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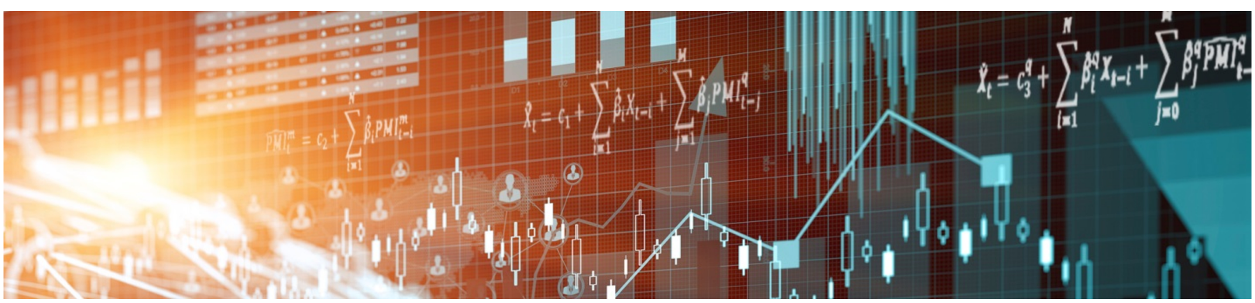

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Understanding the Time Variation in Exchange Rate Pass-Through to Import Prices

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Rose Cunningham,[1] Christian Friedrich,[1] Kristina Hess[1] and Min Jae Kim[2]

[1]International Economic Analysis Department
[2]Funds Management and Banking Department
Bank of Canada
Ottawa, Ontario, Canada K1A 0G9
rcunningham@bankofcanada.ca
cfriedrich@bankofcanada.ca
khess@bankofcanada.ca
minkim@bankofcanada.ca

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Abstract

In this paper, we analyze the presence of time variation in the pass-through from the nominal effective exchange rate to import prices for 24 advanced economies over the period 1995–2015. In line with earlier studies in the literature, we find substantial heterogeneity in the *level* of exchange rate pass-through across countries. But, in addition, we show that the *dynamics* of exchange rate pass-through also differ across countries. Potential explanations for this observation could be of a country-specific nature or could relate to differences in the composition or transmission of global shocks across countries. We then investigate the role of global demand shocks as potential determinants of exchange rate pass-through dynamics in seven advanced economies. We conduct this analysis by running a set of instrumental variable regressions to quantify the contemporaneous exchange rate pass-through that arises from different shocks. Out of the global demand shocks that we examine, we find that oil demand shocks, in particular, are associated with a relatively higher exchange rate pass-through to import prices, while US fiscal policy shocks appear to have the lowest impact.

Bank topics: Exchange Rates, Inflation and Prices, International Topics, Transmission of Monetary Policy
JEL codes: F31, F41, E31

Résumé

Dans cette étude, nous analysons la présence de variations temporelles dans la transmission des variations du taux de change effectif nominal aux prix des importations pour 24 économies avancées, au cours de la période 1995-2015. À l’instar des études de la littérature publiées précédemment, nous constatons une importante hétérogénéité dans le *degré* de transmission des variations du taux de change au sein de divers pays. Cependant, nous montrons aussi que la *dynamique* de cette transmission diffère d’un pays à l’autre. Cette observation pourrait s’expliquer par des facteurs propres à chaque pays ou par des différences dans la composition des chocs économiques mondiaux ou leur transmission entre les pays. Nous nous penchons ensuite sur le rôle des chocs de demande mondiaux en tant que déterminants potentiels de la dynamique de la transmission des variations du taux de change dans sept économies avancées. Nous effectuons cette analyse au moyen d’un ensemble de régressions utilisant des variables instrumentales pour quantifier le degré de transmission actuel des mouvements de change découlant de différents chocs. Parmi les chocs de demande mondiaux que nous examinons, nous découvrons que les chocs de la demande de pétrole, plus particulièrement, sont associés à un degré de transmission relativement élevé des variations du taux de change aux prix des importations, tandis que les chocs liés à la politique budgétaire des États-Unis semblent avoir l'incidence la plus faible.

Sujets : Taux de change, Inflation et prix, Questions internationales, Transmission de la politique monétaire
Codes JEL : F31, F41, E31

Section 1 | Introduction

The global financial crisis and its aftermath were characterized by historically large movements in the relative prices of major currencies (Leigh et al. 2016). When the relative price of a currency changes, foreign exporters must decide whether to reprice their products. The degree to which a change in the domestic nominal effective exchange rate changes import or consumer prices is known as exchange rate pass-through (ERPT).[1] In the standard flexible-price model, an appreciation (depreciation) of the domestic nominal exchange rate is associated with a one-to-one decrease (increase) in the domestic import price, and thus a complete ERPT. In practice, however, where prices are not fully flexible and markets are not perfectly competitive, ERPT is often lower.[2] Since central banks may adjust their policy interest rates to mitigate or even offset the impact of ERPT on consumer prices, reliable, up-to-date estimates of ERPT are an essential input into the policy-making process.

In this paper, we make two contributions to the literature. First, we systematically document a substantial time variation in ERPT to import prices for 24 advanced economies over the period from 1995 to 2015.[3] We obtain this finding by letting the exchange rate coefficients in a standard ERPT regression (i.e., a regression of import prices on the contemporaneous and lagged values of the nominal effective exchange rate) vary over time. We also found that there is substantial heterogeneity in the *level* as well as in the *dynamics* of ERPT across countries.

Second, we provide cross-country evidence consistent with the hypothesis that the composition of factors that cause exchange rates to move matters for determining a country's ERPT. Focusing on global[4] demand shocks, we instrument exchange rate movements with different types of exogenous shock measures from the literature for a sample of seven advanced economies and show that there are significant differences in the resulting (contemporaneous) ERPT coefficients. Of the shocks that we examine, we find that oil demand shocks are associated with a relatively higher ERPT (0.72), while US fiscal policy shocks appear to have a substantially lower impact

[1] The literature distinguishes between two different types of ERPT. The pass-through from the nominal exchange rate into the import price of a good is referred to as "Stage 1 ERPT," while the pass-through from the nominal exchange rate into the final goods price is referred to as "Stage 2 ERPT."

[2] For example, following an appreciation of the domestic exchange rate, foreign exporters' profits increase. This makes foreign exporters reluctant to reduce the import price by the same amount as suggested by the standard flexible-price model, leading to a substantially lower ERPT in practice.

[3] Our core sample consists of 12 advanced economies (Australia, Canada, Denmark, Japan, Korea, New Zealand, Norway, Sweden, Switzerland, the United Kingdom, the United States and the euro area). We also look at a subsample of 12 individual euro area members (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain).

[4] These shocks include a global oil demand shock and three United States-specific shocks (i.e., a US monetary policy shock, a US fiscal policy shock and a US uncertainty shock). Due to the global importance of the US economy and the global impact of US-specific shocks, we refer to all four shocks as "global" throughout the paper.

(0.44). Thus, our findings suggest that the occurrence of different shocks at different times may explain parts of the observed time variation in ERPT. However, even when accounting for differences in ERPT across global demand shocks, substantial heterogeneity in the dynamics of our ERPT estimates across countries remains, indicating that other types of global shocks, such as global supply shocks as well as country-specific shocks and responses, also play an important role.

Our paper relates to an extensive literature that documents substantial heterogeneity in the level of ERPT estimates across countries. A recent and prominent example is Gopinath (2015), who estimates pass-through to import and consumer prices at horizons of up to eight quarters in a sample of both advanced and emerging economies. She finds that a higher share of imports invoiced in a foreign currency significantly increases ERPT. For example, ERPT in the United States is typically lower than in other countries, due to the high share of trade that is invoiced in US dollars. Other studies of the drivers of ERPT have focused primarily on macroeconomic factors (e.g., Bussière, Delle Chiaie and Peltonen 2014), microeconomic factors (e.g., Cao, Dong and Tomlin. 2015; Campa and Goldberg 2005), or a combination of both (e.g., Bussière, Gaulier and Steingress 2016; An and Wang 2011). Even though we document a substantial time variation in ERPT, we show that country-specific averages of our ERPT estimates line up well with the static ERPT estimates from Gopinath (2015).

Our paper also relates to a literature that analyzes non-linearities, asymmetries and the variation of ERPT over time. For example, Bussière (2013) analyzes non-linearities and asymmetries in ERPT by assessing the reaction of profit margins to exchange rate movements. He finds that both the direction of the asymmetries and the magnitude of the non-linearities vary across countries.[5] Further, Forbes (2015) reviews recent research on ERPT and identifies three apparent “misunderstandings” that are frequently put forward in the literature but yet do not hold up very well in data from the United Kingdom (UK): (i) EPRT is greater in sectors with greater import content, (ii) EPRT is greater in sectors that are more tradable and internationally competitive and (iii) EPRT is constant across time.[6] Using the United Kingdom as an example, she shows that ERPT

[5] Other recent studies that examine non-linear ERPT find that these non-linearities are pervasive over countries and time (Brun-Aguerre, Fuertes and Phylatkis 2012), that ERPT is higher in the presence of larger exchange rate movements (Jašová, Moessner and Takáts 2016) and that there are distinct high and low ERPT regimes with country-specific thresholds (Kiliç 2016).

