sweden, Switzerland, the United Kingdom and the United States.

[8] Data are available since 1995 Q1 for Hungary, Israel and Poland; since 1996 Q1 for Chile and the Czech Republic; since 1996 Q2 for India and since 1998 Q1 for the Philippines.

$$\pi_{it} = \alpha_i + \beta_t + \delta\pi_{it-1} - \sum_{j=0}^{3} \gamma_j \Delta NEER_{it-j} - \sum_{k=0}^{3} \mu_k \Delta NEER_{it-k}^2 - \sum_{l=0}^{3} \nu_l \Delta NEER_{it-l}^3 + \phi y_{it} + \varepsilon_{it} \quad (1)$$

Here, π_{it} denotes log differences in quarterly seasonally adjusted consumer price indices (CPI) in country i in quarter t; y_{it} is the domestic output gap in country i in quarter t; $\Delta NEER_{it}$ is the (change in the log of) the nominal effective exchange rate; α_i are country fixed effects, β_t are time (quarter) fixed effects. The estimation period is Q1 1994 – Q4 2015. To capture any non-linearities in the exchange rate pass-through, we extend the specification to include quadratic and cubic changes in exchange rates. The exchange rate terms are presented with a negative sign given that in the original series local exchange rate depreciation is reflected as a decrease in the NEER. The model works with contemporaneous exchange rate change and three additional lags to capture exchange rate pass-through over the period of one year. Furthermore, the specification also satisfies the optimal lag structure based on Akaike and Bayesian information criteria. We present estimates for advanced and emerging economies separately. We also include country fixed effects to control for unobserved country heterogeneity. Moreover, we include time fixed effects to control for global factors driving inflation.

Our estimation assumes a non-linear structure, since the underlying pass-through process may be non-linear (Bussière, 2013; Cheikh and Rault, 2015). Such non-linearity might arise due to menu costs, ie due to the presence of non-negligible costs of adjusting prices. Firms might prefer to avoid these menu costs when exchange rate moves are small, but could be forced to adjust prices for larger exchange rate movements (Forbes, 2014). Alternatively, firms might absorb small changes in input prices but not large ones. Non-linearities might also be explained by imperfect competition which would lead to observationally similar results.

To estimate equation (1), we use generalized method of moments (GMM) following Arellano and Bover (1995) and Blundell and Bond (1998). This method has been widely used to deal with panel data with endogenous explanatory variables, and in our case it is able to control for common shocks that affect both inflation and exchange rates (Shambaugh, 2008; Forbes, 2015; Aron and Muellbauer, 2014). The benchmark model uses System GMM technique with 3-9 lags of log CPI changes, and 2-8 lags of NEER changes and the output gap as GMM instruments for levels and first differences equations. Later, we repeat the estimates with difference GMM and within group estimators for robustness.

Based on equation (1), we estimate linear contemporaneous, yearly and long-run exchange rate pass-through. Contemporaneous linear exchange rate pass-through is defined as the coefficient on the contemporaneous log change in the NEER in equation (1), ie γ_1. Yearly linear pass-through is the sum of the coefficients on log changes in the NEER over four quarters, ie $\gamma_1 + \gamma_2 + \gamma_3 + \gamma_4$. Linear long-run pass-through is defined as yearly pass-through divided by one minus the coefficient on lagged inflation, ie $(\gamma_1 + \gamma_2 + \gamma_3 + \gamma_4)/(1- \delta)$.

Evolution of pass-through

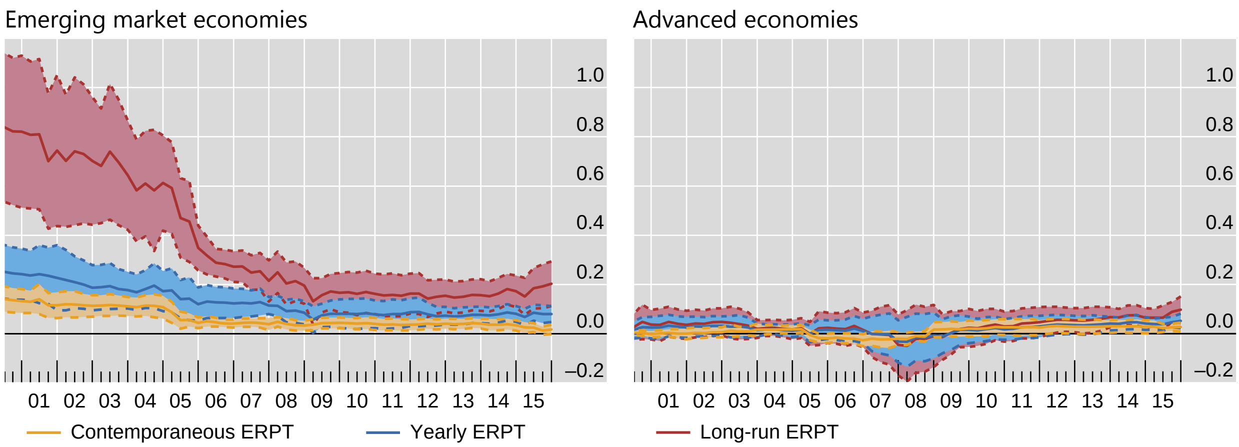
As a first step, we run the benchmark regression (1) on six-year windows to assess the evolution of pass-through over time (Graph 1). We run the regression separately for emerging markets (left-hand panel) and advanced economies (right-hand panel).

For emerging markets (left-hand panel), all three pass-through measures (contemporaneous, yearly and long-run) decline strongly from the pre-crisis levels after the financial crisis. A similar declining pattern also holds when choosing different rolling windows (see Appendix Graph B1).

For advanced economies (right-hand panel) all three pass-through measures (contemporaneous, yearly and long-run) remain relatively stable, at low levels, throughout our estimation period. This results again holds for different rolling windows (see Appendix Graph B2).

Exchange rate pass-through

Six-year rolling windows, based on equation (1) — Graph 1



In order to evaluate whether the decline in pass-through after the financial crisis was indeed significant, we add to the benchmark equation a dummy variable for the post-crisis period. The dummy variable D_t takes the value of one in the post-crisis period (Q3 2009–Q4 2015) and zero in the pre-crisis period (Q1 1994–Q2 2008) – while we omit the volatile crisis years.[9] In sum, we estimate the following equation:

$$\begin{aligned}\pi_{it} = \alpha_i + \beta_t + \delta\pi_{it-1} - \sum_{j=0}^{3}\gamma_j \Delta NEER_{it-j} - \sum_{k=0}^{3}\mu_k \Delta NEER^2_{it-k} \\ - \sum_{l=0}^{3}\nu_l \Delta NEER^3_{it-l} + \phi y_{it} + \delta_D D_t \pi_{it-1} \\ - \sum_{j=0}^{3}\gamma_{jD} D_t \Delta NEER_{it-j} - \sum_{k=0}^{3}\mu_{kD} D_t \Delta NEER^2_{it-k} \\ - \sum_{l=0}^{3}\nu_{lD} D_t \Delta NEER^3_{it-l} + \phi_D D_t y_{it} + \varepsilon_{it}\end{aligned} \tag{2}$$

[9] In the presented specifications we omit the crisis period (Q3 2008–Q2 2009). However, the results are robust to including the crisis years, ie when D_t is set to one for the period Q3 2008-Q4 2015 and zero otherwise. These results are available upon request from the authors.

Table 1 shows that the decrease in linear coefficients of the pass-through in emerging markets after the crisis is statistically significant at the one percent level for all three pass-through measures (contemporaneous, yearly and long-run), see the coefficient estimates of the post-crisis interaction dummy in column (1) of Table 1. By contrast, this pass-through appears to increase slightly, and mostly only at the 10% significance level, in advanced economies in the post-crisis period.

How did the ERPT change in the post-crisis period?

Pass-through coefficients, based on equation (2) Table 1

	Emerging market economies				Advanced economies			
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exchange rate pass-through (pre-crisis):								
Contemporaneous ERPT	0.109***	0.104***	0.105***	0.0908***	0.00469	-0.000156	-0.00261	0.00618
	(0.0265)	(0.0242)	(0.0240)	(0.0236)	(0.00616)	(0.00557)	(0.00774)	(0.00605)
Yearly ERPT	0.200***	0.193***	0.194***	0.198***	0.00573	-0.00569	-0.00967	0.00795
	(0.0539)	(0.0508)	(0.0508)	(0.0504)	(0.00707)	(0.00823)	(0.0130)	(0.0107)
Long-run ERPT	0.670***	0.677***	0.678***	0.497***	0.00855	-0.00806	-0.0140	0.0119
	(0.135)	(0.122)	(0.123)	(0.0982)	(0.0111)	(0.0111)	(0.0177)	(0.0171)
Post-crisis interaction dummy:								
D_t*Contemporaneous ERPT	-0.0896***	-0.0827***	-0.0766***	-0.0746***	0.0218*	0.0246**	0.00559	0.0207*
	(0.0261)	(0.0214)	(0.0202)	(0.0245)	(0.0108)	(0.0110)	(0.0120)	(0.0101)
D_t*Yearly ERPT	-0.118***	-0.127***	-0.108**	-0.120***	0.0460**	0.0605***	0.0465*	0.0445*
	(0.0410)	(0.0384)	(0.0399)	(0.0388)	(0.0206)	(0.0180)	(0.0236)	(0.0216)
D_t*Long-run ERPT	-0.107***	-0.115***	-0.0943**	-0.110***	0.0533*	0.0678***	0.0495*	0.0511*
	(0.0378)	(0.0338)	(0.0338)	(0.0359)	(0.0241)	(0.0206)	(0.0238)	(0.0253)
Exchange rate pass-through (post-crisis):								
Contemporaneous ERPT + D_t*Contemporaneous ERPT	0.0190*	0.0215*	0.0288**	0.0162	0.0265**	0.0244**	0.00299	0.0269***
	(0.0110)	(0.0105)	(0.0108)	(0.0102)	(0.00889)	(0.00886)	(0.0123)	(0.00809)
Yearly ERPT + D_t*Yearly ERPT	0.0820***	0.0661***	0.0853***	0.0781***	0.0518***	0.0549***	0.0368*	0.0524**
	(0.0188)	(0.0171)	(0.0184)	(0.0180)	(0.0153)	(0.0119)	(0.0195)	(0.0169)
Long-run ERPT + D_t*Long-run ERPT	0.209***	0.170***	0.195***	0.160***	0.0970***	0.0915***	0.0585*	0.0972***
	(0.0521)	(0.0479)	(0.0509)	(0.0365)	(0.0279)	(0.0175)	(0.0279)	(0.0278)
Lagged dependent variable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control variables for local factors[a]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control variables for global factors	Time fixed effects	ΔOil prices$_t$	Global output gap$_t$	Time fixed effects	Time fixed effects	ΔOil prices$_t$	Global output gap$_t$	Time fixed effects
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of countries	22	22	22	22	11	11	11	11
Observations	1,721	1,721	1,721	1,721	874	874	858	824
Sargan test[b]	0.985	1	1	0.956	0.0727	0.611	0.573	0.0607
Hansen test[b]	1	1	1	1	1	1	1	1
Serial correlation test[c]	0.517	0.545	0.567	0.423	0.0255	0.0763	0.179	0.0245

Note: System GMM estimation using Arellano and Bover (1995) and Blundell and Bond (1998) dynamic panel estimator. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Full results are reported in Appendix Table B1.

