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Trade margins and exchange rate regimes: evidence from a panel VARX

Lilia Cavallari, *University of Rome III*
Stefano Daddona

Trade margins and exchange rate regimes: new evidence from a Panel VARX model

Lilia Cavallari*   Stefano D'Addona†

Abstract

This paper studies output and trade margin dynamics in the aftermath of external shocks in fixed and floating exchange rate regimes. Using a panel VARX model, it traces the mean responses of output, terms of trade, extensive and intensive margins to real and nominal shocks in 22 developed economies over the period 1988-2011. It clarifies the role of trade margins for the transmission of shocks. A business cycle expansion abroad implies positive output spillovers through the trade channel in any exchange rate regime. Yet in the sample of peggers, there is a switch from trade of previously traded goods towards trade of new products and previously non-traded goods. This in turn exacerbates output fluctuations. Overall, our findings provide novel evidence in support of the stabilization advantages of flexible exchange rates based on their ability to smooth extensive margins. These findings are consistent with the predictions of theoretical models with firm entry.

Keywords: trade margins, international business cycle, Panel VARX, panel VAR, exchange rate regimes, firm entry, product creation.

JEL codes: E32; E52; F41

*Lilia Cavallari, Department of Political Science, University of Rome 3, Via Chiabrera, 199, 00145 Rome, Italy, email: lilia.cavallari@uniroma3.it.

†**Corresponding author**. Department of Political Science, University of Rome 3, Via G. Chiabrera, 199, I-00145 Rome; +39-06-5733-5331; daddona@uniroma3.it.

1 Introduction

It is a well-established fact that a relevant fraction of the growth in trade volumes occurs at the extensive margin, with exports of new products and previously non-traded goods (see Kehoe and Ruhl, 2013). The relevance of product creation and destruction for overall production is amply documented. Bernard et al. (2010) show that the value of new products represents 34 percent of US output over a 5-year horizon and the lost value from product destruction over the same period is 30 percent. The importance of product creation and destruction is confirmed by Broda and Weinstein (2010), who use the finest possible level of disaggregation: the product barcode. In addition, they report that product creation is strongly pro-cyclical at quarterly business cycle frequency. Inspired by these facts, a new generation of DSGE models has emerged stressing the business cycle implications of product creation and destruction.[1] In these models, product creation (destruction) is proxied by firm entry (exit). In open economies, the propagation of shocks worldwide may vary in important dimensions depending on whether trade adjusts at the intensive or the extensive margin. Yet evidence on the role of trade margins in the transmission of shocks is still very limited. This paper aims to bridge the gap.

The paper provides a description of output and trade margin dynamics in the aftermath of external shocks in different exchange rate regimes. It traces the mean responses of output, terms of trade, intensive and extensive margins to real and nominal shocks in twenty-two developed economies over the period 1988-2011. Its purpose is to study the role of trade margins in the propagation of shocks in fixed and floating regimes and assess the stabilization properties of flexible exchange rates compared to fixed regimes. In departing from previous studies, the paper distinguishes trade adjustments at the extensive and the intensive margin. Extensive margins reflect trade of new products and previously non-traded goods while inten-

[1] Non-exhaustive examples include Ghironi and Melitz (2005), Corsetti et al. (2007, 2013) and Bilbiie et al. (2012).

sive margins represent trade of previously traded goods.

The econometric approach in the paper is a panel VARX model where the vector of endogenous variables comprises real output, terms of trade and trade margins, measured on a country pair basis, and the exogenous variables vector, common to all country pairs, comprises US real output, the Federal funds rate and energy prices. The model is semi-structural: external shocks are identified by means of a recursive ordering of the exogenous variables while domestic shocks are left unidentified. Using the bootstrap-bias corrected estimator based on Pesaran and Zhao (1999), we trace the mean responses of the dependent variables to external shocks in the full sample. In order to study the role of the exchange rate regime, we estimate the model in the samples of peggers and floaters.

Our contribution is twofold. First, the paper provides new evidence in support of the stabilization properties of flexible exchange rates. Since Friedman (1953), an advantage typically attributed to flexible exchange rates over fixed regimes is their ability to insulate the economy against real shocks. In a world with sticky prices, changes in the nominal exchange rate allow for larger movements in relative prices that help to smooth adjustment of output to real shocks. An empirical implication of this theory is that the responses to real shocks should differ across exchange rate regimes: flexible regimes should have smoother output (quantity) responses and quicker adjustments in relative price compared to fixed regimes. Advocates of fixed exchange rates, on the other side, point out that exchange rate variability exacerbates business cycle fluctuations in the wake of nominal shocks. More importantly, it may discourage trade flows. One of the major reason for adopting fixed exchange rates, especially hard pegs, in the first place is their ability to promote trade.[2] The stabilization advantages of flexible exchange rates may be more than offset by trade diversion towards countries with fixed exchange rates. Recent studies document

[2]Despite a long history of failures to find a robust relation between exchange rate variability and trade, Rose (1999) has revived the debate by showing that the adoption of a currency union raises bilateral trade by a large amount. Subsequent research has supported the statistical significance, if not the magnitude of this result.

that fixed exchange rates have indeed had a positive effect on the creation of new export varieties, i.e. on extensive margins.[3] This adds a new dimension to the old debate on the choice of the exchange rate regime: as long as fixed exchange rates help to smooth extensive margins, one might observe smoother quantity responses and quicker adjustment in relative prices in fixed regimes in contrast to the Friedman's hypothesis. As far as we know, this paper is the first attempt to provide evidence about the role of trade margins in output stabilization. We find that the mean responses of output in the sample of peggers are significantly larger than in the sample of floaters for all the shocks considered, supporting the Friedman's hypothesis. The finding rests on the extreme reactivity of extensive margins in fixed regimes: the mean responses of extensive margins in fixed regimes are between twice and four times as large as the responses in floating regimes depending on the type of shock. In addition, these responses are fairly persistent. Our interpretation is that flexible exchange rates, by increasing the long-term risks faced by exporters in foreign markets, reduce the incentive to trade new products or previously non-traded goods.