[6] Other papers have considered a more secular approach to time variation that focuses on declines in pass-through over the past several decades. Many of these attribute the decline at least in part to improved monetary policy performance (e.g., Taylor 2000; Sekine 2006; Ozkan and Erden 2015; Carrière-Swallow et al. 2016). Other studies, which focus on the US economy, find that ERPT has declined due to increased trade integration (Gust, Leduc and Vigfusson 2006) or more generally to the evolving nature of competition in global markets and structural changes in international production patterns (Marazzi and Sheets 2007). However, we follow Forbes (2015) in taking a more cyclical approach that examines drivers of shorter-term movements in pass-through.

estimates increased during and after the financial crisis, which could be attributed to the changing nature of exchange rate shocks over time. In related work, Forbes, Hjortsoe and Nenova (2015) find that pass-through to UK import prices is relatively large in response to global shocks but smaller in response to domestic shocks. We relate to this work by generalizing the analysis to a broader set of countries (although restricting ourselves to global demand shocks). At the same time, our results strongly support those of Forbes (2015) and Forbes et al. (2015), as we find that there is considerable time variation of ERPT across countries and that the nature of the exchange rate shock appears to matter for the resulting determination of ERPT.

The remainder of this paper is structured as follows. Section 2 documents the time variation in ERPT for a sample of 24 advanced economies. Section 3 then looks at a set of global demand shocks and examines their impact on ERPT. Finally, section 4 concludes.

Section 2 | Time Variation in ERPT in Advanced Economies

2.1 Motivation

In this section, we examine whether ERPT to import prices differs across countries and over time. To do so, we use rolling regressions based on Forbes' (2015) analysis for the United Kingdom. We extend her analysis to a cross-country setting and estimate ERPT coefficients for 24 economies over 1995–2015.

2.2 Methodology

2.2.1 Empirical specification

We build on the methodology from Forbes (2015) and estimate a standard ERPT equation for each country in a broad sample of advanced economies:

$$IMPP_t = c + \sum_{k=1}^{4} \alpha_k \cdot NEER_{t-(k-1)} + \sum_{k=1}^{4} \beta_k \cdot EXPP_{t-(k-1)} + \varepsilon_t \qquad (1)$$

where $IMPP_t$ is a country-specific measure of import price inflation in period t, $NEER_t$ is the growth rate of the country-specific nominal effective exchange rate[7]—our variable of interest—and $EXPP_t$ is a country-specific measure of export price inflation across a country's trading partners. This measure is added to the specification to control for differences in production costs

[7] An increase in $NEER_t$ corresponds to a nominal effective appreciation of the domestic currency.

across countries and across time.[8] Finally, c is a regression constant that captures time-constant factors and ε_t is an error term. To allow ERPT to vary over time, we estimate equation (1) using a rolling-window regression. We perform the analysis using 10- and 5-year windows. The measure of time-varying ERPT is then obtained by summing the α_k coefficients (i.e., the contemporaneous coefficient on $NEER_t$ and its first three lags, at each point in time).

2.2.2. Data

We estimate equation (1) for a sample of 24 advanced economies at a quarterly frequency over the period 1995Q1 to 2015Q4,[9] using data on import prices, export prices and the nominal effective exchange rate in log-differences. This section briefly describes the data; more detail is provided in Appendix B.

Import Price Index: The dependent variable in all empirical specifications is import price inflation, computed as the log-differences of an economy's import price index.[10] Data from the Organisation for Economic Co-operation and Development (OECD) are used where available; data from Eurostat are used for the euro area aggregate; and data from national sources are used otherwise.[11]

Nominal Effective Exchange Rate: To ensure the comparability of our measure of nominal effective exchange rates across the economies of our sample, we rely on consistently constructed and readily available nominal effective exchange rate series from the Bank for International Settlements (BIS). Their broad nominal effective exchange rate series cover 61 economies and feature regular adjustments in the underlying trade weights to reflect changing global trade patterns, with the most recent weights based on trade in the 2011–2013 period. We use the

[8] Our specification is robust to alternative measures of production costs across countries' trading partners. When we replace the export price inflation measure with a similarly constructed measure of unit labour costs, for example, evidence of time variation remains and the cross-country means of the resulting ERPT 10-year estimates show a correlation of 45 per cent with the estimates based on export prices.

[9] Most countries have import price data available over our full sample period, except Ireland (for which import price data are available from 1997Q1 to 2015Q4) and Korea and the euro area aggregate (for which import price data are available from 2000Q1 to 2015Q4).

[10] The import and export price indexes are re-indexed to base 2005Q1 values and seasonally adjusted. For series that are available only in non-seasonally adjusted terms from the original source, the data are seasonally adjusted through Haver Analytics.

[11] The Canadian import price series is constructed based on information from direct sources (i.e., customs and survey data) and indirect sources (i.e., derived from export price indexes of selected partner countries). To align the data from both sources, Statistics Canada adjusts the data using indirect sources, which include an assumption about expected exchange rate pass-through that has been modified in the past. To this extent, our time-varying ERPT estimates for Canada should be viewed with caution.

growth rate of the nominal effective exchange rate, computed through log-differences, in the regressions.

Trading Partners' Export Price Index: We use export price data from the OECD where available, from Eurostat for the euro area aggregate, and from the International Monetary Fund (IMF) and national sources otherwise, and adjust them to control for changes in the export price of a country's trading partners. To do so, we construct a trade-weighted export price index for each country ($EXPP^{TW}_{i,t}$), using the corresponding trade weights from the BIS nominal effective exchange rate. The $EXPP^{TW}_{i,t}$ index is constructed for a given importing country, i, by calculating the product of the export price index ($XP_{j,t}$) and trade weights ($TW_{ij,t}$) of each trading partner, j.[12] We recalibrate the trade weights to sum to 100 per cent for each country in each period to account for missing data. The resulting expression is then summed across all trading partners to generate the importing country's trade-weighted export price index. The transformations are shown below:

$$EXPP^{TW}{}_{i,t} = \sum_{j=1}^{59} \frac{XP_{j,t} \times TW_{ij,t}}{\sum_{j=1}^{59} TW_{ij,t}}.$$

Like the previous variables, the trading partners' export price index enters the specification in log-differences.

2.3 Results

Overall, our results from estimating equation (1) suggest that there is considerable heterogeneity in the degree of exchange rate pass-through to import prices both across countries and over time.

Table 1 summarizes the import price ERPT coefficients that we find when estimating equation (1) for each economy using a 10-year rolling window. The average ERPT coefficient estimates for our sample economies are all less than one, and even the maximum estimates are rarely higher than one. This suggests that ERPT to import prices is incomplete and that import prices are not fully flexible. The prevalence of partial exchange rate pass-through is a well-known result in the ERPT literature,[13] and several potential explanations have been put forward, including the presence of nominal or real rigidities (such as local market pricing or imperfect competition).

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[12] For economies within the euro area, euro area members are treated as individual economies, for a total of 59 partner economies. For economies outside of the euro area, the aggregate euro area is treated as a single entity, for a total of 41 partner economies.

[13] See, for example, Forbes, Hjortsoe and Nenova (2015); Gopinath (2015); Campa and Goldberg (2005, 2010) and the references therein.

Table 1: Summary Statistics of Estimated ERPT in Advanced Economies (10-year window)

	N	Mean	Std. Dev.	Min	Date	Max	Date
Australia	41	0.70	0.04	0.59	2009q2	0.77	2010q1
Canada	41	0.75	0.06	0.63	2014q3	0.86	2009q2
Denmark	41	0.51	0.14	0.19	2006q4	0.82	2010q3
Euro Area	21	0.76	0.09	0.65	2012q2	0.91	2014q4
Japan	41	0.75	0.17	0.49	2007q1	1.03	2012q3
Korea	21	0.95	0.05	0.89	2012q1	1.07	2015q2
New Zealand	41	0.61	0.10	0.46	2014q2	0.78	2008q3
Norway	41	0.57	0.10	0.43	2009q1	0.78	2014q2
Sweden	41	0.40	0.06	0.28	2009q4	0.48	2006q1
Switzerland	41	0.66	0.21	0.42	2013q3	1.16	2007q4
United Kingdom	41	0.59	0.09	0.50	2014q2	0.86	2008q2
United States	41	0.74	0.09	0.61	2008q3	0.92	2014q3

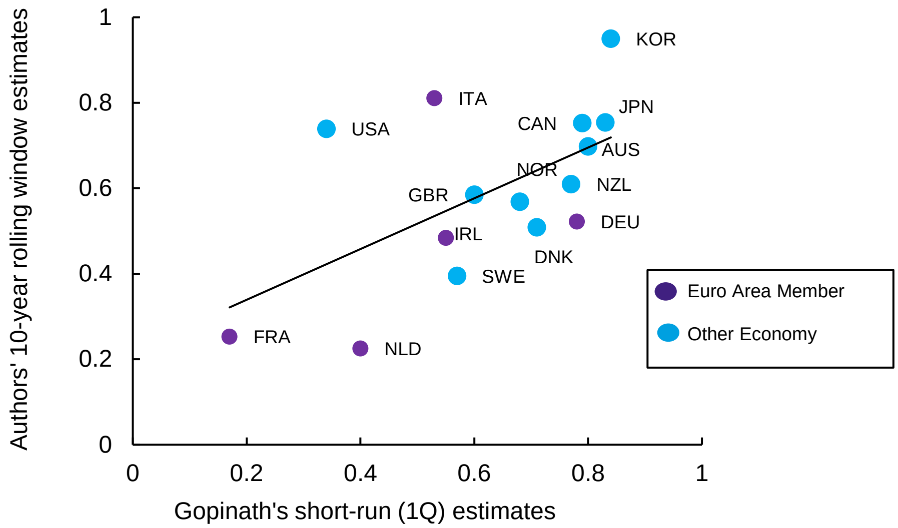
Note: The ERPT estimates reported here are calculated using 10-year rolling windows and import prices.
Source: Authors' calculations, using data from the BIS, OECD, IMF and national sources via Haver Analytics

For most countries, we find the average ERPT estimates range from 0.5 to 0.75. We do not see a clear pattern for small versus large economies, but we do observe some regional differences. European economies (other than the euro area as a whole) tend to have lower average rates of ERPT, while non-European economies, particularly Australia, Canada, Japan, Korea and the United States, have higher rates. This may reflect more extensive nominal and real rigidities in these European economies compared with other advanced economies. When we estimate ERPT for individual euro area countries, we also find some of the major economies tend to have ERPT of 0.5 or lower (see **Chart A1** and **Chart A2** in **Appendix A**).