[a] Control variables for local factors includes domestic output gap in all specifications and inflation expectations in specifications (4) and (8). [b] Reports p-values for the null hypothesis that the instruments used are not correlated with the residuals. [c] Reports p-values for the null hypothesis that the errors in the first difference regression exhibit no second order serial correlation.

For all three pass-through horizons, these results are consistent with the results reported in Graph 1. Table 1 shows that pre-crisis, an exchange rate appreciation of 10% in EMEs was associated with an average decrease in consumer prices of around 2% within the same year; post-crisis, a 10% appreciation was associated with a lower decrease in consumer prices of 0.8%. The estimates of Table 1 also demonstrate that the conclusion is robust to different control variables for global factors, namely to using changes in oil prices or the global output gap instead of time fixed effects, see columns (2) and (3). Table 1 also shows that the results are robust to including inflation expectations to evaluate the pass-through according to a New-Keynesian Phillips curve setup (see column (4)).

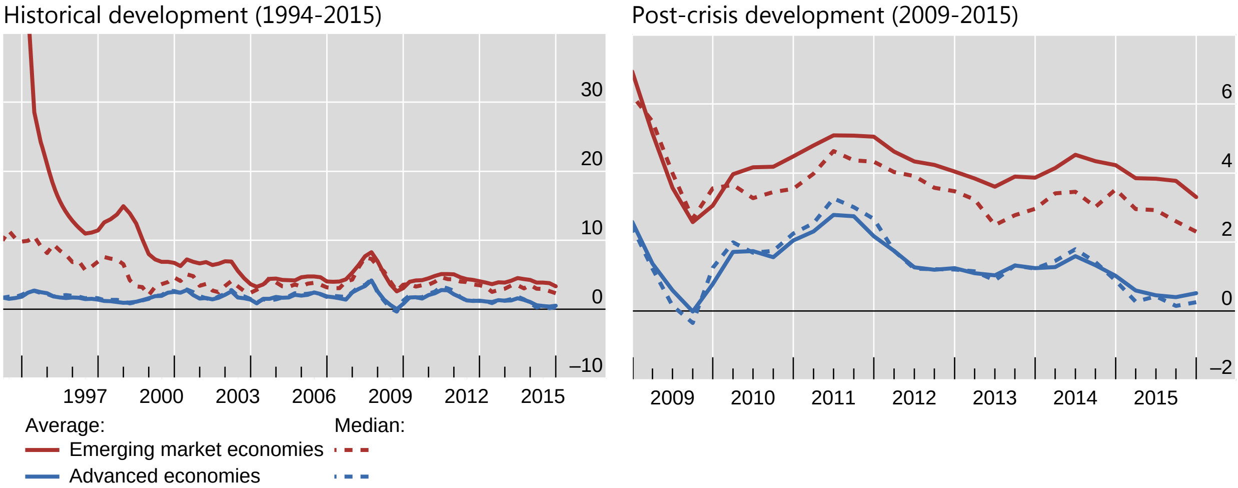
For advanced economies some results seems to suggest an increase in pass-through especially when measured over the one-year or long-run horizons (see columns (5)–(8)). While all pre-crisis pass-through estimates do not appear to be significantly different from zero, we report some positive and statistically significant post-crisis pass-through estimates. Yet, one should be careful when interpreting this: there increase in advanced economies is not robust (as, for instance, the EME post-crisis decline is). Furthermore, the magnitude of decline is also small.

Pass-through and inflation

The large and significant decline in emerging market pass-through requires explanation: what has changed that could account for it? Our hypothesis is that the level of inflation affects the level of pass-through. In terms of the menu cost theory of price setting: when inflation is higher, exchange rate changes are passed through more quickly and to a larger extent because firms have to adjust prices frequently anyway.

Inflation dynamics

Consumer prices, year-on-year changes, in per cent — Graph 2



Sources: national data, authors' calculations.

Indeed, inflation has declined substantially in emerging markets in the years preceding the financial crisis, ie around the time when estimated pass-through fell too (Graph 2). While EME inflation was generally high in the 1990s, it fell rapidly afterwards (red line, left-hand panel). However, in spite of the fall EME inflation levels tended to remain higher than advanced economy levels even after the financial crisis (right-hand panel).

Having seen that average inflation fell around the time when inflation fell, we move to formally test whether lower inflation can indeed explain the decline in pass-through in EMEs. To do so, we add an interaction term for exchange rate movements with a four-quarter lag of inflation, to the original estimated equation (1).

Formally, we estimate the below equation (3).[10]

$$\begin{aligned}\pi_{it} = \alpha_i + \beta_t + \delta\pi_{it-1} - \sum_{j=0}^{3}\gamma_j \Delta NEER_{it-j} \\ - \sum_{k=0}^{3}\mu_k \Delta NEER_{it-k}^2 - \sum_{l=0}^{3}\nu_l \Delta NEER_{it-l}^3 + \phi y_{it} \\ - \sum_{j=0}^{3}\gamma_{j\pi}\pi_{it-4}\Delta NEER_{it-j} - \sum_{k=0}^{3}\mu_{k\pi}\pi_{it-4}\Delta NEER_{it-k}^2 \\ - \sum_{l=0}^{3}\nu_{l\pi}\pi_{it-4}\Delta NEER_{it-l}^3 + \varepsilon_{it}\end{aligned} \tag{3}$$

The results, shown in detail in Table 2, suggest that lower inflation can indeed explain lower pass-through at least at the yearly or long run horizons. This can be seen as the coefficient on the interaction term of linear exchange rate changes with lagged inflation is positive and significant for EMEs at these horizons.

The results provide evidence that lower inflation can induce firms to decide to adjust prices more slowly in response to exchange rate changes, consistent with the existence of menu costs. These results are robust to using changes in oil prices or the global output gap as controls for global factors instead of using time fixed effects (see columns (2) and (3)). The results are also robust to including inflation expectations, with the interaction term for both yearly and long-run pass-through again remaining significant (see column (4)).

The estimated impact of lower inflation on lowering pass-through is also economically significant. The results imply that 1 percentage point lower inflation lowers the long-term average pass-through exchange rate move by around 0.3-0.4 percentage points. This is a sizable impact, as the average pass-through of such a 10 percent exchange rate move is around 2.8 percentage points.

10 The four lag structure ensures that we do not interact contemporaneous inflation and exchange rate terms. However, this is not critical for our results, the results remain robust under fewer lags.

Lower inflation - lower pass-through in emerging markets

Pass-through coefficients, based on equation (3) Table 2

Dependent variable: $Inflation_t$	Emerging market economies				Advanced economies			
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exchange rate pass-through:								
Contemporaneous ERPT	0.0656***	0.0578***	0.0547***	0.0590***	0.00391	0.00487	-0.00054	0.00494
	(0.0161)	(0.0156)	(0.0169)	(0.0115)	(0.00475)	(0.00354)	(0.00737)	(0.00498)
Yearly ERPT	0.119***	0.104***	0.107***	0.121***	0.0167	0.0150*	0.00222	0.0206*
	(0.0268)	(0.0234)	(0.0264)	(0.0245)	(0.00930)	(0.00767)	(0.0124)	(0.0110)
Long-run ERPT	0.276***	0.254***	0.253***	0.233***	0.0259	0.0225	0.00322	0.0316
	(0.0708)	(0.0711)	(0.0754)	(0.0432)	(0.0155)	(0.0129)	(0.0182)	(0.0186)
Inflation interaction:								
$Inflation_{t-4}$* Contemporaneous ERPT	0.677	0.697	0.732	0.602	1.557	1.139	0.0175	1.650
	(0.504)	(0.485)	(0.495)	(0.393)	(1.226)	(0.812)	(1.382)	(1.202)
$Inflation_{t-4}$* Yearly ERPT	1.546*	1.580*	1.635*	1.460**	0.936	0.776	0.253	0.846
	(0.787)	(0.798)	(0.803)	(0.687)	(1.314)	(1.071)	(1.221)	(1.431)
$Inflation_{t-4}$* Long-run ERPT	3.578*	3.862*	3.862*	2.802**	1.454	1.160	0.367	1.297
	(1.283)	(1.336)	(1.308)	(1.058)	(1.895)	(1.489)	(1.741)	(2.085)
Lagged dependent variable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control variables for local factors[a]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control variables for global factors	Time fixed effects	ΔOil $prices_t$	Global output gap_t	Time fixed effects	Time fixed effects	ΔOil $prices_t$	Global output gap_t	Time fixed effects
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of countries	22	22	22	22	11	11	11	11
Observations	1,809	1,809	1,779	1,809	918	918	902	868
Sargan test[b]	0.920	0.998	0.991	0.897	0.229	0.891	0.617	0.221
Hansen test[b]	1	1	1	1	1	1	1	1
Serial correlation test[c]	0.636	0.621	0.737	0.537	0.0566	0.0753	0.627	0.0561

Note: System GMM estimation using Arellano and Bover (1995) and Blundell and Bond (1998) dynamic panel estimator. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Full results are reported in Appendix Table B2.