Second, the paper helps to bring to the data the predictions of international business cycle models with firm entry.[4] As is now well-understood, firm entry and the creation of new varieties influence the transmission of shocks along a number of dimensions. Investments at the extensive margin act as a business cycle amplifier and help to improve the performance of these models at replicating key facts in the data. Cavallari (2013) shows that entry provides a channel for positive international comovements: a business cycle expansion in one country leads to the creation of new varieties in the trading partner's market. One should therefore observe a positive response of extensive margins to external output shocks. We show that this is indeed

[3]See, among others, Bergin and Lin (2012) and Auray et al. (2012).

[4]Since the seminal study of Melitz (2003), a number of papers have investigated the implications of entry for the international business cycle. Open economy models with firm entry include, among others, Bergin and Glick (2007), Ghironi and Melitz (2005), Cavallari (2007, 2010, 2013) and Corsetti et al. (2007, 2013).

the case. In addition, these models suggest that exchange rate variability may affect the extent to which exporters adjust trade at the extensive and the intensive margin. First-time entry in foreign markets and the creation of new products require to strike a balance between expected revenues and sunk entry costs, implying a much longer horizon and hence a greater exposure to exchange rate risk than investments at the intensive margin. In the model of Bergin and Lin (2012), all of the adjustment of trade occurs at the extensive margin when exchange rate uncertainty is completely and permanently eliminated. A comparison of responses in the sample of peggers and floaters confirms this prediction.

The remainder of the paper is organized as follows. Section 2 describes the data and presents the econometric methodology. Section 3 discusses the main results and Section 4 concludes.

2 Empirical strategy

2.1 Data

We use annual panel data for 22 OECD countries plus the US over the period 1988-2011. Gross domestic product (GDP), the Federal funds rate and exchange rates are from the OECD StatExtracts database. The GDP is in domestic currency and expressed in real terms using the GDP deflator. The terms of trade are from the IFS-IMF database or the World Bank upon availability. These are defined as the price of a country's exports towards the world divided by the price of its imports from the world. An increase in the terms of trade is therefore an appreciation.

Trade margins are from the UN Comtrade database.[5] They are calculated from bilateral trade measures at the four-digit Standard International Trade Classification. Following Hummels and Klenow (2005), the extensive margin of exports from country j to country m is defined as:

[5] http://wits.worldbank.org/wits/

$$EM_m^j = \frac{\sum_{i \in I_m^j} X_{m,i}^W}{X_m^W} \tag{1}$$

where $X_{m,i}^W$ is the export value from the world to country m of category i, I_m^j is the set of observable categories in which country j has positive exports to country m, and X_m^W is the aggregate value of world exports to country m. The extensive margin is a weighted sum of country j's exported categories relative to all categories exported to country m, where the categories are weighted by their importance in world's exports to country m. EM_m^j is a positive index between 0 and 1, where 0 means that the extensive margin does not exist and where higher values of the index reflect a larger variety of categories exported.

The intensive margin of exports from country j to country m is defined as:

$$IM_m^j = \frac{X_m^j}{\sum_{i \in I_m^j} X_{m,i}^W} \tag{2}$$

where X_m^j is the total export value from country j to country m. The intensive margin is the value of j's exports to country m relative to the weighted categories in which country j exports to country m. IM_m^j is a positive index between 0 and infinity, where 0 means that the intensive margin does not exist, namely that country j has not previously exported a given product to country m, and where higher values of the index reflect a larger volume of exports of previously traded goods. By definition, the country j's share of world exports to country m is given by the product of the intensive and extensive margins:

$$Sh_m^j = \frac{X_m^j}{X_{m,i}^W} = EM_m^j IM_m^j \tag{3}$$

The measurement implies that for a given level of a country j's share in world exports to country m, the extensive margin would be higher if country j exports many different categories of products to country m whereas the intensive margin would be higher if it only export a few categories of products.

2.2 Panel VARX

The econometric model we adopt is a fixed-effects panel VARX model:

$$Y_{it} = \alpha_i + \beta(L)Y_{it-1} + \gamma(L)X_t + \varepsilon_{it} \tag{4}$$

where $\beta(L)$ and $\gamma(L)$ are matrix polynominals in the lag operator L, the country pair index is $i = j \times m$ with $j = 1, 2, ...N$ denoting the number of countries, $m = 1, 2, ...N$ and $m \neq j$ the destination country, the time index is $t = 1, 2, ...T$ and ε_{it} is the vector of errors in the system. The total number of observations in the panel is $22 \times 22 \times 24$.[6] The fixed effect for each country pair is represented by α_i. The endogenous variables vector Y_{it} comprises the log difference of the terms of trade and GDP together with any one of the extensive and intensive margin, i.e. $Y_{it} = (\Delta \log TOT_{it}, \Delta \log GDP_{it}, EM_{it})$ or $Y_{it} = (\Delta \log TOT_{it}, \Delta \log GDP_{it}, IM_{it})$ where Δ denotes the first-difference operator. The exogenous variables vector X_t, common to all country pairs, represents the log difference of US output, the Federal funds rate and the log difference of energy prices, i.e. $X_t = (\Delta \log GDP_t^{US}, FFR_t, \Delta \log Energy_t)$.

The dynamics of exogenous variables is given by the VAR model:

$$X_t = a + b(L)X_{t-1} + e_t \tag{5}$$

where e_t is the vector of exogenous errors with variance $E(e_t e_t') = \Sigma$ for all t.[7] As mentioned above, we focus our attention on the impact of external shocks on the dependent variables in the VARX. Before turning to the identification of these shocks, it is worth mentioning that global factors may affect the dependent variables and omitting them in the model (4) can lead to serious estimation bias (see Forni and Reichlin, 1998). This is the reason why we also include energy prices as a control variable. Moreover, energy prices belong to the information set of central

[6] The destination country includes the US.

[7] The exogenous VAR model is estimated over the period 1970-2011 in order to improve efficiency.

banks and omitting them would imply a price puzzle, i.e., a counter-factual increase in inflation after a rise in the monetary policy rate.