Despite differences in methodology and sample periods from earlier studies in the literature, our results are strongly in line with their findings. **Chart 1** shows, for example, that our average ERPT estimates from the 10-year rolling regressions generally line up very well with Gopinath's (2015) aggregate ERPT estimates. While it should be noted that there is a certain degree of heterogeneity in ERPT estimates for specific countries across different studies, we still find, for example, that our estimate for the average ERPT coefficient in Canada (which is about 0.75) lies between Gopinath's aggregate estimate of about 0.8 and recent estimates from Devereux, Dong and Tomlin (2015), who find an overall ERPT estimate of 0.6.[14]

[14] Gopinath (2015) estimates the effect of changes in Canada's nominal exchange rate on Canada's import price index over the period from 1990 to 2014 and then uses the coefficient to obtain the cumulative pass-through estimate. Devereux, Dong and Tomlin's (2015) is derived by regressing the change in prices on the log of the nominal exchange rate and controls for the cumulative change in the foreign consumer price level, the Canadian consumer price level, Canadian GDP and fixed effects for the products at each specific time period. This regression is estimated using product-level data and then obtaining the overall estimate of ERPT by pooling all products together over the period from 2002 to 2008.

Chart 1: Comparison of authors' and Gopinath's ERPT estimates



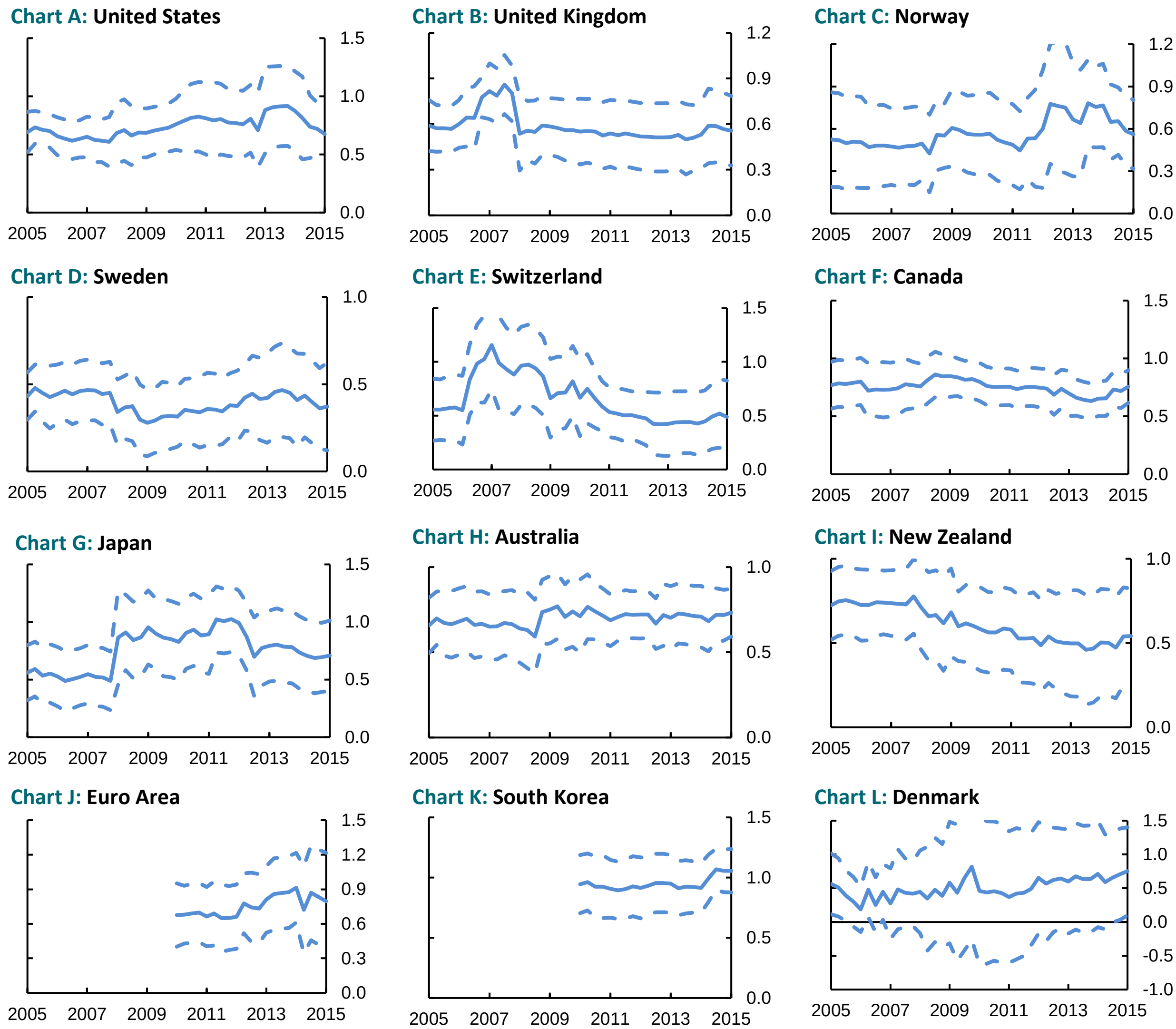
Note: Authors' estimates are calculated as an average of the time-varying estimates reported in Chart 1 (covering 1995-2015). Gopinath's estimates report the static estimates of ERPT reported in Figure 8 of Gopinath (2015) (covering 1990-2014). The three estimates with the highest standard deviations (Spain, Finland, and Switzerland) have been excluded from the chart.

Sources: Gopinath (2015) and authors' calculations

We then show how the ERPT coefficient estimates change as the regression sample (i.e., the rolling window) moves in steps of one quarter from 1995–2005 to 2005–2015. **Chart 2** presents the rolling-window regression results for each economy, using a 10-year window. We find considerable movement in the ERPT coefficient estimates over the 2005 to 2015 period.

Chart 2: Estimated ERPT in advanced economies (over a 10-year rolling window)