[a] Control variables for local factors includes domestic output gap in all specifications and inflation expectations in specifications (4) and (8). [b] Reports p-values for the null hypothesis that the instruments used are not correlated with the residuals. [c] Reports p-values for the null hypothesis that the errors in the first difference regression exhibit no second order serial correlation.

Omitting nonlinearity

For comparison, we also present pass-through estimates when omitting the nonlinear terms in equation (1). The aim of the exercise is to demonstrate that omitting these non-linear terms can cause pass-through estimates to pick up the impact of exchange rate volatility. This exercise is very relevant as nonlinear terms are often neglected in the literature.

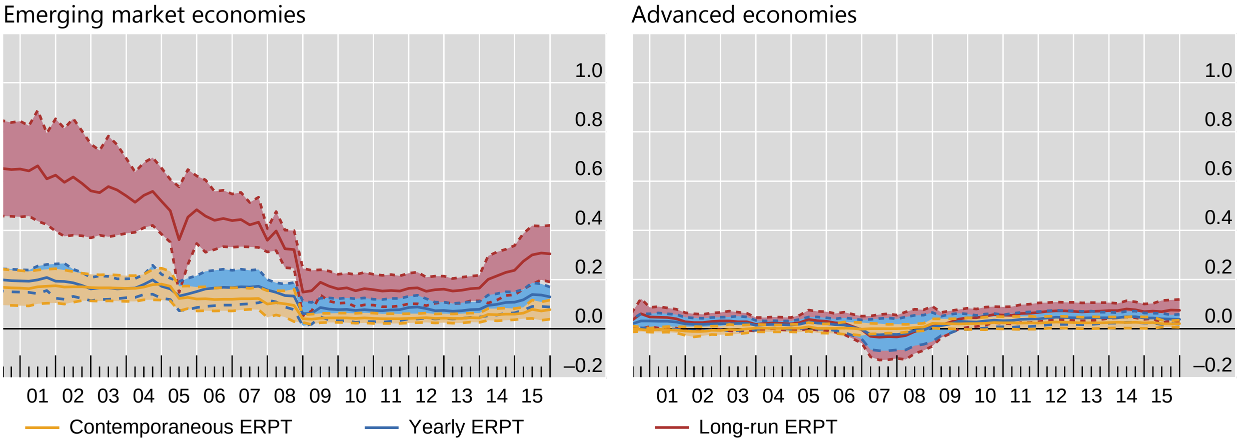
The basic pattern in linear pass-through over time is broadly similar for both emerging markets and advanced economies (Graph 3). Pass-through is declining in emerging markets (left-hand panel), while it remains low and stable in advanced economies (right-hand panel). However, the linear pass-through estimates show a steady increase after mid-2013, ie following tapering of asset purchases by the Federal Reserve and the increase of exchange rate volatility in emerging markets.

These larger exchange rate movements are expected to pass-through more strongly to consumer prices than smaller movements, because they are more likely to overcome the menu costs associated with price changes. Consequently, simple linear pass-through estimates, which ignore these non-linearities, would suggest some increase in pass-through in EMEs after tapering by the Federal Reserve, while such an increase is not visible in the specification that takes non-linearities into account (Graph 1).

Pass-through omitting non-linear terms

Six-year rolling windows, based on equation (1) without non-linear terms

Graph 3



This underlines the importance of controlling for non-linearities. Furthermore, when estimating equation (1), the coefficients on some of the nonlinear terms are significant for EMEs (see Appendix Table B1).

4. Robustness

Next we extend our analysis to check the robustness of the main findings.

First, we change the size of the rolling window from six to eight, five, four and three years in the main specification of equation (1) and report the results in Appendix Graphs B1 and B2. We find that for all horizons (contemporaneous, yearly and long-run) the pattern for EMEs of lower linear pass-through post-crisis is robust to the length of the estimation window, for all the window sizes considered. Similarly, the pattern that the pass-through has been relatively stable in advanced economies in is preserved for different rolling window sizes.

Second, we present the results for equation (3) when using log changes in bilateral exchange rates against the US dollar, instead of in NEERs (Table 3 and Appendix Graph B3). The reason is, as Gopinath (2015) found, that the pass-through might work through the invoicing currency, typically the US dollar (USD), and not through the effective exchange rates. We find that the patterns of the pass-through estimates are roughly similar whether we use changes in the nominal exchange rate or the US dollar bilateral exchange rate, though some of our results are actually stronger when using US dollar bilateral exchange rates. For EMEs, the inflation interaction terms appear somewhat larger and more significant than in case of the NEERs. (see Table 3 and Appendix Table B3). In particular, when using the US dollar bilateral exchange rates, the inflation interaction term also becomes significant for contemporaneous pass-through. Moreover, the coefficients on the inflation interaction terms are slightly larger for yearly and long-run pass-through, and more significant, namely at the 5% level, than when using NEERs.

Lower inflation – lower pass-through with USD bilateral exchange rates

Pass-through coefficients, based on equation (3) Table 3

	Dependent variable: $Inflation_t$			
	Emerging market economies		Advanced economies	
	(1)	(2)	(3)	(4)
Explanatory variables	NEER	Bilateral USD exchange rate	NEER	Bilateral USD exchange rate
Exchange rate pass-through:				
Contemporaneous ERPT	0.0656***	0.0410**	0.00391	0.00576
	(0.0161)	(0.0173)	(0.00475)	(0.00430)
Yearly ERPT	0.119***	0.0841***	0.0167	0.0176**
	(0.0268)	(0.0172)	(0.00930)	(0.00612)
Long-run ERPT	0.276***	0.182***	0.0259	0.0280**
	(0.0708)	(0.0472)	(0.0155)	(0.0113)
Inflation interaction:				
$Inflation_{t-4}$*Contemporaneous ERPT	0.677	0.955*	1.557	0.825
	(0.504)	(0.549)	(1.226)	(0.608)
$Inflation_{t-4}$*Yearly ERPT	1.546*	1.831**	0.936	0.784
	(0.787)	(0.759)	(1.314)	(1.131)
$Inflation_{t-4}$*Long-run ERPT	3.578*	3.969**	1.454	1.248
	(1.283)	(1.113)	(1.895)	(1.639)
Lagged dependent variable	Yes	Yes	Yes	Yes
Control variables for local factors	Domestic output gap	Domestic output gap	Domestic output gap	Domestic output gap
Time fixed effect	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Number of countries	22	22	11	10
Observations	1,809	1,809	918	834
Sargan test[a]	0.920	0.775	0.229	0.190
Hansen test[a]	1	1	1	1
Serial correlation test[b]	0.636	0.660	0.0566	0.0670

Note: System GMM estimation using Arellano and Bover (1995) and Blundell and Bond (1998) dynamic panel estimator. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Full results are reported in Appendix Table B3.

[a] Reports p-values for the null hypothesis that the instruments used are not correlated with the residuals. [b] Reports p-values for the null hypothesis that the errors in the first difference regression exhibit no second order serial correlation.

Third, our results also remain robust to changes in the empirical estimation techniques. While our benchmark specification was system GMM, the results remain materially unchanged when using difference GMM and within group estimators (Table 4). This suggests that the methodological choice is not critical for our results. In all three cases we also test for different lag structures of instrumental variables to confirm that the results do not depend on the instrument lag choice (Table B5 in the appendix). Furthermore, the basic pattern - the post-crisis decrease for EMEs and relative stability of pass-through for advanced economies, remains unchanged for all three pass-through horizons.

Lower inflation – lower pass-through: different methodologies

Pass-through coefficients, based on equation (3) Table 4

	Dependent variable: Inflation_t					
	Emerging market economies			Advanced economies		
	(1)	(2)	(3)	(4)	(5)	(6)
Explanatory variables	System GMM	Difference GMM	Within group estimator	System GMM	Difference GMM	Within group estimator
Exchange rate pass-through:						
Contemporaneous ERPT	0.0656***	0.0565***	0.0567***	0.00391	0.00176	0.00176
	(0.0161)	(0.0144)	(0.0141)	(0.00475)	(0.00446)	(0.00445)
Yearly ERPT	0.119***	0.109***	0.108***	0.0167	0.0296***	0.0296***
	(0.0268)	(0.0234)	(0.0230)	(0.00930)	(0.00806)	(0.00804)
Long-run ERPT	0.276***	0.210***	0.211***	0.0259	0.0350***	0.0350***
	(0.0708)	(0.0490)	(0.0481)	(0.0155)	(0.0106)	(0.0105)
Inflation interaction:						
Inflation_{t-4}*Contemporaneous ERPT	0.677	0.700	0.687	1.557	2.503**	2.503**
	(0.504)	(0.497)	(0.489)	(1.226)	(1.100)	(1.096)
Inflation_{t-4}*Yearly ERPT	1.546*	1.692**	1.670**	0.936	2.065	2.065
	(0.787)	(0.755)	(0.739)	(1.314)	(1.340)	(1.336)
Inflation_{t-4}*Long-run ERPT	3.578*	3.265**	3.247**	1.454	2.438	2.438
	(1.283)	(1.062)	(1.049)	(1.895)	(1.485)	(1.480)
Lagged dependent variable	Yes	Yes	Yes	Yes	Yes	Yes
Control variables for local factors	Domestic output gap	Domestic output gap	Domestic output gap	Domestic output gap	Domestic output gap	Domestic output gap
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of countries	22	22	22	11	11	11
Observations	1,809	1,787	1,809	918	907	918
Sargan test[a]	0.920	0.604		0.229	0.0111	
Hansen test[a]	1	1		1	1	
Serial correlation test[b]	0.636	0.705		0.0566	0.251	
Within R^2			0.814			0.467

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

[a] Reports p-values for the null hypothesis that the instruments used are not correlated with the residuals. [b] Reports p-values for the null hypothesis that the errors in the first difference regression exhibit no second order serial correlation.