In equation (4) we assume the homogeneous error structure $E(\varepsilon_{it}\varepsilon_{it}') = \Omega$ for all i and t. Furthermore, we assume independence of the errors within the equations, $E(\varepsilon_{is}\varepsilon_{it}') = 0$ for $s \neq t$, and across equations, $E(\varepsilon_{is}\varepsilon_{ht}') = 0$ for any s and t when $i \neq h$. Since we are interested in the average responses to common shocks, overlooking variance heterogeneity (the fact that the shocks hitting different countries may have different magnitude) and static interdependencies (the fact that the shocks may be correlated across countries) is less restrictive than it might appear at first. In our exercise, it is more important to allow for slope heterogeneity (different countries may respond differently to the shocks). This is captured by country pair fixed effects as well as by differences in the estimated parameters across sub-samples.

After controlling for fixed effects, the multiplier form of the model can be written as:

$$Y_{it} = \beta(L)^{-1}\gamma(L)X_t + \beta(L)^{-1}\varepsilon_{it} \tag{6}$$

The mean responses to external shocks are therefore captured by the lag polynomial $\beta(L)^{-1}\gamma(L)$. As pointed out by Nickell (1981), the least-squares dummy variable (LSDV) estimator or within (fixed-effect) estimator is inconsistent in dynamic models with small T, even if the number of countries N goes to infinity. The bias decreases as T grows. In our model, the time dimension is not large enough for the LSDV estimator. In order to obtain a bias correction of the LSDV estimator, we apply the bootstrap strategy in Pesaran and Zhao (1999). As stressed by these authors, the bootstrap-bias corrected estimator (BSBC) is appealing compared to analytical bias corrections for a number of reasons. First and foremost, it does not require theoretical assumptions on the model. Specifically, analytical corrections imply assumptions on the short-run coefficients of the model that may be difficult to reconcile with the non-linear dependence of the mean responses on these coefficients.

Second, the bootstrap approach provides a direct correction of the mean responses while these are mediated by the short-run coefficient with analytical corrections. We follow Fomby et al. (2013) in adapting the bootstrap algorithm of Pesaran and Zhao (1999) to our unbalanced panel.

Identification of external shocks is achieved by assuming a contemporaneous recursive ordering where the exogenous variables are ordered as given in the definition of X_t. This entails the assumption that the US GDP does not react to a contemporaneous innovation in the Federal funds rate either directly or through the effect of the policy rate on energy prices. Moreover, the Federal funds rate does not react to a contemporaneous innovation in energy prices. The first two restrictions distinguish between real (GDP) and nominal shocks while the latter sorts monetary policy and energy price shocks. All these restrictions are standard in structural VAR models (see Christiano et al., 1999). Domestic shocks are left unidentified. [8]

In order to assess the impact of the exchange rate regime, the model is applied to two different groups of countries: peggers and floaters. The sample of "peggers" includes all country pairs with a fixed exchange rate regime (i.e., to be included in the sample of peggers both the origin and destination countries must adopt a fixed exchange rate regime in our classification). In our data, the sample of peggers comprises European country pairs and reflects intra-EMU trade. The sample of "floaters" includes the pairs with a flexible exchange rate (i.e. to be included among the floaters at least one country must adopt a flexible exchange rate regime in our classification). We test the significance of differences in the mean responses in the two samples using bootstrapping methods as in Born et al. (2013).

2.3 Diagnostic tests

The VARX model presented in the previous section rests on the assumption of stationarity of the variables. Before we can proceed to estimate the model, we need

[8] We tried several recursive orderings of the endogenous vector in the VARX model. This did not significantly change our results.

to determine the stationary form of the variables that will be used. To this end we perform individual and panel unit root tests on the following 6 variables: the log of real GDP, the log of the terms of trade, the level of external and internal margins, the level of the Federal funds rate and the log of energy prices. We use the log transformation whenever possible for two reasons. The first is the well-known variance stabilizing property of the log transformation. The second is that if a unit root is contained in the logged variables, then differencing them provides a straightforward interpretation of the differenced data as percentage change.

The individual unit root tests are the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test applied on a series-by-series basis. The panel unit root test is the ADF test in the model with individual country effects as in Levin et al. (2002). All these unit root tests are dependent on the specification of the deterministic part of the unit root (auto-regressive) equations. We test the significance of the trend in the above 6 variables by testing the significance of the intercept in the following AR(2) equation of the variable in question, country by country:

$$\Delta Z_{it} = \alpha_i + \phi_i Z_{it-1} + \varphi_i \Delta Z_{it-1} + \epsilon_{it}$$

In the case that the null $H_0 : \alpha_i = 0$ is not rejected, we conclude that the data do not have a time trend. The hypothesis that the data do not have a time trend is supported for extensive and intensive margins, and the Federal funds rate. The null hypothesis is rejected for the remaining variables. Therefore, in applying the unit root tests we treat the data for real GDP, terms of trade and energy prices as having a trend. In the remaining data, the ADF equations include an intercept.

Individual unit root tests could not reject the existence of a unit root in the data for GDP, the terms of trade and energy prices in almost all countries.[9] The hypothesis of a unit root is rejected when differenced data for these variables are

[9]Details on these statistics are available upon request.

considered. These results are confirmed by the panel unit root tests. We therefore conclude that GDP, terms of trade and energy prices are I(1). Individual and panel unit root tests allow to reject the null hypothesis of a unit root in all remaining data. We conclude that extensive margins, intensive margins and the Federal funds rate are I(0).

The presence of non-stationary variables raises the question whether an error correcting specification, namely a VECM model, might be appropriate for describing the dynamics of the model. A linear combination of GDP and the terms of trade, the cointegrating vector, might be stationary implying the existence of a long-run relation between these two variables. We test the significance of a cointegrating relation between GDP and the terms of trade with the Westerlund ECM panel cointegration test. The null hypothesis of no cointegration could not be rejected against the alternative hypothesis that a cointegrating relation between GDP and the terms of trade exists for at least one country in the sample. Consequently, estimating the VARX model in first differences for GDP and the terms of trade without imposing any cointegrating relation between these two variables is a good approximation.

Before estimating the VARX model, we need to know how many lags of the dependent and the exogenous variables need to be included. As is standard practice, we use the Akaike Information Criterion (AIC) and the Schwartz's Bayesian information criterion (SBC). In all panels, these criteria suggest including either one or two lags. We use a parsimonious one-lag specification for our VARX model, though we checked that using two lags would not lead to different conclusions. In the exogenous VAR model standard criteria suggest including 2 lags.