Estimates cover 1995Q4 to 2015Q4



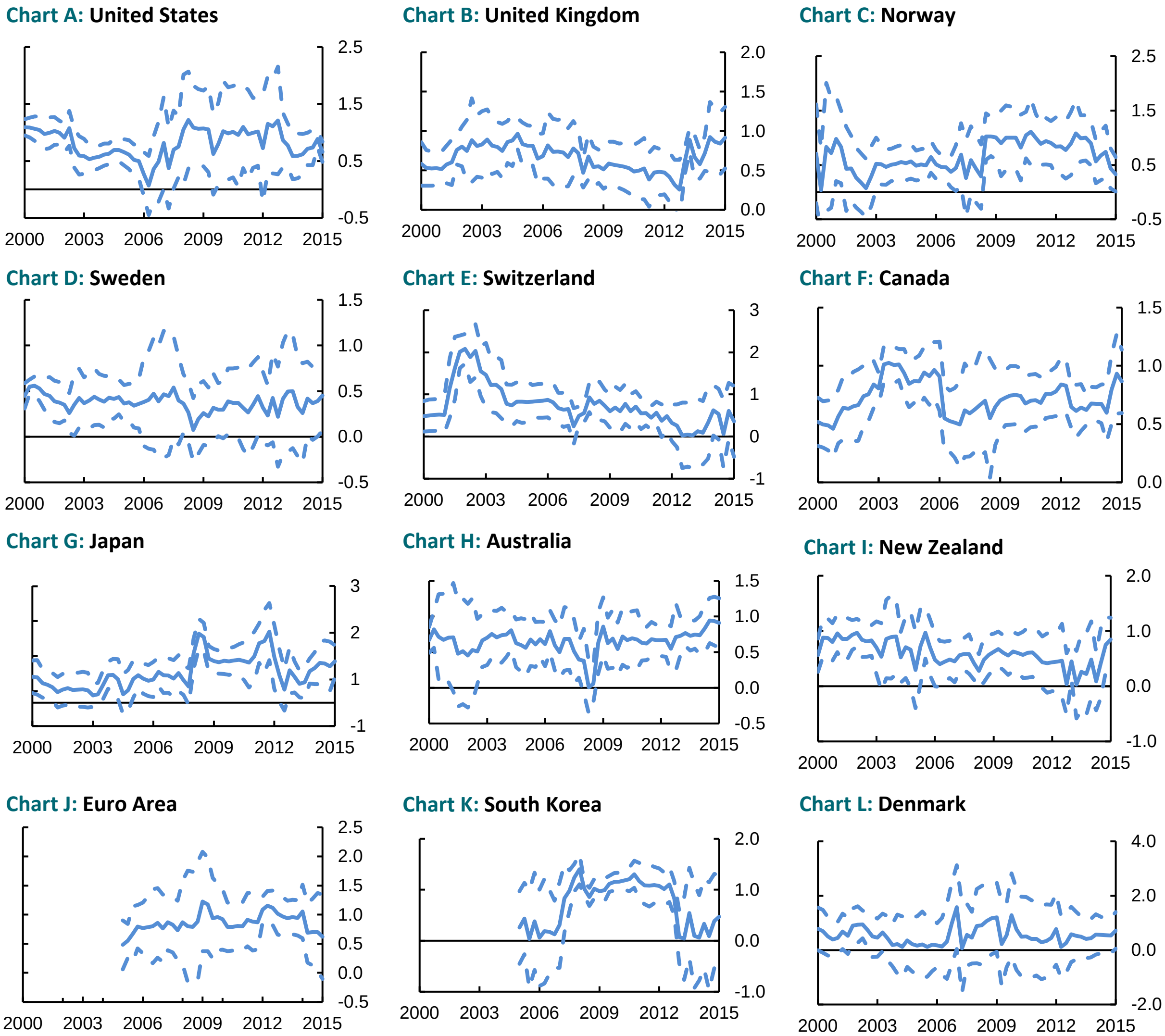
Note: Dashed lines report the 95 per cent confidence interval, which is obtained by computing a joint *t*-test for the hypothesis that the sum of the α_i coefficients in equation (1) is equal to zero.

Sources: Authors' calculations, using data from the BIS, OECD, IMF and national sources via Haver Analytics

Most notably, **Chart 2** shows that ERPT estimates change by 0.2 or more for the United Kingdom, Norway, Switzerland, Sweden and Japan when the 10-year rolling regression window is used. If a smaller 5-year window is used for the rolling-regression estimates, we see an even stronger time variation in the ERPT estimates (**Chart 3**).[15]

[15] **Table A1** in **Appendix A** lists the corresponding summary statistics for the 5-year rolling-window case.

Chart 3: Estimated ERPT in advanced economies (over a 5-year rolling window)
Estimates cover 1995Q4 to 2015Q4



Note: Dashed lines report the 95 per cent confidence interval, which is obtained by computing a joint *t*-test for the hypothesis that the sum of the α_i coefficients in equation (1) is equal to zero.

Sources: Authors' calculations, using data from the BIS, OECD, IMF and national sources via Haver Analytics

Section 3 | Global Shocks as Potential Determinants of ERPT

3.1 Motivation

In this section, we try to shed light on why ERPT varies over time by examining whether different types of shocks to the exchange rate have different degrees of pass-through. If the degree of pass-through does indeed vary by shock and an economy is exposed to different shocks at different times, these facts could explain why overall pass-through differs over time. The varying sensitivities of different countries to certain types of exchange rate shocks may in turn explain why this time variation differs across countries. Forbes, Hjortsoe and Nenova (2015) present evidence for the United Kingdom, which shows that different shocks have different implications in terms of ERPT. We try to generalize this finding to other countries by estimating the ERPT impact of several global demand shocks for a set of seven advanced economies, using instrumental variable (IV) regressions. Specifically, we use these exogenous shocks from the literature as instruments for the nominal effective exchange rate movement in the ERPT equation estimated in Section 2. This approach allows us to identify the degree of pass-through due to the exchange rate movement that results from a given global demand shock.

3.2 Methodology

3.2.1. Empirical specification and data

To conduct the two-stage least-squares estimation, equation (1) is simplified by removing the lagged terms for the growth rate of the NEER and the trading partners' export price inflation.[16] The second-stage equation therefore becomes:

$$IMPP_t = c + \alpha_1 \cdot \hat{N}EER_t + \beta_1 \cdot EXPP_t + \varepsilon_t \qquad (2)$$

At the same time, a variable representing a global demand shock is used to instrument the NEER, which is modelled by the following first-stage equation:

$$NEER_t = c + \gamma_1 \cdot Shock_{t-n} + \gamma_2 \cdot EXPP_t + u_t, \quad n \in [0,4] \qquad (3)$$

where $Shock_{t-n}$ is one of the global demand shocks described in Section 3.2.2.

Given the range of countries and shocks in our sample, we do not expect that shocks would affect the nominal effective exchange rate in each country at the same time. Therefore, we allow the timing of $Shock_{t-n}$ to vary both by country and by shock. We then select as our instrumental variable the contemporaneous or lagged term (with $n \in [0,4]$) that yields the highest first-stage F-statistic.

Our estimation of equation (2) and equation (3) focuses on a subset of seven of the economies analyzed in Section 2. We use the same data on exchange rates, import prices and export prices as in Section 2 and supplement them with the global demand shock variables described below (see **Appendix B** for more details on the construction of the shocks).

[16] The correlation between the country-specific mean of the ERPT coefficients from Section 2 (which included the first three lags of the pass-through coefficient as well as the contemporaneous value) and the corresponding contemporaneous ERPT coefficients estimated by ordinary least squares for the countries in Chart 2 and Chart 3 amounts to 0.77 and 0.50 (for the 10- and 5-year windows, respectively). Hence, focusing only on the contemporaneous portion of the effect seems to be a reasonable approach to reducing complexity.

3.2.2. Global demand shocks that could affect ERPT

In this exercise, we examine how different global demand shocks, particularly an oil demand shock, a US monetary policy shock and a US fiscal policy shock, could help to explain changes in ERPT across countries and over time. We also examine the impact of a US uncertainty shock, which is not a demand shock in the traditional sense but would be expected to affect global investment demand (e.g., Bussière, Ferrar and Milovich 2015; Leboeuf and Fay 2016) and is thus included in our analysis. We selected these shocks because they are expected to have a significant impact on the nominal effective exchange rate and are relatively straightforward to identify. Further, due to their global impact, we refer to all shocks as “global” throughout the paper, even though three of them are US-related.

- **A global oil demand shock:** The global oil demand shock captures unexpected changes in oil demand. We expect the sensitivity of import prices to an oil demand shock to be substantial, since changing demand patterns for oil are usually thought of as persistent and consequential for consumers in most economies. We measure the oil demand shock based on an economic activity indicator in a reduced-form vector autogregression that includes measures for real economic activity, oil production, oil inventories and the real price of oil. We use data for this shock over our complete sample period, from 1995Q1 to 2015Q4.
- **A US monetary policy shock:** The US monetary policy shock captures unexpected changes in the US monetary policy interest rate. We use the monetary policy shock based on Romer and Romer (2004), which, after the update by Wieland and Yang (2016), is available until 2007Q4. To consider a longer sample, we construct as a robustness check a monetary policy shock based on surprises in the 3-month US T-bill rate (i.e., obtained by taking the difference between its 1-quarter-ahead forecast obtained from the Survey of Professional Forecasters and its realized value).[17]
- **A US fiscal policy shock:** Our third shock is the US fiscal policy shock, which captures all exogenous legislated US tax changes from Romer and Romer (2010). We then use two alternative specifications of the US fiscal policy shock as a robustness exercise. First, we allow for the non-exogenous tax changes in Romer and Romer (2010), which increase the number of non-zero values slightly. Second, we construct a US fiscal policy shock by taking

[17] For both monetary policy shocks (based on Romer and Romer and on the Survey of Professional Forecasters), we exclude the crisis period between 2007Q1 and 2009Q4 from our analysis, since monetary policy decision making during and after the global financial crisis featured a substantial number of largely new and thus potentially unexpected conditions and policies (e.g., interest rates at the zero lower bound, forward guidance, quantitative easing) that could possibly confound the construction of the monetary policy shock.