Furthermore, we also modify the main specification to allow for asymmetry in pass-through for exchange rate depreciations and appreciations. However, we do not find evidence for consistent asymmetries when estimating the exchange rate pass-through separately for depreciations and appreciations.

Caveats

However, the results should be read with appropriate caveats. Importantly, they apply only for groups of countries, and not for individual economies. In particular, while we see a large drop in pass-through for emerging markets as a group after the financial crisis, some emerging economies could still have experienced stable or even increasing pass-through. Similarly, in spite of the stable average results, different pass-through trends might prevail in some advanced economies.

Furthermore, our setup is limited to macroeconomic factors, while micro-economic factors, such as price competition or pricing-to-market, might also play a role in determining pass-through (Campa and Goldberg, 2005). For instance, the more oligopolistic/less price taking behaviour is the weaker pass-through from input prices (which might be affected by exchange rate movements) to final prices is. However, these concerns are mitigated by the fact that our setup captures the time-invariant microeconomic factors by the country fixed effects. Further mitigation, as Forbes (2015) argues, is that these structural microeconomic differences might matter less than thought earlier: recent pass-through estimates for the United Kingdom do not show much difference between goods with differing import content, or between economic sectors with different tradability or degree of international competition.

Another caveat arises due to new limitations in monetary policy, namely reaching the zero lower bound and in some cases outright negative interest rates. To the degree that this constrains monetary policy, pass-though could be affected. Having said that, this constraint is unlikely to affect our main conclusion: First, there is no such constraint in emerging markets where we see a larger decline in pass-through. Second, pass-through estimates seem to remain low in advanced economies even under low interest rates. Yet, this issue highlights that one should not be complacent about low pass-through in advanced economies: the slight and not very robust increase in pass-through in some of our estimates shown for advanced economies could warrant further investigation and research in light of these policy constraints.

Finally, our approach does not distinguish between exogenous and endogenous exchange rate shocks – and this distinction might matter as Forbes et al. (2015) and Shambaugh (2008) show. However, we consciously control for global factors, either through time fixed effects or explicitly, in order to consistently exclude global shocks.[11] On the one hand, this exclusion of global factors is reassuring: the results are not contaminated by shifting global shocks. On the other hand, this also implies that the inclusion of global shocks could add further dynamics in principle – though our tests suggests that removing the time-fixed effects does not materially affect the main results .[12]

5. Conclusions

We studied how exchange rate pass-through has changed since the global financial crisis. We found that exchange rate pass-through to CPI inflation in emerging economies decreased in the wake of the financial crisis, and that this decline in pass-through in emerging economies is linked to declining inflation. By contrast, exchange rate pass-through in advanced economies has remained relatively stable over time, at a lower level than in emerging economies. These results hold for both short-run and long-run pass-through. The results are found to be robust to a range of controls and specifications.

[11] The dynamic panel estimates in the baseline specification include time fixed effects and thereby the pass-through estimates are derived only from the cross-sectional variation.

[12] We explored this point above by running our specification without time fixed effects for robustness (see columns (2),(3), (6) and (7) of Tables 1 and 2 for robustness).

The results have policy relevance, particularly when assessing broad changes in how exchange rate changes are transmitted to consumer prices in the global economy. Providing such a global context might help thinking about monetary policy in many countries, even if the pass-through estimates are not directly applicable to any individual country. In this regard, the generally low pass-through levels today imply that central banks in general should "fear" less the "floating" of their exchange rates, at least from an inflation perspective. Yet, the lower pass-through in emerging markets also implies that the exchange rate channel of monetary policy might be less effective to affect inflation than before the financial crisis.

Finally, the results further confirm the importance of price stability by showing that lower inflation, among its other benefits, also reduces exchange rate pass-through to consumer prices.

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Appendix A

Data sources

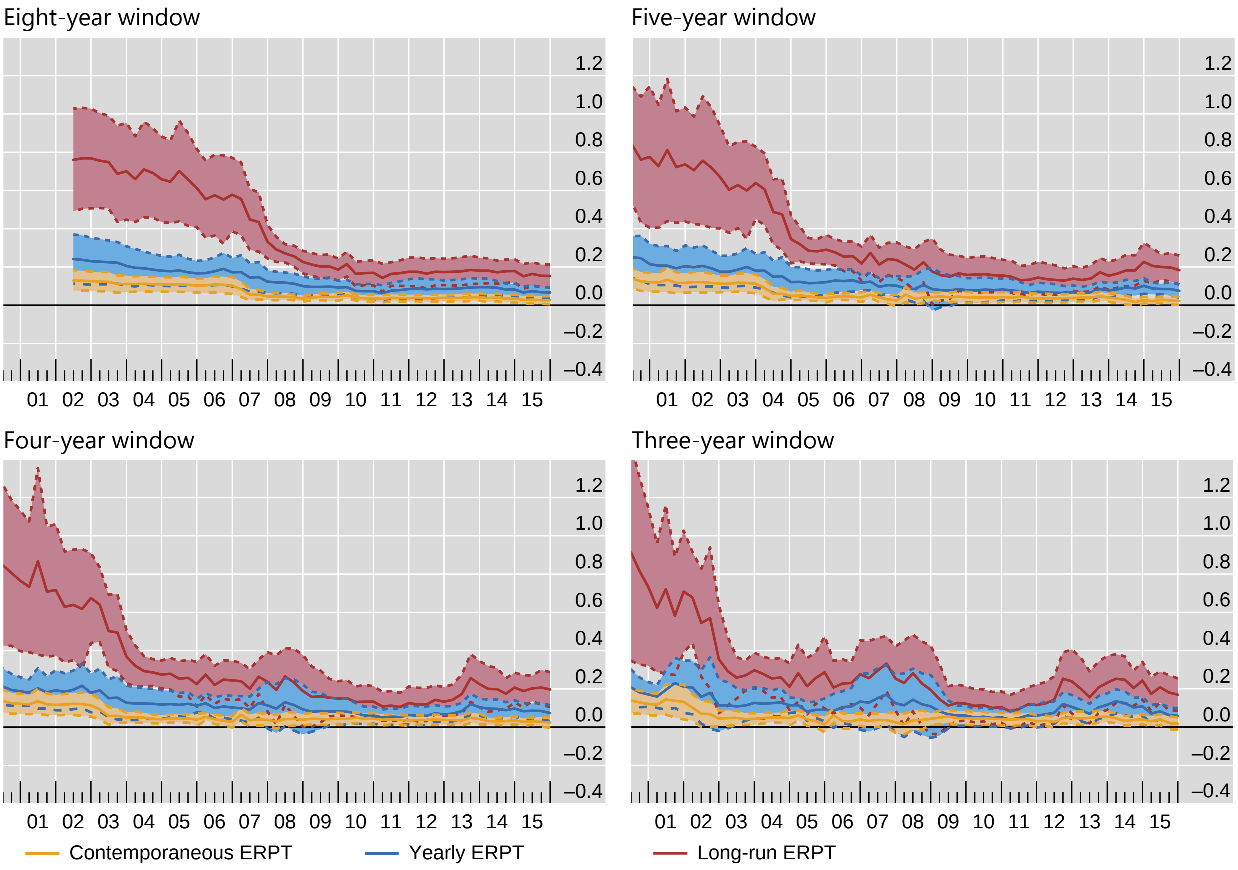
Table A1

Variable	Description	Source
Inflation		
Consumer price index	Quarter-on-quarter log changes, seasonally adjusted.	Datastream National data BIS
Exchange rates		
Nominal effective exchange rate	Nominal effective exchange rate indices are calculated as geometric weighted averages of bilateral exchange rates. Broad indices comprise of 61 economies, with data from 1994. Quarterly averages, quarter-on-quarter log changes.	BIS
Bilateral USD exchange rates	Bilateral US dollar exchange rate against local currency Quarterly averages, quarter-on-quarter log changes.	National data BIS
Control variables for local factors		
Domestic output gap	Standard Hodrick-Prescott filter applied on quarterly real GDP series. GDP in levels; domestic currency units.	National data BIS Authors' calculations
Inflation expectations	Quarter-on-quarter inflation expectations. Data are derived from yearly Consensus surveys' inflation expectations by assuming constant inflation over the coming quarters within the year.	Consensus Economics Datastream National data BIS Authors' calculations
Control variables for global factors		
Oil prices	West Texas Intermediate (WTI) crude oil spot price. Quarterly averages, quarter-on-quarter log changes.	Bloomberg
Global output gap	Standard Hodrick-Prescott filter applied on quarterly real GDP series.	IMF IFS Authors' calculations