A key assumption in the VARX model (4) is block exogeneity of US variables and energy prices, namely the assumption that these variables are exogenous in the time series sense with respect to the dependent variables (Y_{it} cannot help forecast X_t). In principle, large economies might exert a non-negligible influence on external variables. For instance, energy producers might influence energy prices in world markets. In practice, however, we will soon show that such an influence has no significant impact on the predictability of the exogenous variables in our data. This in turn suggests that the bias eventually introduced by assuming that US variables and energy prices are exogenous is small. We test the hypothesis that the vector X_t is block exogenous in the model (4) using the panel Granger-non causality test of Dumitrescu and Hurlin (2012). The test is a Wald statistic and is applied to all country pairs. The null hypothesis is that the dependent variables do not Granger-cause the exogenous variables. The test does not reject the null hypothesis at the 1% significance level in almost all country pairs. Precisely, the null is rejected only in 9% of all country pairs. We have excluded these country pairs from the estimations with no major consequence for the results.

3 Results

We now discuss the main results on the impact of external shocks. We organize the presentation by type of shock: a real shock is a one-standard deviation increase in US output growth, a monetary policy shock is a one-standard deviation increase in the Federal funds rate and the energy price shock is a one-standard deviation increase in energy inflation. For each of them, we consider the dynamic effect on output growth, terms of trade growth and trade margins in the full sample. Then, we estimate these effects separately for the samples of peggers and floaters.

Since we are interested in tracing out the dynamic path of adjustment in the aftermath of external shocks, we consider the mean responses of the dependent variables to a given shock for each year since the shock occurred. As explained before, these mean responses combine the conditional effects of external shocks on the dependent variables with their own auto-regressive process. Since the effects of the shocks dye out in approximately 6 years we consider the mean responses for years 0 to 6. In addition, we report 10% confidence intervals generated by Monte Carlo simulations with 1000 replications.

The main results for the full sample are presented in Figures 1 and 2 for the model with, respectively, extensive and intensive margins. In order to assess the stabilization advantages of the exchange rate regime, we then compare the mean responses in the sample of peggers with those in the sample of floaters. In this exercise, we focus on US shocks. Figure 3 and 4 display the mean responses to output shocks in the model with extensive and intensive margins respectively. Figure 7 and 8 do the same for monetary policy shocks.

For ease of interpretation, we report below the expected signs of the responses.

	GDP^{US}	FFR	$Energy$
GDP_i	+	+/-	-
TOT_i	+/-	+/-	-
XM_i	+	+/-	-
IM_i	+/-	+/-	-

External output shocks are expected to have positive spillovers through the trade channel: a business cycle expansion in the US leads to higher US imports thereby stimulating output in US trading partners. In principle, these spillovers may imply any combination of changes at the extensive and the intensive margin. In traditional business cycle models, all of the adjustment takes place at the intensive margin: exporters increase the volume of previously traded goods whenever business conditions are favourable. We should therefore observe a positive response of intensive margins to external output shocks. Entry models predict that exporters will react to a favourable business environment by creating new products and trading previously non-traded goods. The expected response of extensive margins is therefore positive. In these models trade of new products may come at the expense of previously traded goods: when a large number of new firms enters the export market the average size of incumbents may decline. As a consequence, the response of intensive margins may turn negative. As it will be clear soon, adjustment takes place mostly along the extensive margin and particularly so in fixed exchange rate regimes.

The response of the terms of trade is in principle ambiguous as it depends on the extent to which relative prices in global markets are affected by changes in relative prices with the US as well as by changes in bilateral exchange rates with the US dollar. All these adjustments in turn are affected by the structure of trade of each country with respect to the US and the rest of the world. To get an intuitive account consider for example a situation where prices are fixed in the currency of consumers. The appreciation of the US currency in a US business cycle expansion will improve the terms of trade of countries that export substitutes of US exports. Export prices will in fact rise in domestic currency and the more so the higher the switch of world demand away from US products. By the same token, the US dollar appreciation deteriorates the terms of trade of countries that import substitutes of US goods.

External monetary policy shocks have two opposing effects on the trade channel. First, a monetary tightening in the US reduces US imports (the income effect), thereby generating negative output spillovers in the US trading partners. These spillovers are large especially in countries for which the US represent a major export market. Second, it appreciates the US dollar, making US products less competitive in global markets and switching world demand towards the products of US trading partners (the substitution effect). Output spillovers are clearly positive in this case. Which one of these two effects prevails depends on the elasticity of demand for US imports and for the substitutes of US exports as well as on the relevance of US products in a country's overall trade. For given elasticities, the larger the share of substitutes of US products in a country's trade the larger the substitution effect. As we will see, there are remarkable differences in the transmission of monetary policy shocks in fixed and floating exchange rate regimes.

Energy price shocks are expected to have negative effects on all variables. In particular, a negative response of the terms of trade reflects the fact that our sample includes only a limited number of energy producers so that the eventual appreciation of their terms of trade has a negligible impact on the mean response.

[Figure 1 about here.]

[Figure 2 about here.]

3.1 Real shocks

In the full sample, US output shocks have positive spillovers on output and trade margins as expected. The mean response of output is high on impact then it gradually reduces over time and dyes out completely after three years. The cumulated average increase in output growth in the aftermath of the output shock is 1.93 percent.

The mean response of trade margins is positive: the cumulated average increase in extensive and intensive margins is, respectively, 0.63 and 0.06 percent over their mean. The response of extensive margins is persistent throughout the transition and reverts to the mean in approximately 8 years (not shown in Figure 1). It has a hump shape with a peak after one year and a half. Intensive margins display a gradual decline after the initial impulse. We stress that the response of extensive margins is consistent with the predictions of international business cycle models with firm entry. As pointed out by Cavallari (2013), firm entry generates positive comovements across countries: a business cycle expansion in one country leads to export of new products (i.e., a rise in the extensive margin) in the trading partner's market. Moreover, the presence of a hump accords with the idea suggested in these models that adjustments at the extensive margin enatil time-varying trade-offs between entry costs and the prospective revenues of investments in new products.