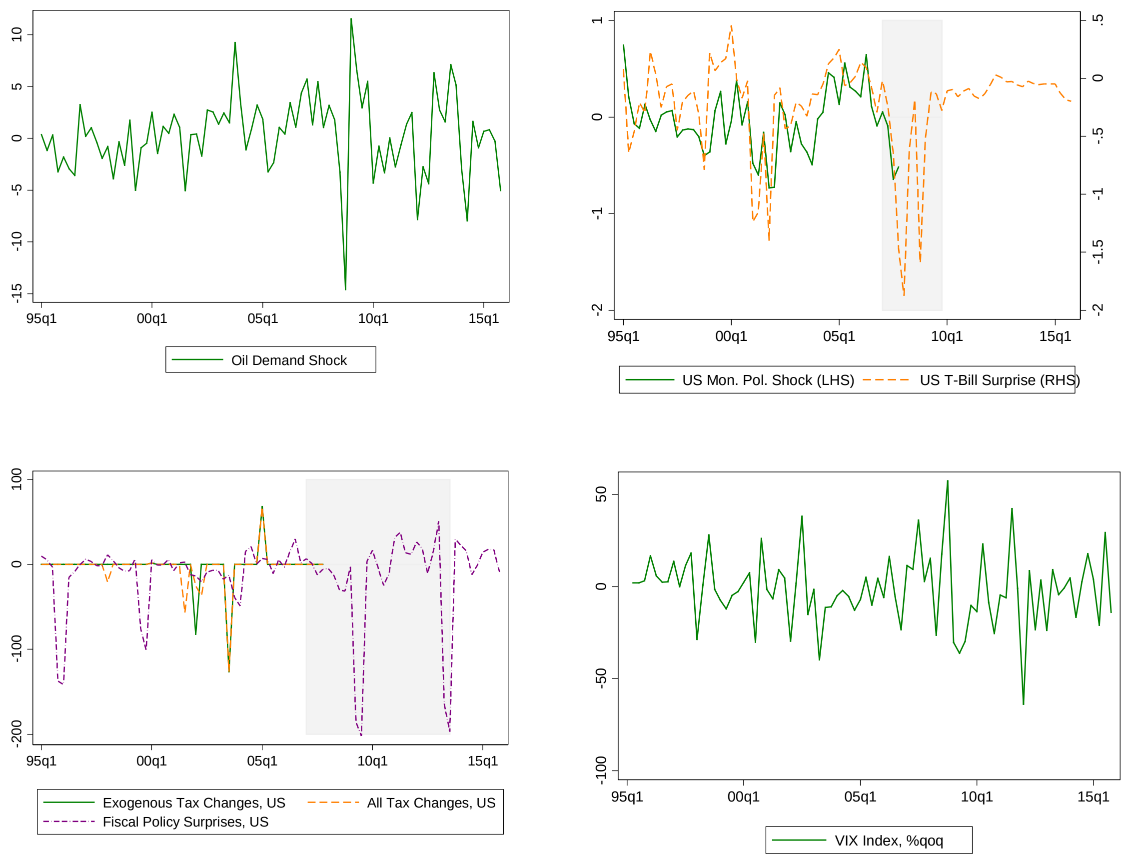
the difference between the 1-quarter-ahead forecast of real federal government spending and its actual realized value.[18]

- **A US uncertainty shock:** Since uncertainty can affect investment demand, we also include an uncertainty shock. We use the quarter-over-quarter change in the Chicago Board Options Exchange Volatility Index (VIX) as a proxy for an uncertainty shock. The uncertainty shock ranges from the beginning to the end of our sample.

Chart 4 displays the dynamics of our four shocks in the baseline specification (solid line) and in the robustness exercise (dashed line) over time.

Chart 4: Global shocks that could affect ERPT

Shading indicates the financial crisis, which is excluded from the estimation



[18] As with the US monetary policy shock, we exclude the crisis period from our analysis (in the case of the US fiscal shock, this is from 2007Q1 to 2013Q3), since the global financial crisis entailed unusually large unexpected changes in fiscal policy (e.g., bailout packages for banks, stimulus packages for the recovery of the economy).

3.3 Results

In this section, we present the results of the IV regression to assess the impact of different global demand shocks on ERPT in a set of seven advanced economies. The corresponding regression tables are located in **Appendix A** (i.e., **Tables A2–Table A8**).

We start with a brief discussion of the first-stage regression results based on equation (3). A central requirement of an IV regression is that the instrument is sufficiently correlated with the endogenous variable in the first-stage regression (i.e., the nominal effective exchange rate). Following the empirical approach outlined in Section 3.2.1., we find an intuitive and statistically significant correlation between the global shock measures and a change in the nominal effective exchange rate in 23 out of 28 cases. We consider a correlation to be intuitive if it corresponds to our expectations about the main impact of each of the shocks. These expectations are as follows:

- We anticipate that an oil demand shock would cause an appreciation of the currency of oil exporters and a depreciation of the currency of oil importers.
- For a US monetary policy shock, we expect the US dollar to appreciate against all other currencies.
- For a US fiscal policy shock, we expect the US-dollar response to be systematically different from the exchange rate response of other countries. However, we do not specify an "intuitive" direction of the exchange rate impact because this direction is ambiguous. While the traditional Mundell-Fleming framework suggests that an increase in government spending (increase in taxation) leads to an appreciation (depreciation) of the domestic currency, our results are more consistent with evidence from Bouakez and Eyquem (2015), who argue in favour of the opposite relationship. Bouakez and Eyquem (2015) first show that a number of recent empirical studies in fact document a significant and persistent depreciation of the real exchange rate following an expansionary government spending shock, and then construct a small open economy model that rationalizes these findings.[19]
- The expected first-stage result for an uncertainty shock is that the currencies of safe-haven countries appreciate (particularly the US dollar and, to a lesser extent, the Japanese yen and Swiss franc), while currencies of the other countries depreciate.

We next turn to a discussion of the second-stage results based on equation (2). **Table 2** contains the country-specific ERPT coefficients of our four global shocks—the oil demand shock, the US

[19] Using a model that contains incomplete and imperfect international financial markets, sticky prices and a not-too-aggressive monetary policy, the authors show that in response to an unexpected increase in public spending, the long-term real interest rate differential vis-à-vis the rest of the world falls, leading the domestic currency to depreciate in real terms.

monetary policy shock, the US fiscal policy shock and the US uncertainty shock—for seven advanced economies. We do not report a second-stage regression in Table 2 for a shock-country pair if the F-statistic of the first stage is lower than 3 (indicated by a dot in Table 2).[20] A closer look at the results leads to two hypotheses.

Table 2: Estimated ERPT, by shock and by country

	Oil demand	US monetary policy	US fiscal policy	Uncertainty	*Average*
United States	**1.10**	**0.49**	0.30	**0.72**	*0.65*
United Kingdom	**0.60**	**0.79**	**0.54**	.	*0.64*
Euro Area	**0.38†**	**0.67**	0.15	.	*0.40*
Japan	**1.23**	**0.61**	**0.56**	.	*0.80*
Switzerland	.	**0.60**	**0.39**	-0.19	*0.27*
Australia	**0.67**	**0.63**	**0.51**	**0.64**	*0.61*
New Zealand	**0.32**	**0.47**	**0.60**	**0.35**	*0.44*
Average	*0.72*	*0.61*	*0.44*	*0.38*	

† Indicates the case where a significant first-stage correlation has the opposite sign than expected.

Note: Missing values correspond to estimates with first-stage F-statistics of less than 3. Bolded values indicate ERPT estimates that are statistically significant in the second state (p-value < 0.10); un-bolded values indicate estimates that are not.

Source: Authors' calculations

Hypothesis 1: The ERPT impact of global demand shocks differs across countries

In the country-specific averages of the resulting ERPT estimates across all global demand shocks (last column of Table 2), we observe a substantial cross-country variation, ranging from 0.27 in Switzerland to 0.80 in Japan. While the fact that ERPT is country-specific has been documented in the literature before (e.g., Gopinath 2015; Bussière, Delle Chiaie and Peltonen 2014; An and Wang 2011; and Campa and Goldberg 2005), our analysis provides evidence that this even holds for global (demand) shocks that affect different countries in a similar way. This could have at least two explanations. First, the direct impact of global shocks may differ across countries. A straightforward example of this channel would be that an oil price shock has a different impact on oil-producing and oil-importing countries. Second, the response of the country's central bank to the exchange rate impact of the same global shock differs across countries. For example, certain central banks may look through global shocks altogether, while others may have an implicit target value for the exchange rate that they try to support.

The following implications for the monetary policy-making process in central banks result from this finding. The fact that the ERPT of global shocks is country-specific makes it important to

[20] This is lower than the usual threshold of 10, so that several of the displayed specifications potentially exhibit a problem of weak instruments. Of the 23 results reported in Table 2, six have first-stage F-statistics that are greater than 10. However, all reported first-stage results contain instruments that are significantly correlated with the endogenous variable.

calibrate economic models with estimates for each respective country. While our stylized analysis in this section illustrates these cross-country differences in a consistent way, it is not a substitute for a carefully specified and identified empirical model that estimates ERPT based on data that are used for policy analysis in each country. This includes the careful selection of the most relevant import and export price series, as well as of the measure of the nominal effective exchange rate and, in particular, its trade-weighting procedure.[21]

Hypothesis 2: The ERPT impact of global demand shocks differs by the type of shock
Alternatively, we can explore the information in Table 2 by computing the average ERPT of each shock across all sample countries, which is reported in the bottom row of the table. The average ERPT of the oil demand shock in our assessment amounts to 0.72, followed by the US monetary policy shock, with an average ERPT of 0.61, and the US fiscal policy shock, with an average ERPT of 0.44. Finally, the uncertainty shock has an even lower average ERPT of 0.38 but turns out to be largely irrelevant for the exchange rate determination in most of the countries in our sample. Overall, these results appear to suggest that each shock is associated with a different ERPT to import prices. A potential rationale behind the magnitude of the corresponding ERPT coefficients across these shocks is outlined below.