Appendix B: Robustness checks

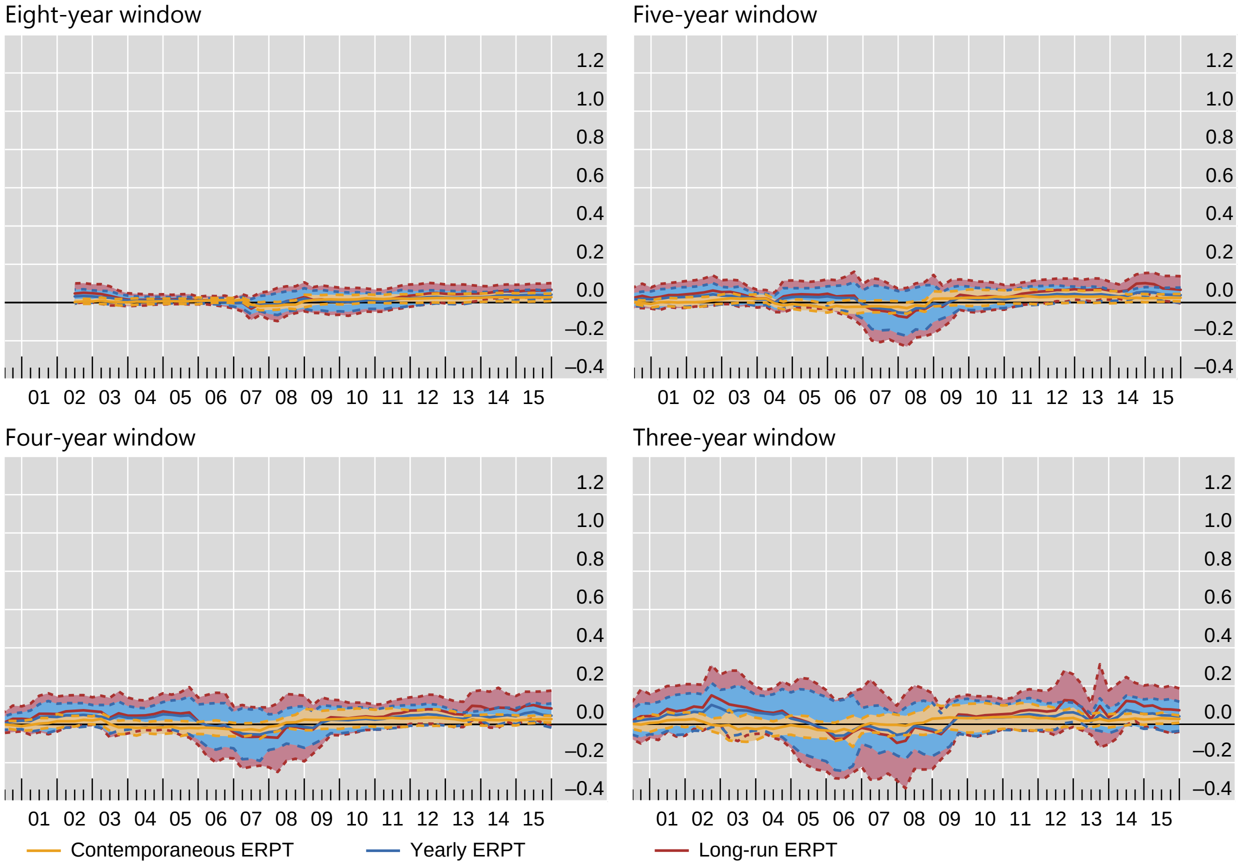
Pass-through to emerging market economies

Baseline specification with different rolling window sizes — Graph B1



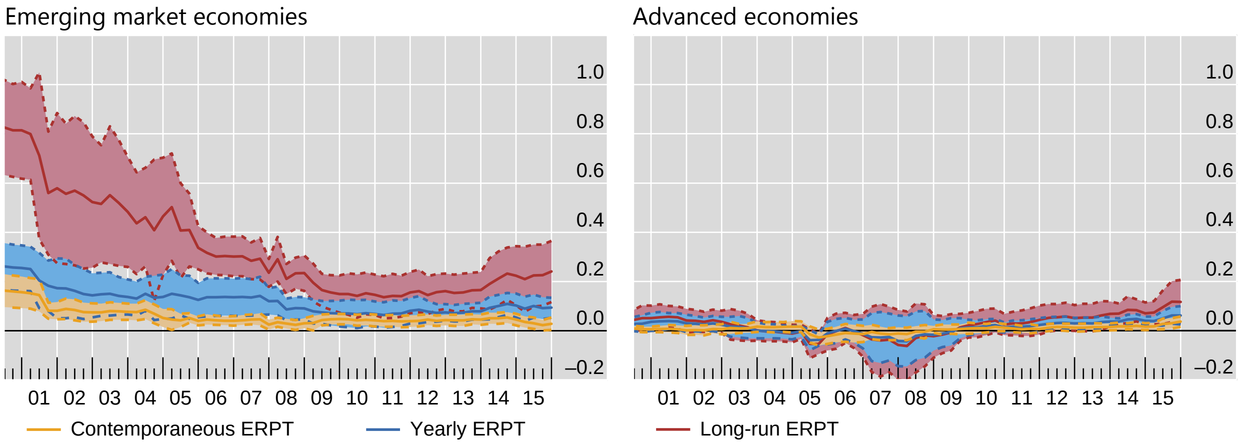
Pass-through to advanced economies

Baseline specification with different rolling window sizes — Graph B2



Pass-through using bilateral USD exchange rate

Six-year rolling windows, based on equation (1) — Graph B3



How did the ERPT change in the post-crisis period?

Full results for Table 1 — Table B1

Dependent variable: $Inflation_t$								
	Emerging market economies				Advanced economies			
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Inflation_{t-1}$	0.702***	0.715***	0.714***	0.601***	0.330***	0.294***	0.311***	0.330***
	(0.0280)	(0.0274)	(0.0269)	(0.0370)	(0.0989)	(0.0828)	(0.0894)	(0.0875)
$\Delta NEER_t$	0.109***	0.104***	0.105***	0.0908***	0.00469	-0.000156	-0.00261	0.00618
=Contemporaneous ERPT	(0.0265)	(0.0242)	(0.0240)	(0.0236)	(0.00616)	(0.00557)	(0.00774)	(0.00605)
$\Delta NEER_{t-1}$	0.0584**	0.0580**	0.0580**	0.0626**	0.00347	0.00270	0.00193	0.00244
	(0.0236)	(0.0250)	(0.0251)	(0.0235)	(0.00989)	(0.00898)	(0.00768)	(0.0106)
$\Delta NEER_{t-2}$	0.00472	0.00283	0.00310	0.00880	0.00131	0.00127	0.00238	0.00185
	(0.0194)	(0.0150)	(0.0150)	(0.0211)	(0.00763)	(0.00685)	(0.00651)	(0.0101)
$\Delta NEER_{t-3}$	0.0278***	0.0278***	0.0273***	0.0361***	-0.00373	-0.00951	-0.0114	-0.00252
	(0.00765)	(0.00758)	(0.00740)	(0.0108)	(0.0106)	(0.00736)	(0.00754)	(0.0110)
$\Delta NEER_t^2$	0.144	0.143	0.151	0.159**	0.0517	-0.100	-0.0892	0.0538
	(0.104)	(0.116)	(0.114)	(0.0760)	(0.170)	(0.138)	(0.189)	(0.181)
$\Delta NEER_{t-1}^2$	-0.0943	-0.0799	-0.0805	-0.0811	-0.0639	-0.0304	0.0145	-0.0795
	(0.121)	(0.131)	(0.131)	(0.109)	(0.403)	(0.294)	(0.270)	(0.394)
$\Delta NEER_{t-2}^2$	0.112	0.123	0.119	0.156**	0.258	0.192	0.173	0.249
	(0.0732)	(0.0746)	(0.0750)	(0.0707)	(0.221)	(0.157)	(0.204)	(0.250)
$\Delta NEER_{t-3}^2$	-0.0120	-0.0118	-0.0139	0.0427	0.0622	0.0924	0.0307	0.0978
	(0.0453)	(0.0425)	(0.0419)	(0.0510)	(0.223)	(0.209)	(0.226)	(0.233)
$\Delta NEER_t^3$	0.295***	0.305***	0.311***	0.320***	-1.576	0.271	0.313	-1.721
	(0.102)	(0.103)	(0.100)	(0.0981)	(0.987)	(1.425)	(1.846)	(0.995)
$\Delta NEER_{t-1}^3$	-0.198	-0.181	-0.184	-0.174	2.681	3.370	2.955	2.837
	(0.169)	(0.183)	(0.182)	(0.156)	(2.548)	(2.024)	(2.027)	(2.753)
$\Delta NEER_{t-2}^3$	0.0652	0.0854	0.0805	0.138	0.00240	0.956	-0.398	0.258
	(0.123)	(0.129)	(0.126)	(0.124)	(1.030)	(1.313)	(1.541)	(1.083)
$\Delta NEER_{t-3}^3$	-0.0392	-0.0385	-0.0389	0.00909	0.996	2.050	1.534	0.848
	(0.0515)	(0.0505)	(0.0497)	(0.0454)	(1.487)	(1.180)	(1.289)	(1.676)
Output gap_t	-0.0104	0.0268	0.00513	0.0199	0.0283*	0.0509***	0.0590***	0.0261
	(0.0363)	(0.0336)	(0.0371)	(0.0241)	(0.0147)	(0.00795)	(0.0157)	(0.0149)
D_t*$Inflation_{t-1}$	-0.0940	-0.105**	-0.151***	-0.0902**	0.137	0.106	0.0601	0.130
	(0.0661)	(0.0453)	(0.0469)	(0.0373)	(0.115)	(0.0722)	(0.0820)	(0.127)
D_t*$\Delta NEER_t$	-0.0896***	-0.0827***	-0.0766***	-0.0746***	0.0218*	0.0246**	0.00559	0.0207*
*=D_t*Contemporaneous ERPT*	(0.0261)	(0.0214)	(0.0202)	(0.0245)	(0.0108)	(0.0110)	(0.0120)	(0.0101)
D_t*$\Delta NEER_{t-1}$	-0.0116	-0.0206	-0.0165	-0.0170	0.0168	0.0165	0.0148	0.0182
	(0.0203)	(0.0213)	(0.0213)	(0.0203)	(0.0137)	(0.0121)	(0.00929)	(0.0148)
D_t*$\Delta NEER_{t-2}$	0.00139	0.00324	0.00515	0.00215	-0.00633	-0.00334	-0.00601	-0.00698
	(0.0214)	(0.0173)	(0.0175)	(0.0220)	(0.0118)	(0.0123)	(0.0127)	(0.0132)
D_t*$\Delta NEER_{t-3}$	-0.0177	-0.0268**	-0.0205*	-0.0308*	0.0138	0.0228**	0.0321**	0.0125
	(0.0109)	(0.00981)	(0.0102)	(0.0151)	(0.0127)	(0.00995)	(0.0115)	(0.0127)
D_t*$\Delta NEER_t^2$	-0.143	-0.159	-0.232	-0.244	0.168	0.331**	0.799***	0.163
	(0.268)	(0.256)	(0.271)	(0.255)	(0.188)	(0.135)	(0.151)	(0.186)
D_t*$\Delta NEER_{t-1}^2$	-0.0520	0.0103	-0.246	-0.0877	-0.178	-0.157	-0.337	-0.167
	(0.178)	(0.176)	(0.232)	(0.147)	(0.367)	(0.369)	(0.308)	(0.375)
D_t*$\Delta NEER_{t-2}^2$	-0.0204	-0.0895	-0.194	-0.0454	-0.309	-0.160	-0.258	-0.303
	(0.142)	(0.121)	(0.135)	(0.131)	(0.278)	(0.183)	(0.244)	(0.295)