The mean response of the terms of trade is positive on impact, then it turns negative for a while before reverting to the trend. As discussed above, changes in the terms of trade reflect changes in relative prices and nominal exchange rates. Considering that prices are likely to be sticky in the early part of the transition, one might interpret the initial response as the result of a change in the nominal exchange rate with the US dollar. As long as a business cycle expansion in the US appreciates the US dollar, the products of US trading partners become more appealing and world demand switches towards substitutes of US products. Consequently, the terms of trade appreciate. Over time, as nominal prices adjust the effect is reversed.

[Figure 3 about here.]

[Figure 4 about here.]

Comparing mean responses in the samples of peggers and floaters reveals a number of interesting features. A visual inspection of Figures 3 and 4 shows that there are remarkable differences in the transmission of real shocks. First, the mean response of output is higher in the sample of peggers than in the sample of floaters: the difference in the cumulated response is as large as 0.22 (0.21) in the model with extensive (intensive) margins. This accords with the Friedman's hypothesis that flexible exchange rates help to smooth output in the wake of real shocks.

Second, adjustment seems to occur mainly at the extensive margin in fixed regimes. The mean response of extensive margins in the sample of peggers is almost 4 times as high as the response among floaters. By contrast, the responses of intensive margins are similar in quantitative terms yet opposite in sign. The behaviour of trade margins is consistent with the findings of recent studies showing that trade flows vary mostly along the extensive margin in fixed regimes.[10] A novel contribution of our study is to clarify the role of trade margins for the transmission of shocks. A business cycle expansion abroad implies positive output spillovers

[10] In panel regressions for European countries, Bergin and Lin (2012) show that extensive margins have responded aggressively to the implementation of the Economic and Monetary Union in Europe (EMU). They find a statistically significant rise in extensive margins already four years ahead of actual EMU adoption, and ahead of any rise in overall trade. The estimated effect of the adoption of the Euro on the intensive margin of trade is, on the contrary, negligible. See also Auray et al. (2012).

through the trade channel in any exchange rate regime. Yet in the sample of peggers, trade switches from previously traded goods towards new products and previously non-traded goods (the so-called variety effect). A strong variety effect in turn exacerbates output fluctuations. Our interpretation is that flexible exchange rates, by increasing the long-term risks faced by exporters in foreign markets, reduce the incentive to trade new products at the expense of previously traded goods. The finding that flexible regimes smooth the responses of extensive margins strengthens the traditional argument in favour of the stabilization property of these regimes.

Finally, consider the responses of the terms of trade across exchange rate regimes. In the sample of peggers, the terms of trade depreciate on impact, then gradually appreciate before reverting to the trend in approximately 2 years. The terms of trade of floaters move in the opposite direction. Since all countries in our dataset have flexible exchange rates with the US dollar, these responses reflects differences in the structure of trade between peggers and floaters. In order to see why, consider an appreciation of the US dollar. US products become less competitive in global markets and this tends to improve the terms of trade of countries that export substitutes of US products and to deteriorate the terms of trade of countries that import substitutes of US products. Which one of these opposing effects prevails depends on the structure of trade as well as on the degree of exchange rate pass-through in import and export prices. In the sample of peggers, that includes Euro-zone countries in our dataset, the latter effect dominates.

In order to test the statistical significance of the impact of the exchange rate regime, Figures 5 and 6 depict the difference in the mean responses of peggers and floaters together with 10% confidence intervals in the model with, respectively, extensive and intensive margins. Confidence intervals are computed by bootstrapping methods as in Born et al. (2012). [11] All differences are statistically significant.

[11] Confidence intervals for the difference of the mean responses in the sample of peggers and floaters reflect differences in the variance of the estimated coefficients equation by equation (i.e., differences in the variance structure of floaters and peggers) as well as across equations (i.e. difference in the covariance structure between floaters and peggers).

Those of the terms of trade are high on impact then rapidly reduce and vanish completely after 2 years. The reason is easy to grasp: the advantages of flexible exchange rates hinge on price stickiness, i.e. on their ability to affect relative prices when nominal prices are sticky. Over time, as prices adjust, the impact of the exchange rate regime becomes negligible. Differences in the responses of output and trade margins are persistent up to 5 years, and all of them except intensive margins are hump-shaped.

[Figure 5 about here.]

[Figure 6 about here.]

3.2 Monetary policy shocks

In the full sample, the mean response of output to a US monetary restriction is positive. As is discussed above, positive spillovers reflect the switch of world demand towards substitutes of US products when the US dollar appreciates. It is worth noticing that trade flows adjust positively at the extensive margin and negatively at the intensive margin: trade shifts from previously traded goods to new products and prevously non-traded goods. The possibility of exporters adjusting the weight of new and previously traded goods over the cycle is stressed in models with firm entry. It is due to the fact that business cycle fluctuations affect the balance between sunk entry costs and expected dividends of investments at the extensive margin, thereby altering the attractiveness of exporting new products compared to previously traded goods. Following this argument, our findings can be interpreted as evidence that entry costs provide an important channel for the transmission of monetary policy shocks.

[Figure 7 about here.]

[Figure 8 about here.]

Comparing mean responses across exchange rate regimes reveals interesting insights on the transmission of monetary policy shocks worldwide. Output spillovers are higher in the sample of peggers: the responses of output in Figures 7 and 8 are almost twice as large for peggers than for floaters. In addition, trade spillovers are higher in fixed regimes. While extensive margins increase in both samples and the more so for peggers, intensive margins decline in the sample of peggers.

These results are in contrast with the view that fixed exchange rates help to smooth cyclical fluctuations in the wake of nominal shocks: since Poole (1970) an advantage typically attributed to fixed exchange rates is their ability to insulate the economy from external nominal shocks. Our findings support an alternative explanation: flexible exchange rates, by raising the risks faced by exporters, help to smooth trade at the extensive margin. This in turn facilitates output stabilization. As before, we test the significance of differences in the mean responses in the sample of peggers and floaters. The responses in the botton row of Figures 5 and 6 show that all differences are significant.