If, on the one hand, global demand shocks are perceived as relatively persistent, exporters are more likely to adjust their prices in response to the subsequent exchange rate movement. A change in the exchange rate following an unexpected improvement in the economic situation in China (and thus an increase in global oil demand) or an unexpected change in US monetary policy, for example, might have lasting effects on exchange rates for a broad set of countries. If, on the other hand, global demand shocks are perceived as mainly temporary, as would be the case for global uncertainty shocks, exporters might be more hesitant to make adjustments to their prices. The following example illustrates this idea. There was substantial financial market volatility and resulting exchange rate fluctuations in the aftermath of the “Brexit” vote even for countries with relatively few trade links to the United Kingdom. In such a case, one would suspect the exporters of such indirectly affected countries to be relatively cautious about adjusting their prices in response to exchange rate movements vis-à-vis typical safe-haven countries such as the United States, Switzerland or Japan, for example.

The finding that different global demand shocks have different ERPT on import prices in a broader set of advanced countries lends additional support to the work of Forbes, Hjortsoe and Nenova

[21] One could also think of an analysis that focuses on a differently weighted effective exchange rate or even on bilateral exchange rates. In particular, for countries that have strong financial ties (but weak trade links) with the United States, the impact of US-specific shocks under these alternative exchange rate measures could be even stronger.

(2015), who show that different shocks have different ERPT implications in the United Kingdom. This is potentially an important result for monetary policy-makers. If different types of shocks have systematically different ERPT implications, the central bank's optimal policy response following a movement in the exchange rate should differ as well, depending on the nature of the underlying shock. While central banks have always responded differently to different shocks—a central bank could address the deflationary impact of a negative demand shock more aggressively than the impact of a positive supply shock, for example—this new evidence points to differences in ERPT even when conditioning on the exchange rate movement.

Further work could expand our analysis as follows: in this exercise, we only consider a set of four global demand shocks. There are additional global shocks, particularly from the supply side, such as productivity shocks, that could have an even longer-lasting impact than demand shocks. More importantly, a large number of domestic shocks are potentially even stronger drivers of the nominal effective exchange rate of a country. Accounting for the most relevant domestic and global shocks that a country faces would deepen the analysis further.

3.4 Robustness Checks

In this subsection, we conduct a set of robustness checks that rely on alternative definitions of the US monetary policy shock and the US fiscal policy shock, since both were only available over a shorter sample. **Table 3** presents the results.

Table 3: Estimated ERPT, by shock and by country—Alternative shocks

	US monetary policy (T-bill surprises)	US fiscal policy (all tax changes)	US fiscal policy (fiscal policy surprises)	*Average*
United States	**0.72†**	-0.16	.	*0.28*
United Kingdom	.	**0.66**	0.13	*0.40*
Euro Area	0.42	0.35	.	*0.39*
Japan	.	**0.79**	.	*0.79*
Switzerland	**0.34**	**0.81**	**0.49**	*0.55*
Australia	**0.63**	.	**0.58**	*0.61*
New Zealand	**0.64**	**0.44**	**0.60**	*0.56*
Average	*0.55*	*0.48*	*0.45*	

† Indicates the case where a significant first-stage correlation has the opposite sign to that predicted by theory

Note: Missing values correspond to estimates with first-stage F-statistics of less than 3. Bolded values indicate ERPT estimates that are statistically significant in the second state (p-value < 0.10); un-bolded values indicate estimates that are not.

First, we replace the Romer and Romer (2004) US monetary policy shock with a 3-month T-Bill surprise shock that covers both the pre- and post-crisis periods. While the individual country results differ somewhat, the average ERPT estimate across countries based on the US monetary policy shock amounts to 0.55 and thus comes close to the 0.61 estimate from our baseline specification.

Second, we allow for the inclusion of non-exogenous tax changes from Romer and Romer (2010) so that the US fiscal policy shock experiences more variation over time. The resulting ERPT estimates differ somewhat with respect to those of the baseline specification again, but the average ERPT estimate across our sample countries of 0.48 for the US fiscal policy shock closely resembles the previous number of 0.44.

Third, we use our newly constructed fiscal policy surprise shock that covers the post-crisis period as well as the pre-crisis period. Although we observe relatively similar values for the United States (insignificant), Australia (0.51 vs. 0.58) and New Zealand (0.60 in both cases), we do not obtain ERPT estimates (due to an insignificant first-stage correlation) for the United Kingdom, the euro area and Japan in this case. However, the average ERPT estimate based on the US fiscal policy shock remains essentially the same as in the baseline specification (0.44 vs. 0.45).

Overall, these results demonstrate that our choice to end the sample for the US monetary and US fiscal policy shocks prior to the global financial crisis did not drive the differences behind the shock-specific average ERPT estimates in Table 2.

Section 4 | Conclusion

This paper has examined ERPT to import prices in advanced economies. We first presented empirical estimates of ERPT to import prices based on aggregate data for a sample of 24 advanced economies over the period 1995 to 2015. Our estimates show that ERPT to import prices varies considerably both across countries and over time within countries. Using an instrumental-variable approach, we examined how the composition of global demand shocks that an economy experiences helps to explain the degree of ERPT to import prices. We found that the effect of different types of shocks on ERPT differs across countries. In addition, the ERPT impact of shocks differs by the type of shock. In particular, oil demand shocks seem to be associated with a higher degree of ERPT to import prices, and US fiscal policy shocks have a lower impact (uncertainty shocks, in addition, potentially have an even lower impact). These findings suggest that the types of shocks that an economy experiences matter, and this can explain in part some of the heterogeneity that we observe in ERPT across countries and over time.

While this analysis has focused on ERPT to import prices (first-stage ERPT), future research could extend this analysis to ERPT to consumer prices (second-stage ERPT). In particular, import prices and exchange rates are the main channels through which global inflation shocks are transmitted across countries.[22] Changes in the exchange rate can have both direct and indirect effects on consumer prices, through their impact on imported final and intermediate goods prices, as well as changes in the composition and level of aggregate demand (Savoie-Chabot and Khan 2015). ERPT is generally lower to consumer prices than to import prices, as changes in consumer prices also reflect numerous domestic factors that are not related to exchange rate movements.

[22] The phenomenon of global inflation is examined in Friedrich (2016) and Ferroni and Mojon (2015).

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Appendix A | Figures and Tables

Chart A1: Estimated ERPT in euro area countries (10-year rolling window)

Chart A: Austria

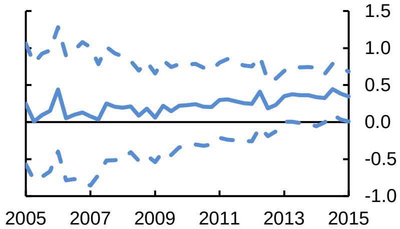


Chart B: Belgium

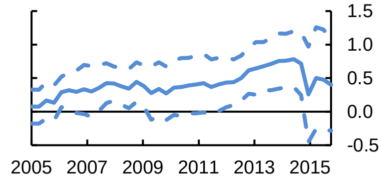


Chart C: Finland

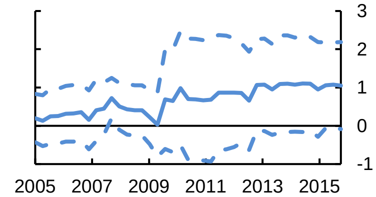


Chart D: France

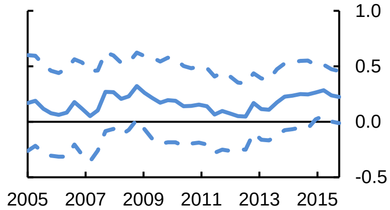


Chart E: Germany

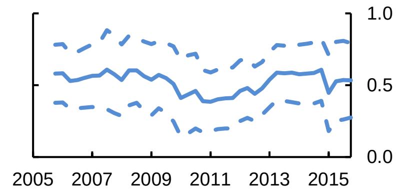


Chart F: Greece

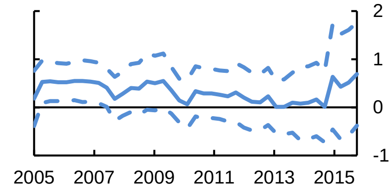


Chart G: Ireland

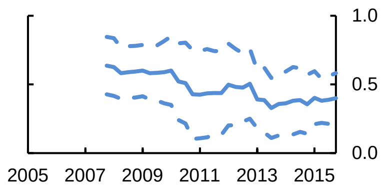


Chart H: Italy

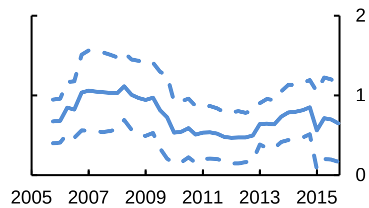


Chart I: Luxembourg

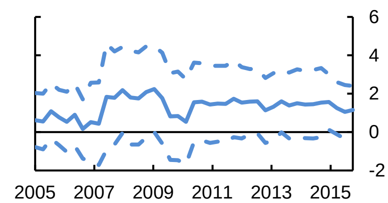


Chart J: Netherlands

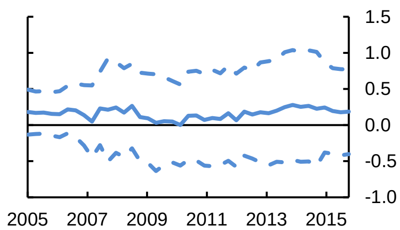


Chart K: Portugal

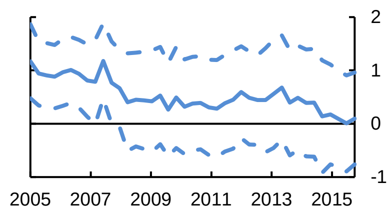
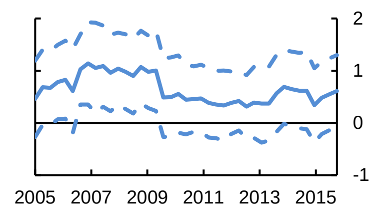