Table B1 continued

	Dependent variable: $Inflation_t$							
	Emerging market economies				Advanced economies			
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
D_t*$\Delta NEER_{t-3}^2$	-0.157	-0.278***	-0.330***	-0.139	0.0379	-0.0147	0.0454	0.00464
	(0.117)	(0.0970)	(0.107)	(0.111)	(0.217)	(0.214)	(0.226)	(0.212)
D_t*$\Delta NEER_t^3$	2.811***	2.652***	2.282***	2.398***	0.813	-1.573	3.380	0.902
	(0.364)	(0.362)	(0.258)	(0.292)	(1.884)	(2.513)	(2.812)	(1.847)
D_t*$\Delta NEER_{t-1}^3$	-0.656	-0.231	-1.727**	-0.775	-5.221	-6.421**	-6.418*	-5.422
	(0.447)	(0.430)	(0.740)	(0.489)	(3.559)	(2.715)	(3.034)	(3.549)
D_t*$\Delta NEER_{t-2}^3$	-0.720	-0.874*	-0.957*	-0.855*	-0.103	-0.960	0.0153	-0.304
	(0.530)	(0.478)	(0.512)	(0.496)	(1.856)	(1.812)	(2.357)	(1.842)
D_t*$\Delta NEER_{t-3}^3$	-0.713	-1.059**	-1.209**	-0.433	-0.814	-2.008*	-1.556	-0.668
	(0.482)	(0.491)	(0.579)	(0.477)	(1.412)	(1.094)	(1.310)	(1.586)
D_t*Output gap_t	0.0303	-0.0158	-0.0260	0.000481	-0.0191	-0.0489	-0.100**	-0.0158
	(0.0427)	(0.0374)	(0.0400)	(0.0342)	(0.0453)	(0.0332)	(0.0413)	(0.0449)
ΔOil $prices_t$		0.00718***				0.0123***		
		(0.00201)				(0.00125)		
Global output gap_t			0.123***				0.0207	
			(0.0395)				(0.0243)	
Inflation $expectations_t^{t+1}$				0.165***				0.0157
				(0.0197)				(0.107)
Constant	0.000698	0.00329***	0.00340***	0.000114	0.000913	0.00272***	0.00292***	0.000449
	(0.00191)	(0.000641)	(0.000578)	(0.00171)	(0.000687)	(0.000512)	(0.000523)	(0.00184)
Yearly ERPT	0.200***	0.193***	0.194***	0.198***	0.00573	-0.00569	-0.00967	0.00795
	(0.0539)	(0.0508)	(0.0508)	(0.0504)	(0.00707)	(0.00823)	(0.0130)	(0.0107)
Long-run ERPT	0.670***	0.677***	0.678***	0.497***	0.00855	-0.00806	-0.0140	0.0119
	(0.135)	(0.122)	(0.123)	(0.0982)	(0.0111)	(0.0111)	(0.0177)	(0.0171)
*D_t*Yearly ERPT*	-0.118***	-0.127***	-0.108**	-0.120***	0.0460**	0.0605***	0.0465*	0.0445*
	(0.0410)	(0.0384)	(0.0399)	(0.0388)	(0.0206)	(0.0180)	(0.0236)	(0.0216)
*D_t*Long-run ERPT*	-0.107***	-0.115***	-0.0943**	-0.110***	0.0533*	0.0678***	0.0495*	0.0511*
	(0.0378)	(0.0338)	(0.0338)	(0.0359)	(0.0241)	(0.0206)	(0.0238)	(0.0253)
*Contemporaneous ERPT + D_t*Contemporaneous ERPT*	0.0190*	0.0215*	0.0288**	0.0162	0.0265**	0.0244**	0.00299	0.0269***
	(0.0110)	(0.0105)	(0.0108)	(0.0102)	(0.00889)	(0.00886)	(0.0123)	(0.00809)
*Yearly ERPT + D_t*Yearly ERPT*	0.0820***	0.0661***	0.0853***	0.0781***	0.0518***	0.0549***	0.0368*	0.0524**
	(0.0188)	(0.0171)	(0.0184)	(0.0180)	(0.0153)	(0.0119)	(0.0195)	(0.0169)
*Long-run ERPT + D_t*Long-run ERPT*	0.209***	0.170***	0.195***	0.160***	0.0970***	0.0915***	0.0585*	0.0972***
	(0.0521)	(0.0479)	(0.0509)	(0.0365)	(0.0279)	(0.0175)	(0.0279)	(0.0278)
Observations	1,721	1,721	1,691	1,721	874	874	858	824
Number of countries	22	22	22	22	11	11	11	11
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	No	No	Yes	Yes	No	No	Yes
Sargan test[a]	0.985	1	1	0.956	0.0727	0.611	0.573	0.0607
Hansen test[a]	1	1	1	1	1	1	1	1
Serial correlation test[b]	0.517	0.545	0.567	0.423	0.0255	0.0763	0.179	0.0245

Note: System GMM estimation using Arellano and Bover (1995) and Blundell and Bond (1998) dynamic panel estimator. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

[a] Reports p-values for the null hypothesis that the instruments used are not correlated with the residuals. [b] Reports p-values for the null hypothesis that the errors in the first difference regression exhibit no second order serial correlation.

Can lower inflation explain lower pass-through in EMEs?

Full results for Table 2 — Table B2

Dependent variable: $Inflation_t$								
	Emerging market economies				Advanced economies			
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Inflation_{t-1}$	0.568***	0.591***	0.577***	0.479***	0.356***	0.331***	0.310***	0.347***
	(0.0724)	(0.0713)	(0.0713)	(0.0619)	(0.0844)	(0.0734)	(0.0767)	(0.0691)
$\Delta NEER_t$	0.0656***	0.0578***	0.0547***	0.0590***	0.00391	0.00487	-0.00054	0.00494
=Contemporaneous ERPT	(0.0161)	(0.0156)	(0.0169)	(0.0115)	(0.00475)	(0.00354)	(0.00737)	(0.00498)
$\Delta NEER_{t-1}$	0.0268**	0.0243**	0.0249**	0.0254**	0.0111	0.00868	0.00422	0.0111
	(0.0124)	(0.0112)	(0.0116)	(0.0111)	(0.00738)	(0.00646)	(0.00709)	(0.00722)
$\Delta NEER_{t-2}$	-0.00472	-0.00632	-0.00310	0.00236	0.00312	0.00288	0.000250	0.00484
	(0.0148)	(0.0120)	(0.0123)	(0.0158)	(0.00480)	(0.00275)	(0.00468)	(0.00621)
$\Delta NEER_{t-3}$	0.0316**	0.0283**	0.0304***	0.0346***	-0.00142	-0.00139	-0.00171	-0.00023
	(0.0122)	(0.0110)	(0.0106)	(0.0109)	(0.00382)	(0.00345)	(0.00493)	(0.00370)
$\Delta NEER_t^2$	0.0243	0.0199	0.0322	0.0731	0.0516	0.0770	0.297**	0.0500
	(0.0633)	(0.0638)	(0.0619)	(0.0683)	(0.0538)	(0.0595)	(0.133)	(0.0599)
$\Delta NEER_{t-1}^2$	-0.0972	-0.0750	-0.0823	-0.107	0.00849	0.0297	0.0978	0.00483
	(0.126)	(0.129)	(0.127)	(0.110)	(0.112)	(0.0692)	(0.0652)	(0.103)
$\Delta NEER_{t-2}^2$	0.0858	0.0961	0.0759	0.124	0.0457**	0.0783**	-0.0824	0.0406**
	(0.105)	(0.101)	(0.104)	(0.0941)	(0.0160)	(0.0345)	(0.0580)	(0.0149)
$\Delta NEER_{t-3}^2$	-0.0788	-0.0831	-0.0923	-0.00274	0.0610	0.0140	-0.0338	0.0696
	(0.0597)	(0.0606)	(0.0601)	(0.0628)	(0.0470)	(0.0407)	(0.0490)	(0.0518)
$\Delta NEER_t^3$	0.230**	0.245***	0.262***	0.278**	0.0168	0.0782	0.588	-0.0613
	(0.0958)	(0.0830)	(0.0889)	(0.118)	(0.278)	(0.235)	(0.401)	(0.357)
$\Delta NEER_{t-1}^3$	-0.117	-0.0905	-0.101	-0.122	0.0844	0.0961	0.232	0.0474
	(0.137)	(0.138)	(0.138)	(0.121)	(0.289)	(0.255)	(0.329)	(0.223)
$\Delta NEER_{t-2}^3$	0.0724	0.0912	0.0620	0.137	0.468	0.359	0.214	0.475
	(0.102)	(0.104)	(0.103)	(0.0996)	(0.286)	(0.234)	(0.273)	(0.325)
$\Delta NEER_{t-3}^3$	-0.150**	-0.152**	-0.164**	-0.0481	0.540*	0.655**	0.553**	0.531*
	(0.0714)	(0.0683)	(0.0696)	(0.0732)	(0.269)	(0.246)	(0.240)	(0.287)
Output gap_t	-0.0121	0.0285	0.00566	0.0131	0.0330*	0.0451***	0.0414**	0.0326**
	(0.0277)	(0.0282)	(0.0340)	(0.0180)	(0.0148)	(0.0123)	(0.0172)	(0.0144)
$Inflation_{t-4} * \Delta NEER_t$	0.677	0.697	0.732	0.602	1.557	1.139	0.0175	1.650
*=$Inflation_{t-4}$*Contemp. ERPT*	(0.504)	(0.485)	(0.495)	(0.393)	(1.226)	(0.812)	(1.382)	(1.202)
$Inflation_{t-4} * \Delta NEER_{t-1}$	0.610**	0.620**	0.633**	0.677**	-0.110	0.159	-0.0533	-0.0175
	(0.234)	(0.253)	(0.249)	(0.252)	(0.564)	(0.751)	(0.801)	(0.523)
$Inflation_{t-4} * \Delta NEER_{t-2}$	0.309*	0.312*	0.322*	0.237	-1.029*	-0.555	-0.0121	-1.243**
	(0.175)	(0.171)	(0.175)	(0.154)	(0.554)	(0.485)	(0.744)	(0.500)
$Inflation_{t-4} * \Delta NEER_{t-3}$	-0.0502	-0.0492	-0.0522	-0.0557	0.519	0.0329	0.301	0.457
	(0.0736)	(0.0735)	(0.0753)	(0.0551)	(0.588)	(0.463)	(0.436)	(0.821)
ΔOil $prices_t$		0.0122***				0.0126***		
		(0.00181)				(0.00142)		
Global output gap_t			0.123***				0.0280	
			(0.0423)				(0.0223)	
Inflation $expectations_t^{t+1}$				0.162***				0.0446
				(0.0266)				(0.111)
Constant	0.00691	0.0041***	0.0045***	0.00565	0.00119	0.0028***	0.0031***	0.00105
	(0.00583)	(0.00074)	(0.00075)	(0.00685)	(0.00100)	(0.00058)	(0.00060)	(0.00115)
Yearly ERPT	0.118***	0.103***	0.107***	0.120***	0.0167	0.0150*	0.00222	0.0206*
	(0.0266)	(0.0234)	(0.0264)	(0.0243)	(0.0093)	(0.0077)	(0.0124)	(0.0110)