4 Conclusions

This paper studied the dynamics of output and trade margins in the wake of external shocks in fixed and floating exchange rate regimes. The objective of the analysis is twofold. It verifies the predictions of international business cycle models about the behaviour of export margins over the cycle and across exchange rate regimes. It re-assesses the stabilization properties of flexible exchange rates when trade adjusts at the intensive and the extensive margin.

Using a panel VARX model, the paper traces the mean responses of output, terms of trade and trade margins to real and nominal shocks in twenty-two developed economies over the period 1988-2011. We find that the mean responses of output in the sample of peggers are larger than in the sample of floaters independently of the type of shock considered. An important contribution of our study is to clarify the role of trade margins for the transmission of shocks. A business cycle expansion abroad implies positive output spillovers through the trade channel in any exchange rate regime. Yet in the sample of peggers, there is a switch from trade of previously traded goods towards trade of new products and previously non-traded goods (the so-called variety effect). A strong variety effect in turn exacerbates output fluctuations.

Overall, our findings provide novel evidence in support of the stabilization advantages of flexible exchange rates based on their ability to smooth extensive margins. These findings are consistent with the predictions of theoretical models with firm entry.

References

Auray, Stphane, Aurlien Eyquem, and Jean-Christophe Poutineau, "The effect of a common currency on the volatility of the extensive margin of trade," *Journal of International Money and Finance*, 2012, *31* (5), 1156 – 1179.

Bergin, Paul and Reuven Glick, "A Model of Endogenous Nontradability and its Implications for the Current Account," *Review of International Economics*, November 2007, *15* (5), 916–931.

Bergin, Paul R. and Ching-Yi Lin, "The dynamic effects of a currency union on trade," *Journal of International Economics*, 2012, *87* (2), 191 – 204.

Bernard, Andrew B., Stephen J. Redding, and Peter K. Schott, "Multiple-Product Firms and Product Switching," *American Economic Review*, 2010, *100* (1), 70 – 97.

Bilbiie, Florin O., Fabio Ghironi, and Marc J. Melitz, "Endogenous Entry, Product Variety, and Business Cycles," *Journal of Political Economy*, 2012, *120* (2), 304 – 345.

Born, Benjamin, Falko Juessen, and Gernot J. Mller, "Exchange rate regimes and fiscal multipliers," *Journal of Economic Dynamics and Control*, 2013, *37* (2), 446 – 465.

Broda, Christian and David E. Weinstein, "Product Creation and Destruction: Evidence and Price Implications," *American Economic Review*, 2010, *100* (3), 691 – 723.

Cavallari, Lilia, "A Macroeconomic Model of Entry with Exporters and Multinationals," *The B.E. Journal of Macroeconomics*, 2007, *7* (1), 446 – 465.

_ , "Exports and foreign direct investments in an endogenous-entry model with real and nominal uncertainty," *Journal of Macroeconomics*, 2010, *32* (1), 300 – 313.

_ , "Firms' entry, monetary policy and the international business cycle," *Journal of International Economics*, 2013, *91*, 263–274.

Christiano, Lawrence J., Martin Eichenbaum, and Charles L. Evans, "Monetary policy shocks: What have we learned and to what end?," in John B. Taylor and Michael Woodford, eds., , Vol. 1, Part A of *Handbook of Macroeconomics*, Elsevier, 1999, pp. 65 – 148.

Corsetti, Giancarlo, Philippe Martin, and Paolo Pesenti, "Productivity, terms of trade and the home market effect," *Journal of International Economics*, 2007, *73* (1), 99 – 127.

_ , _ , and _ , "Varieties and the transfer problem," *Journal of International Economics*, 2013, *89* (1), 1 – 12.

Dumitrescu, Elena-Ivona and Christopher Hurlin, "Testing for Granger non-causality in heterogeneous panels," *Economic Modelling*, 2012, *29* (4), 1450–1460.

Fomby, Thomas, Yuki Ikeda, and Norman V. Loayza, "The growth aftermath of natural disasters," *Journal of Applied Econometrics*, 2013, *28* (3), 412–434.

Forni, Mario and Lucrezia Reichlin, "Let's Get Real: A Factor Analytical Approach to Disaggregated Business Cycle Dynamics," *The Review of Economic Studies*, 1998, *65* (3), 453–473.

Friedman, M., "The case for flexible exchange rates," in University of Chicago Press, ed., *Essays in Positive Economics*, Milton Friedman, Chicago, IL.: University of Chicago Press, 1953.

Ghironi, Fabio and Marc J. Melitz, "International Trade and Macroeconomic Dynamics with Heterogeneous Firms," *The Quarterly Journal of Economics*, 2005, *120* (3), 865–915.

Hummels, David and Peter J. Klenow, "The Variety and Quality of a Nation's Exports," *American Economic Review*, 2005, *95* (3), 704–723.

Kehoe, Timothy J. and Kim J. Ruhl, "How Important Is the New Goods Margin in International Trade?," *Journal of Political Economy*, 2013, *121* (2), 358–392.

Levin, Andrew, Chien-Fu Lin, and Chia-Shang James Chu, "Unit root tests in panel data: asymptotic and finite-sample properties," *Journal of Econometrics*, 2002, *108* (1), 1 – 24.

Melitz, Marc J., "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, 2003, *71* (6), 1695–1725.

Nickell, Stephen J, "Biases in Dynamic Models with Fixed Effects," *Econometrica*, November 1981, *49* (6), 1417–26.

Pesaran, M.H. and Zhirong Zhao, "Bias reduction in estimating long-run relationships from dynamic heterogeneous panels," in Hsiao C., Pesaran M.H., Lahiri K., and Lee L.F., eds., *Analysis of Panels and Limited Dependent Variable Models*, Cambridge, UK: Cambridge University Press, 1999, pp. 297–322.

Poole, William, "Optimal Choice of Monetary Instruments in a Simple Stochastic Macromodel," *The Quarterly Journal of Economics*, 1970, *84* (2), pp. 197–216.

Rose, Andrew K., "One Money, One Market: Estimating the Effect of Common Currencies on Trade," NBER Working Papers 7432, National Bureau of Economic Research, Inc December 1999.

Figure 1: Mean responses in the model with extensive margins. Full sample.