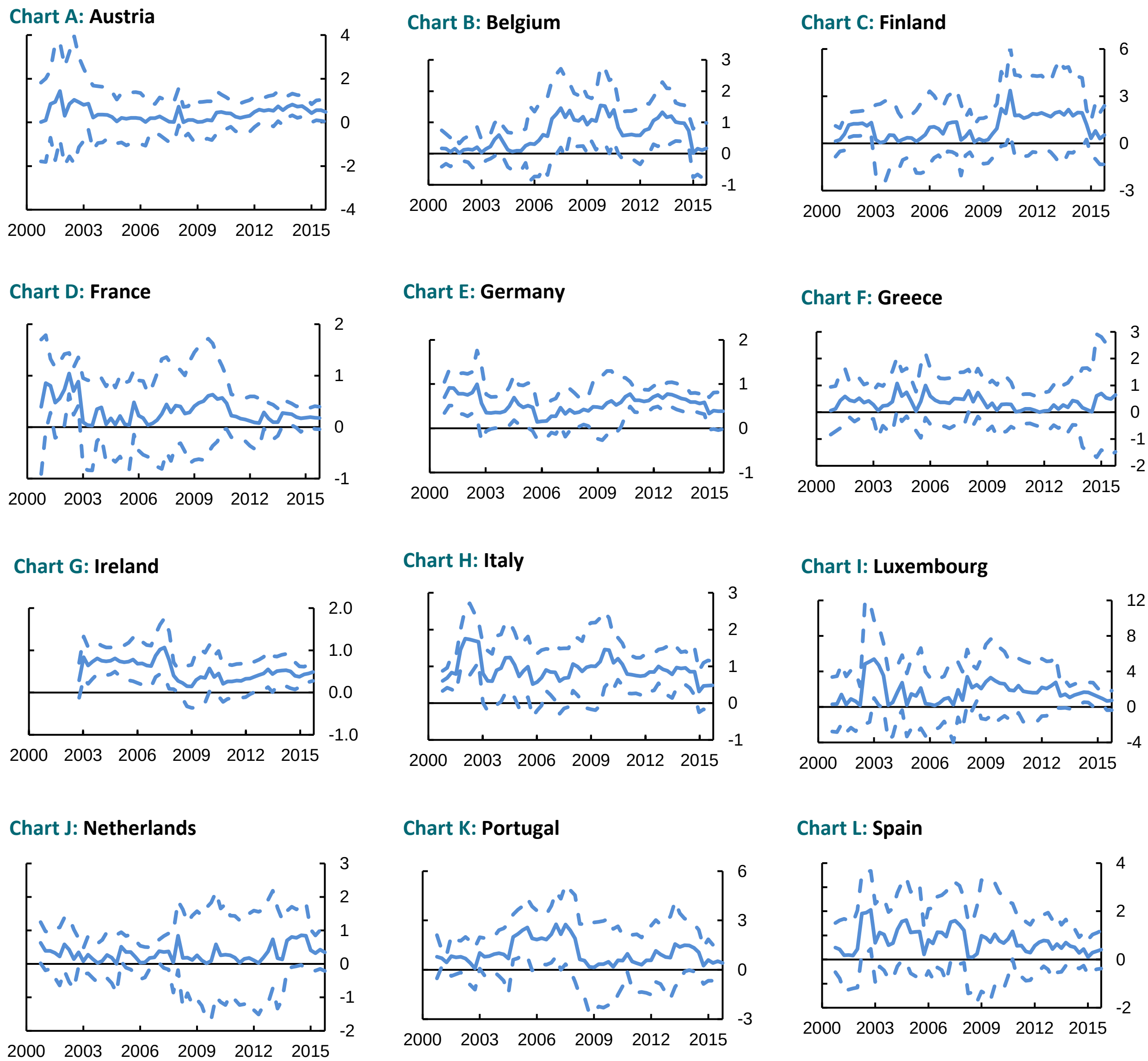
Chart L: Spain



Note: Dashed lines report the 95 per cent confidence interval, which is obtained by computing a joint t-test for the hypothesis that the sum of the α_i coefficients in equation (1) is equal to zero.

Source: Authors' calculations, using data from the BIS, OECD, IMF and national sources via Haver Analytics

Chart A2: Estimated ERPT in euro area countries (5-year rolling window)



Note: Dashed lines report the 95 per cent confidence interval, which is obtained by computing a joint t-test for the hypothesis that the sum of the α_i coefficients in equation (1) is equal to zero.

Source: Authors' calculations, using data from the BIS, OECD, IMF and national sources via Haver Analytics

Table A1: Summary statistics of estimated ERPT in advanced economies (5-year window)

	N	Mean	Std. Dev.	Min	Date	Max	Date
Australia	61	0.65	0.16	0.01	2009q1	0.94	2015q2
Canada	61	0.72	0.15	0.46	2001q3	1.03	2004q2
Denmark	61	0.54	0.32	0.07	2008q1	1.58	2007q4
Euro Area	41	0.86	0.16	0.48	2005q4	1.23	2009q4
Japan	61	0.64	0.33	0.16	2003q4	1.52	2012q3
Korea	41	0.71	0.46	0.03	2006q2	1.40	2008q4
New Zealand	61	0.59	0.23	0.03	2014q1	0.97	2006q2
Norway	61	0.66	0.28	0.04	2001q1	1.11	2011q3
Sweden	61	0.38	0.09	0.07	2009q2	0.56	2001q2
Switzerland	61	0.74	0.48	0.03	2013q4	2.08	2002q4
United Kingdom	61	0.66	0.17	0.26	2013q3	0.97	2005q3
United States	61	0.81	0.26	0.07	2007q1	1.22	2009q1

Note: The ERPT estimates reported here are calculated using 5-year rolling windows and import prices.

Source: Authors' calculations, using data from the BIS, OECD, IMF and national sources via Haver Analytics

Table A2: ERPT to import prices: First- and second-stage IV regressions, United States

	Oil Demand (1995-2015)		US Mon. Pol. (1995-2006)		US Fis. Pol. (1995-2006)		Uncertainty (1995-2015)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exchange rate		-1.102***		-0.490*		-0.295		-0.720***
		(0.00)		(0.08)		(0.24)		(0.00)
Export prices	0.268	0.934***	0.542**	0.591**	0.520*	0.457**	0.033	0.874***
	(0.17)	(0.00)	(0.04)	(0.04)	(0.08)	(0.04)	(0.87)	(0.00)
Oil Demand Shock$_{t-1}$	-0.002***							
	(0.00)							
US Mon Pol Shock$_{t-4}$			0.020*					
			(0.05)					
US Fiscal Shock$_{t-1}$					0.000***			
					(0.00)			
VIX Shock$_t$							0.000**	
							(0.02)	
N	83	83	44	44	47	47	83	83
F test, 1st stage		15.01		3.92		56.27		5.36

All specifications include a constant. P-values in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Exchange rate in nominal effective terms. Exchange rate, import prices and export prices calculated as log differences.

Table A3: ERPT to import prices: First- and second-stage IV regressions, United Kingdom

	Oil Demand (1995-2015)		US Mon. Pol. (1995-2006)		US Fis. Pol. (1995-2006)		Uncertainty (1995-2015)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exchange rate		-0.603**		-0.789***		-0.544***		-0.344
		(0.05)		(0.00)		(0.00)		(0.11)
Export prices	0.221	0.770***	0.355	0.690***	0.360	0.620***	0.096	0.731***
	(0.53)	(0.00)	(0.18)	(0.00)	(0.17)	(0.00)	(0.76)	(0.00)
Oil Demand $\text{Shock}_{t\text{-}3}$	-0.001*							
	(0.05)							
US Mon Pol $\text{Shock}_{t\text{-}1}$			-0.015*					
			(0.09)					
US Fiscal $\text{Shock}_{t\text{-}2}$					-0.000***			
					(0.00)			
VIX $\text{Shock}_{t\text{-}1}$							-0.000*	
							(0.09)	
N	81	81	47	47	46	46	82	82
F test, 1st stage		3.85		3.06		37.76		2.94

All specifications include a constant. P-values in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Exchange rate in nominal effective terms. Exchange rate, import prices and export prices calculated as log differences.