Table B2 continued

Dependent variable: $Inflation_t$								
	Emerging market economies				Advanced economies			
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Long-run ERPT	0.274***	0.252***	0.252***	0.231***	0.0259	0.0225	0.00322	0.0316
	(0.0702)	(0.0709)	(0.0751)	(0.0429)	(0.0155)	(0.0129)	(0.0182)	(0.0186)
*$Inflation_{t-4}$*Yearly ERPT*	1.550*	1.584*	1.637*	1.464**	0.936	0.776	0.253	0.846
	(0.786)	(0.797)	(0.802)	(0.686)	(1.314)	(1.071)	(1.221)	(1.431)
*$Inflation_{t-4}$*Long-run ERPT*	3.589*	3.873*	3.867*	2.812	1.454	1.160	0.367	1.297
	(1.281)	(1.336)	(1.307)	(1.059)	(1.895)	(1.489)	(1.741)	(2.085)
Observations	1,832	1,832	1,801	1,832	918	918	902	868
Number of countries	23	23	23	23	11	11	11	11
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	No	No	Yes	Yes	No	No	Yes
Sargan test[a]	0.926	0.999	0.992	0.905	0.229	0.891	0.617	0.221
Hansen test[a]	1	1	1	1	1	1	1	1
Serial correlation test[b]	0.635	0.618	0.736	0.536	0.0566	0.0753	0.627	0.0561

Note: System GMM estimation using Arellano and Bover (1995) and Blundell and Bond (1998) dynamic panel estimator. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

[a] Reports p-values for the null hypothesis that the instruments used are not correlated with the residuals. [b] Reports p-values for the null hypothesis that the errors in the first difference regression exhibit no second order serial correlation.

Lower inflation – lower pass-through: NEER vs USD exchange rates

Full results for Table 3 Table B3

Dependent variable: Inflation$_t$				
	Emerging market economies		Advanced economies	
	(1)	(2)	(3)	(4)
Explanatory variables	NEER	Bilateral USD exchange rate	NEER	Bilateral USD exchange rate
Inflation$_{t-1}$	0.568***	0.539***	0.356***	0.372***
	(0.0724)	(0.0695)	(0.0844)	(0.0939)
ΔExchange rate$_t$	0.0656***	0.0410**	0.00391	0.00576
=*Contemporaneous* ERPT	(0.0161)	(0.0173)	(0.00475)	(0.00430)
ΔExchange rate$_{t-1}$	0.0268**	0.0315**	0.0111	0.0103
	(0.0124)	(0.0138)	(0.00738)	(0.00586)
ΔExchange rate$_{t-2}$	-0.00472	-0.0248	0.00312	0.000270
	(0.0148)	(0.0183)	(0.00480)	(0.00547)
ΔExchange rate$_{t-3}$	0.0316**	0.0364**	-0.00142	0.00125
	(0.0122)	(0.0129)	(0.00382)	(0.00423)
ΔExchange rate$_t^2$	0.0243	0.195**	0.0516	0.0294
	(0.0633)	(0.0846)	(0.0538)	(0.0743)
ΔExchange rate$_{t-1}^2$	-0.0972	0.0781	0.00849	0.000712
	(0.126)	(0.0735)	(0.112)	(0.131)
ΔExchange rate$_{t-2}^2$	0.0858	-0.0785	0.0457**	-0.0222
	(0.105)	(0.127)	(0.0160)	(0.0587)
ΔExchange rate$_{t-3}^2$	-0.0788	0.0486	0.0610	-0.0517
	(0.0597)	(0.0548)	(0.0470)	(0.0289)
ΔExchange rate$_t^3$	0.230**	-0.0403	0.0168	-0.104
	(0.0958)	(0.0941)	(0.278)	(0.252)
ΔExchange rate$_{t-1}^3$	-0.117	-0.0312	0.0844	0.0760
	(0.137)	(0.0683)	(0.289)	(0.509)
ΔNEER$_{t-2}^3$	0.0724	0.131	0.468	0.155
	(0.102)	(0.0959)	(0.286)	(0.219)
ΔExchange rate$_{t-3}^3$	-0.150**	-0.199***	0.540*	0.354
	(0.0714)	(0.0573)	(0.269)	(0.223)
Output gap$_t$	-0.0121	-0.00761	0.0330*	0.0347*
	(0.0277)	(0.0242)	(0.0148)	(0.0153)
Inflation$_{t-4}$ *ΔExchange rate$_t$	0.677	0.955*	1.557	0.825
=*Inflation$_{t-4}$*Contemporaneous ERPT*	(0.504)	(0.549)	(1.226)	(0.608)
Inflation$_{t-4}$*ΔExchange rate$_{t-1}$	0.610**	0.435**	-0.110	-0.235
	(0.234)	(0.187)	(0.564)	(0.711)
Inflation$_{t-4}$*ΔExchange rate$_{t-2}$	0.309*	0.442**	-1.029*	-0.258
	(0.175)	(0.159)	(0.554)	(0.341)
Inflation$_{t-4}$*ΔExchange rate$_{t-3}$	-0.0502	-0.000641	0.519	0.453
	(0.0736)	(0.0820)	(0.588)	(0.472)
Constant	0.00691	0.00521*	0.00119	0.000551
	(0.00583)	(0.00293)	(0.000968)	(0.00120)
Yearly ERPT	0.119***	0.0841***	0.0167	0.0176**
	(0.0268)	(0.0172)	(0.00930)	(0.00612)
Long-run ERPT	0.276***	0.182***	0.0259	0.0280**
	(0.0708)	(0.0472)	(0.0155)	(0.0113)

Table B3 continued

Dependent variable: $Inflation_t$				
	Emerging market economies		Advanced economies	
	(1)	(2)	(3)	(4)
Explanatory variables	NEER	Bilateral USD exchange rate	NEER	Bilateral USD exchange rate
*$Inflation_{t-4}$*Yearly ERPT*	1.546*	1.831**	0.936	0.784
	(0.787)	(0.759)	(1.314)	(1.131)
*$Inflation_{t-4}$*Long-run ERPT*	3.578*	3.969**	1.454	1.248
	(1.283)	(1.113)	(1.895)	(1.639)
Observations	1,809	1,809	918	834
Number of countries	22	22	11	10
Country fixed effect	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Sargan test[a]	0.920	0.775	0.229	0.190
Hansen test[a]	1	1	1	1
Serial correlation test[b]	0.636	0.660	0.0566	0.0670

Note: System GMM estimation using Arellano and Bover (1995) and Blundell and Bond (1998) dynamic panel estimator. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

[a] Reports p-values for the null hypothesis that the instruments used are not correlated with the residuals. [b] Reports p-values for the null hypothesis that the errors in the first difference regression exhibit no second order serial correlation.