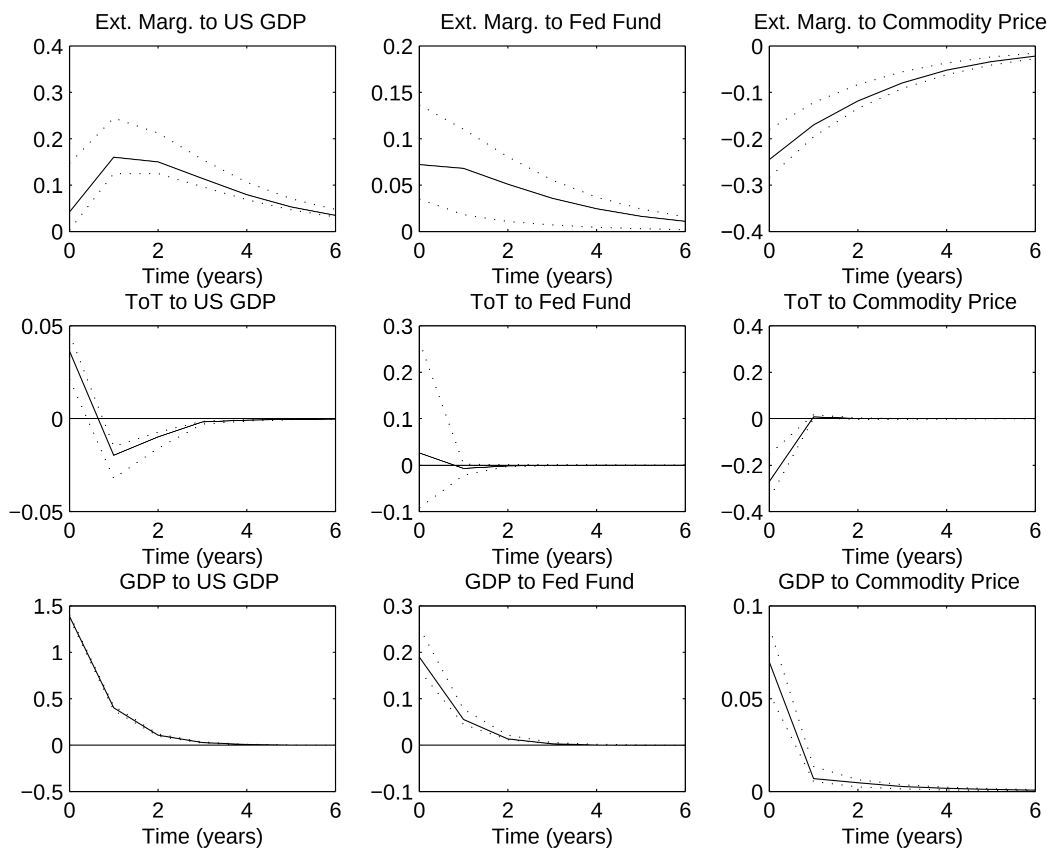

Figure 2: Mean responses in the model with intensive margins. Full sample.

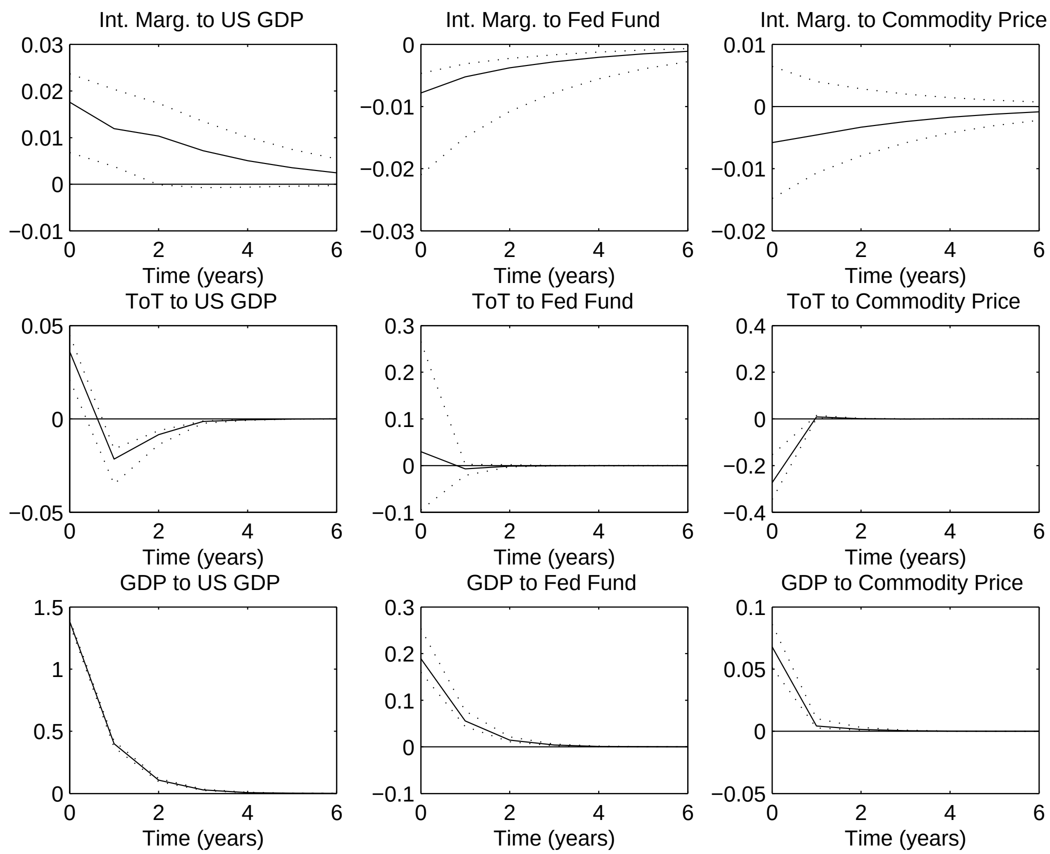

Figure 3: Mean responses in the model with extensive margins.

Mean responses to real shocks in the model with extensive margins in the sample of peggers (first row) and in the sample of floaters (second row).