Table A4: ERPT to import prices: First- and second-stage IV regressions, euro area

	Oil Demand (1995-2015)		US Mon. Pol. (1995-2006)		US Fis. Pol. (1995-2006)		Uncertainty (1995-2015)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exchange rate		-0.383*		-0.669**		0.147		-0.561*
		(0.07)		(0.03)		(0.70)		(0.09)
Export prices	-0.081	1.370***	-0.506	1.259***	-0.586	1.877***	-0.102	1.350***
	(0.72)	(0.00)	(0.46)	(0.00)	(0.31)	(0.00)	(0.71)	(0.00)
Oil Demand Shock_{t}	0.003***							
	(0.00)							
US Mon Pol $\text{Shock}_{t\text{-}2}$			-0.022**					
			(0.04)					
US Fiscal $\text{Shock}_{t\text{-}1}$					-0.000***			
					(0.01)			
VIX $\text{Shock}_{t\text{-}3}$							0.000	
							(0.12)	
N	63	63	27	27	27	27	63	63
F test, 1st stage		41.46		4.71		9.53		2.51

All specifications include a constant. P-values in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Exchange rate in nominal effective terms. Exchange rate, import prices and export prices calculated as log differences.

Table A5: ERPT to import prices: First- and Second-stage IV regressions, Japan

	Oil Demand (1995-2015)		US Mon. Pol. (1995-2006)		US Fis. Pol. (1995-2006)		Uncertainty (1995-2015)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exchange rate		-1.229***		-0.611***		-0.561**		-1.452**
		(0.00)		(0.00)		(0.01)		(0.01)
Export prices	0.226	1.653***	0.126	0.800***	-0.067	0.839***	0.045	1.604***
	(0.61)	(0.00)	(0.89)	(0.00)	(0.94)	(0.00)	(0.92)	(0.00)
Oil Demand Shock$_{t-1}$	-0.003**							
	(0.01)							
US Mon Pol Shock$_{t-2}$			-0.045***					
			(0.00)					
US Fiscal Shock$_{t-1}$					-0.000***			
					(0.00)			
VIX Shock$_{t-1}$							0.000*	
							(0.09)	
N	83	83	46	46	47	47	82	82
F test, 1st stage		6.93		9.03		31.66		2.93

All specifications include a constant. P-values in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Exchange rate in nominal effective terms. Exchange rate, import prices and export prices calculated as log differences.

Table A6: EPRT to import prices: First- and second-stage IV regressions, Switzerland

	Oil Demand (1995-2015)		US Mon. Pol. (1995-2006)		US Fis. Pol. (1995-2006)		Uncertainty (1995-2015)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exchange rate		0.550		-0.602**		-0.389**		0.190
		(0.39)		(0.03)		(0.04)		(0.70)
Export prices	-0.179	0.714**	-0.594**	0.336	-0.573**	0.459***	-0.245	0.631***
	(0.47)	(0.02)	(0.03)	(0.17)	(0.04)	(0.01)	(0.34)	(0.00)
Oil Demand Shock$_{t-1}$	-0.001*							
	(0.09)							
US Mon Pol Shock$_{t-4}$			-0.017***					
			(0.01)					
US Fiscal Shock$_{t-4}$					-0.000**			
					(0.02)			
VIX Shock$_{t-3}$							-0.000*	
							(0.08)	
N	83	83	44	44	44	44	80	80
F test, 1st stage		2.96		8.78		5.77		3.24

All specifications include a constant. P-values in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Exchange rate in nominal effective terms. Exchange rate, import prices and export prices calculated as log differences.

Table A7: ERPT to import prices: First- and second-stage IV regressions, Australia

	Oil Demand (1995-2015)		US Mon. Pol. (1995-2006)		US Fis. Pol. (1995-2006)		Uncertainty (1995-2015)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exchange rate		-0.666***		-0.633***		-0.514***		-0.639***
		(0.00)		(0.01)		(0.01)		(0.00)
Export prices	0.158	0.861***	-0.033	0.945***	-0.085	0.971***	0.412	0.851***
	(0.80)	(0.00)	(0.95)	(0.00)	(0.86)	(0.00)	(0.36)	(0.00)
Oil Demand Shock$_{t-1}$	0.003*							
	(0.06)							
US Mon Pol Shock$_{t-1}$			-0.027*					
			(0.07)					
US Fiscal Shock$_{t-1}$					-0.000***			
					(0.00)			
VIX Shock$_t$							-0.001***	
							(0.00)	
N	83	83	47	47	47	47	83	83
F test, 1st stage		3.75		3.54		12.37		16.09

All specifications include a constant. P-values in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Exchange rate in nominal effective terms. Exchange rate, import prices and export prices calculated as log differences.

Table A8: ERPT to import prices: First- and second-stage e IV regressions, New Zealand

	Oil Demand (1995-2015)		US Mon. Pol. (1995-2006)		US Fis. Pol. (1995-2006)		Uncertainty (1995-2015)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exchange rate		-0.320***		-0.474*		-0.599***		-0.351*
		(0.01)		(0.06)		(0.00)		(0.06)
Export prices	-0.667***	0.858***	-0.893**	0.921**	-0.982**	0.805***	-0.375	0.840***
	(0.00)	(0.00)	(0.04)	(0.02)	(0.02)	(0.00)	(0.26)	(0.00)
Oil Demand Shock$_{t-1}$	0.004***							
	(0.00)							
US Mon Pol Shock$_{t-4}$			-0.032*					
			(0.08)					
US Fiscal Shock$_{t-4}$					-0.001***			
					(0.00)			
VIX Shock$_t$							-0.001*	
							(0.05)	
N	83	83	44	44	44	44	83	83
F test, 1st stage		18.53		3.20		26.76		3.88

All specifications include a constant. P-values in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Exchange rate in nominal effective terms. Exchange rate, import prices and export prices calculated as log differences.

Appendix B | Data Sources and Transformations

B.1 Data sources

Import Price Index		
Country	Series	Source
Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States	Imports of Goods & Services, Price Index (SA, 2010=100)	OECD
Euro Area	EA19: Import Unit Value Index with NonEA (NSA, 2010=100) - Seasonal Adjustment, All	Eurostat

Export Price Index		
Country	Series	Source
Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, Colombia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Russia, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States	Exports of Goods & Services, Price Index (SA, 2010 = 100)	OECD
Malaysia	Malaysia: Export Unit Value Index (SA, 2010=100)	DSM/H
Peru	Peru: Nominal Prices: Exports (SA, 2007=100)	BCRP/H
China	China: Export Price Index (SA, 2010=100)	Chinese Customs
Taiwan Province of China	Taiwan: Export Prices (SA, 2011=100)	DGBASY/H
Croatia, Cyprus, Romania and Malta	Exports: Unit Value Index w/ World (NSA, 2010=100) - Seasonal Adjustment, All	Eurostat
Euro area	EA19: Export Unit Value Index with NonEA (NSA, 2010=100) - Seasonal Adjustment, All	Eurostat
Philippines	Philippines: Export Prices (2005=100)	IMF
Hong Kong SAR	China, PR: Hong Kong: Unit Value of Exports (2010=100, NSA) - Seasonal Adjustment, All	IMF
Singapore	Singapore: Export Prices (2010=100, NSA) - Seasonal Adjustment, All	IMF
Thailand	Thailand: Unit Value of Exports (2010=100, NSA) - Seasonal Adjustment, All	IMF

Shocks		
Shock type	Underlying Series	Source & Construction
Oil demand shock	Reduced-form oil price shock	"The Role of Inventories and Speculative Trading in the Global Market for Crude Oil" by Kilian and Murphy
US monetary policy shock	Romer and Romer monetary shock series *Robustness:* TBILL_surprise series	Wieland and Yang's (2016) update of "A New Measure of Monetary Shocks: Derivation and Implications" by Romer and Romer (2004). TBILL_surprise series is constructed by taking the difference of TBILL1 and TBILL3 series from the Survey of Professional Forecasters. [23] This is the difference between the 1-quarter-ahead treasury bill forecast and the realized treasury bill.
US fiscal policy shock	Exogenous legislated tax changes *Robustness:* All legislated tax changes RFEDGOV_surprise series	"The macroeconomic effects of tax changes: estimated based on a new measure of fiscal shocks" by Romer and Romer (2010) "The macroeconomic effects of tax changes: estimated based on a new measure of fiscal shocks" by Romer and Romer (2010) RFEDGOV_surprise series is constructed by taking the difference of RFED1 and RFED3 series from the Survey of Professional Forecasters (St. Louis Fed). This is the difference between the 1-quarter-ahead forecasted real federal government spending and the realized real federal government spending.
US Uncertainty Shock	VIX	Chicago Board Options Exchange; shocks are constructed as the quarter-on-quarter percentage change of the index

B.2 Data Coverage

The BIS data on trade weights used in this paper cover the following 61 economies: Algeria, Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, China, Chinese Taipei, Colombia, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Euro Area, Finland, France, Germany, Greece, Hong Kong SAR, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Malaysia, Malta, Mexico, Netherlands, New Zealand, Norway, Peru, Philippines, Poland, Portugal, Romania, Russia, Saudi Arabia, Singapore, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, United Arab Emirates, United Kingdom, United States and Venezuela.

[23] To take the difference, TBILL1, TBILL3, RFEDGOV1 and RFEDGOV3 series had to be brought to the right quarter, as TBILL1 and RFEDGOV1 observation at time t are realized values of respective variable at time t-1 and TBILL3 and RFEDGOV3 observations are forecasted values of each variable of time t+1. So, TBILL1 and RFEDGOV1 were brought back by 1 quarter, and TBILL3 and RFEDGOV3 series was pushed forward 1 quarter.