Lower inflation – lower pass-through: different methodologies

Full results for Table 4 | Table B4

	Dependent variable: $Inflation_t$					
	Emerging market economies			Advanced economies		
	(1)	(2)	(3)	(4)	(5)	(6)
Explanatory variables	System GMM	Difference GMM	Within group estimator	System GMM	Difference GMM	Within group estimator
$Inflation_{t-1}$	0.568***	0.482***	0.486***	0.356***	0.153**	0.153**
	(0.0724)	(0.0728)	(0.0715)	(0.0844)	(0.0541)	(0.0539)
$\Delta NEER_t$	0.0656***	0.0565***	0.0567***	0.00391	0.00176	0.00176
=*Contemporaneous* ERPT	(0.0161)	(0.0144)	(0.0141)	(0.00475)	(0.00446)	(0.00445)
$\Delta NEER_{t-1}$	0.0268**	0.0235**	0.0234**	0.0111	0.0136*	0.0136*
	(0.0124)	(0.0112)	(0.0110)	(0.00738)	(0.00706)	(0.00704)
$\Delta NEER_{t-2}$	-0.00472	-0.00393	-0.00411	0.00312	0.00927*	0.00927*
	(0.0148)	(0.0138)	(0.0138)	(0.00480)	(0.00512)	(0.00510)
$\Delta NEER_{t-3}$	0.0316**	0.0328***	0.0324**	-0.00142	0.00498	0.00498
	(0.0122)	(0.0116)	(0.0117)	(0.00382)	(0.00290)	(0.00289)
$\Delta NEER_t^2$	0.0243	0.00607	0.00636	0.0516	0.00726	0.00726
	(0.0633)	(0.0600)	(0.0622)	(0.0538)	(0.0734)	(0.0732)
$\Delta NEER_{t-1}^2$	-0.0972	-0.115	-0.113	0.00849	-0.0332	-0.0332
	(0.126)	(0.119)	(0.120)	(0.112)	(0.0676)	(0.0674)
$\Delta NEER_{t-2}^2$	0.0858	0.0875	0.0893	0.0457**	-0.00779	-0.00779
	(0.105)	(0.0965)	(0.0962)	(0.0160)	(0.0295)	(0.0294)
$\Delta NEER_{t-3}^2$	-0.0788	-0.0702	-0.0683	0.0610	0.0194	0.0194
	(0.0597)	(0.0585)	(0.0575)	(0.0470)	(0.0356)	(0.0355)
$\Delta NEER_t^3$	0.230**	0.219**	0.220**	0.0168	-0.486	-0.486
	(0.0958)	(0.0998)	(0.103)	(0.278)	(0.293)	(0.292)
$\Delta NEER_{t-1}^3$	-0.117	-0.110	-0.109	0.0844	-0.369	-0.369
	(0.137)	(0.128)	(0.129)	(0.289)	(0.249)	(0.248)
$\Delta NEER_{t-2}^3$	0.0724	0.0923	0.0945	0.468	0.0786	0.0786
	(0.102)	(0.0967)	(0.0972)	(0.286)	(0.314)	(0.313)
$\Delta NEER_{t-3}^3$	-0.150**	-0.143**	-0.140**	0.540*	0.261	0.261
	(0.0714)	(0.0634)	(0.0626)	(0.269)	(0.248)	(0.247)
Output gap_t	-0.0121	-0.0152	-0.0158	0.0330*	0.0425*	0.0425*
	(0.0277)	(0.0278)	(0.0280)	(0.0148)	(0.0208)	(0.0207)
$Inflation_{t-4}$ *$\Delta NEER_t$	0.677	0.700	0.687	1.557	2.503**	2.503**
=*$Inflation_{t-4}$*Contemp. ERPT*	(0.504)	(0.497)	(0.489)	(1.226)	(1.100)	(1.096)
$Inflation_{t-4}$*$\Delta NEER_{t-1}$	0.610**	0.716***	0.710***	-0.110	0.570	0.570
	(0.234)	(0.215)	(0.212)	(0.564)	(0.657)	(0.655)
$Inflation_{t-4}$*$\Delta NEER_{t-2}$	0.309*	0.329*	0.324*	-1.029*	-1.044	-1.044
	(0.175)	(0.159)	(0.156)	(0.554)	(0.788)	(0.786)
$Inflation_{t-4}$*$\Delta NEER_{t-3}$	-0.0502	-0.0533	-0.0516	0.519	0.0358	0.0358
	(0.0736)	(0.0717)	(0.0706)	(0.588)	(0.655)	(0.653)
Constant	0.00691		0.0124***	0.00119		0.00790***
	(0.00583)		(0.00291)	(0.000968)		(0.00107)
Yearly ERPT	0.119***	0.109***	0.108***	0.0167	0.0296***	0.0296***
	(0.0268)	(0.0234)	(0.0230)	(0.00930)	(0.00806)	(0.00804)
Long-run ERPT	0.276***	0.210***	0.211***	0.0259	0.0350***	0.0350***
	(0.0708)	(0.0490)	(0.0481)	(0.0155)	(0.0106)	(0.0105)

Table B4 continued

	Dependent variable: $Inflation_t$					
	Emerging market economies			Advanced economies		
	(1)	(2)	(3)	(4)	(5)	(6)
Explanatory variables	System GMM	Difference GMM	Within group estimator	System GMM	Difference GMM	Within group estimator
*$Inflation_{t-4}$*Yearly ERPT*	1.546*	1.692**	1.670**	0.936	2.065	2.065
	(0.787)	(0.755)	(0.739)	(1.314)	(1.340)	(1.336)
*$Inflation_{t-4}$*Long-run ERPT*	3.578*	3.265**	3.247**	1.454	2.438	2.438
	(1.283)	(1.062)	(1.049)	(1.895)	(1.485)	(1.480)
Observations	1,809	1,787	1,809	918	907	918
Number of countries	22	22	22	11	11	11
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Sargan test[a]	0.920	0.604		0.229	0.0111	
Hansen test[a]	1	1		1	1	
Serial correlation test[b]	0.636	0.705		0.0566	0.251	
Within R^2			0.814			0.467

Note: Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

[a] Reports p-values for the null hypothesis that the instruments used are not correlated with the residuals. [b] Reports p-values for the null hypothesis that the errors in the first difference regression exhibit no second order serial correlation.

Lower inflation – lower pass-through: different structure of GMM instruments

System GMM, different lag structure of GMM-type instruments — Table B5

Dependent variable: $Inflation_t$				
	Emerging market economies			
	(1)	(2)	(3)	(4)
Explanatory variables	GMM instruments: 2-8 lags	GMM instruments: 2-7 lags	GMM instruments: 2-6 lags	GMM instruments: 2-5 lags
$Inflation_{t-1}$	0.568***	0.568***	0.566***	0.562***
	(0.0724)	(0.0724)	(0.0724)	(0.0736)
$\Delta Exchange\ rate_t$	0.0656***	0.0655***	0.0667***	0.0682***
=*Contemporaneous* ERPT	(0.0161)	(0.0162)	(0.0159)	(0.0160)
$\Delta Exchange\ rate_{t-1}$	0.0268**	0.0268**	0.0273**	0.0254*
	(0.0124)	(0.0124)	(0.0123)	(0.0128)
$\Delta Exchange\ rate_{t-2}$	-0.00472	-0.00472	-0.00380	-0.00474
	(0.0148)	(0.0148)	(0.0149)	(0.0152)
$\Delta Exchange\ rate_{t-3}$	0.0316**	0.0316**	0.0318**	0.0312**
	(0.0122)	(0.0122)	(0.0122)	(0.0121)
$\Delta Exchange\ rate_t^2$	0.0243	0.0241	0.0358	0.0243
	(0.0633)	(0.0634)	(0.0676)	(0.0689)
$\Delta Exchange\ rate_{t-1}^2$	-0.0972	-0.0971	-0.106	-0.113
	(0.126)	(0.126)	(0.128)	(0.131)
$\Delta Exchange\ rate_{t-2}^2$	0.0858	0.0858	0.0887	0.0886
	(0.105)	(0.105)	(0.106)	(0.108)
$\Delta Exchange\ rate_{t-3}^2$	-0.0788	-0.0788	-0.0830	-0.0847
	(0.0597)	(0.0597)	(0.0605)	(0.0635)
$\Delta Exchange\ rate_t^3$	0.230**	0.230**	0.242**	0.226**
	(0.0958)	(0.0958)	(0.100)	(0.101)
$\Delta Exchange\ rate_{t-1}^3$	-0.117	-0.117	-0.128	-0.135
	(0.137)	(0.137)	(0.141)	(0.143)
$\Delta NEER_{t-2}^3$	0.0724	0.0724	0.0740	0.0763
	(0.102)	(0.102)	(0.104)	(0.106)
$\Delta Exchange\ rate_{t-3}^3$	-0.150**	-0.150**	-0.153**	-0.157**
	(0.0714)	(0.0714)	(0.0709)	(0.0729)
$Output\ gap_t$	-0.0121	-0.0119	-0.00606	-0.0116
	(0.0277)	(0.0277)	(0.0254)	(0.0274)
$Inflation_{t-4}$ *$\Delta Exchange\ rate_t$	0.677	0.677	0.662	0.657
=*$Inflation_{t-4}$*Contemporaneous ERPT*	(0.504)	(0.504)	(0.507)	(0.507)
$Inflation_{t-4}$*$\Delta Exchange\ rate_{t-1}$	0.610**	0.610**	0.616**	0.632**
	(0.234)	(0.234)	(0.234)	(0.238)
$Inflation_{t-4}$*$\Delta Exchange\ rate_{t-2}$	0.309*	0.310*	0.307*	0.313*
	(0.175)	(0.175)	(0.175)	(0.177)
$Inflation_{t-4}$*$\Delta Exchange\ rate_{t-3}$	-0.0502	-0.0502	-0.0497	-0.0476
	(0.0736)	(0.0736)	(0.0736)	(0.0734)
Constant	0.00691	0.00219	0.00147	0.00148
	(0.00583)	(0.00495)	(0.00215)	(0.00215)
Yearly ERPT	0.119***	0.119***	0.122***	0.120***
	(0.0268)	(0.0268)	(0.0271)	(0.0285)
Long-run ERPT	0.276***	0.276***	0.281***	0.274***
	(0.0708)	(0.0708)	(0.0702)	(0.0728)

Table B5 continued

Dependent variable: $Inflation_t$				
	Emerging market economies			
	(1)	(2)	(3)	(4)
Explanatory variables	GMM instruments: 2-8 lags	GMM instruments: 2-7 lags	GMM instruments: 2-6 lags	GMM instruments: 2-5 lags
*$Inflation_{t-4}$*Yearly ERPT*	1.546*	1.546*	1.536*	1.554*
	(0.787)	(0.787)	(0.785)	(0.791)
*$Inflation_{t-4}$*Long-run ERPT*	3.578*	3.579*	3.539*	3.548*
	(1.283)	(1.283)	(1.277)	(1.271)
Observations	1,809	1,809	1,809	1,809
Number of countries	22	22	22	22
Country fixed effect	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Sargan test[a]	0.920	0.917	0.170	0.0001
Hansen test[a]	1	1	1	1
Serial correlation test[b]	0.636	0.636	0.637	0.647

Note: System GMM estimation using Arellano and Bover (1995) and Blundell and Bond (1998) dynamic panel estimator. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

[a] Reports p-values for the null hypothesis that the instruments used are not correlated with the residuals. [b] Reports p-values for the null hypothesis that the errors in the first difference regression exhibit no second order serial correlation.

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