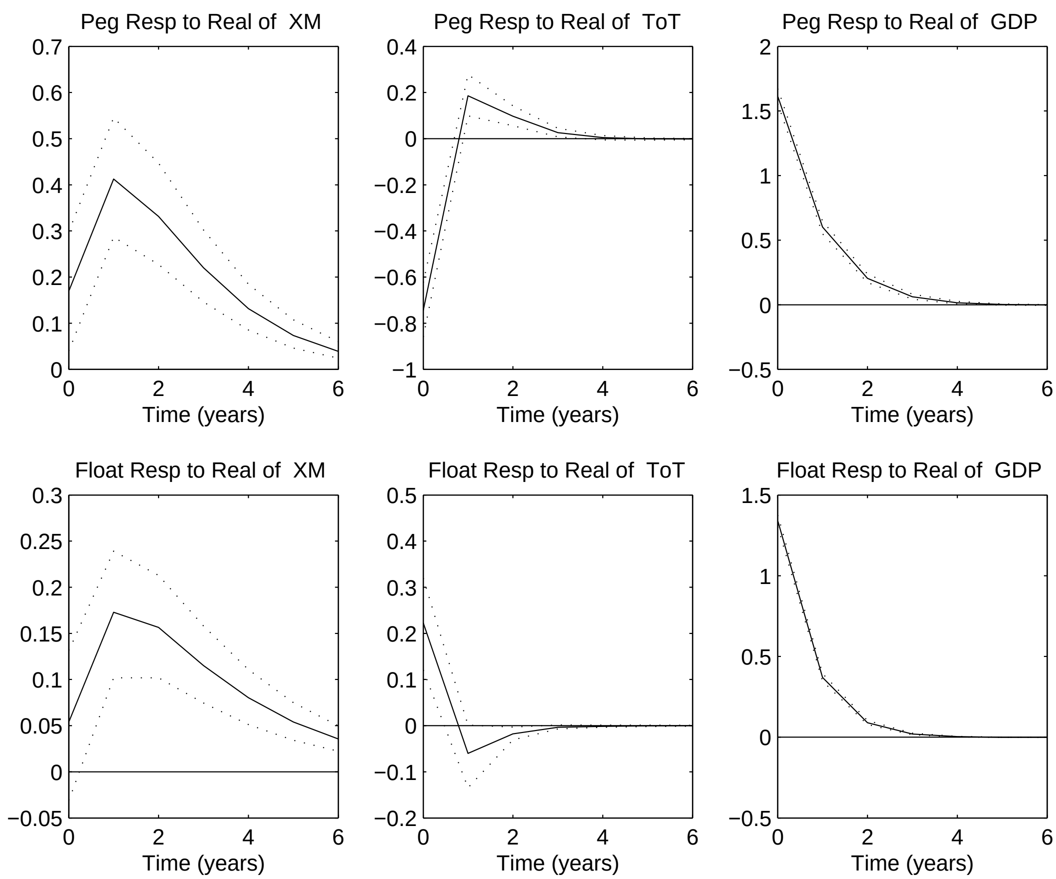

Figure 4: Mean responses in the model with intensive margins.

Mean responses to real shocks in the model with extensive margins in the sample of peggers (first row) and in the sample of floaters (second row).

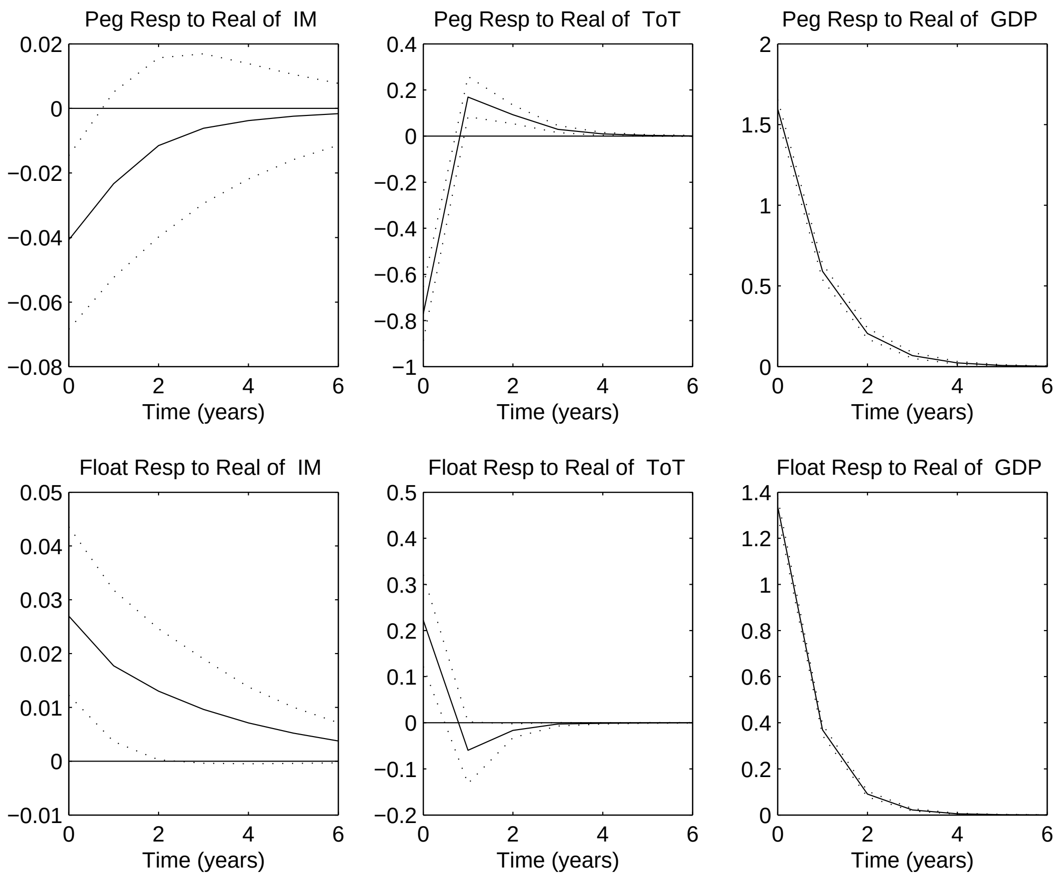

Figure 5: Difference in the mean responses of peggers and floaters in the model with extensive margins.

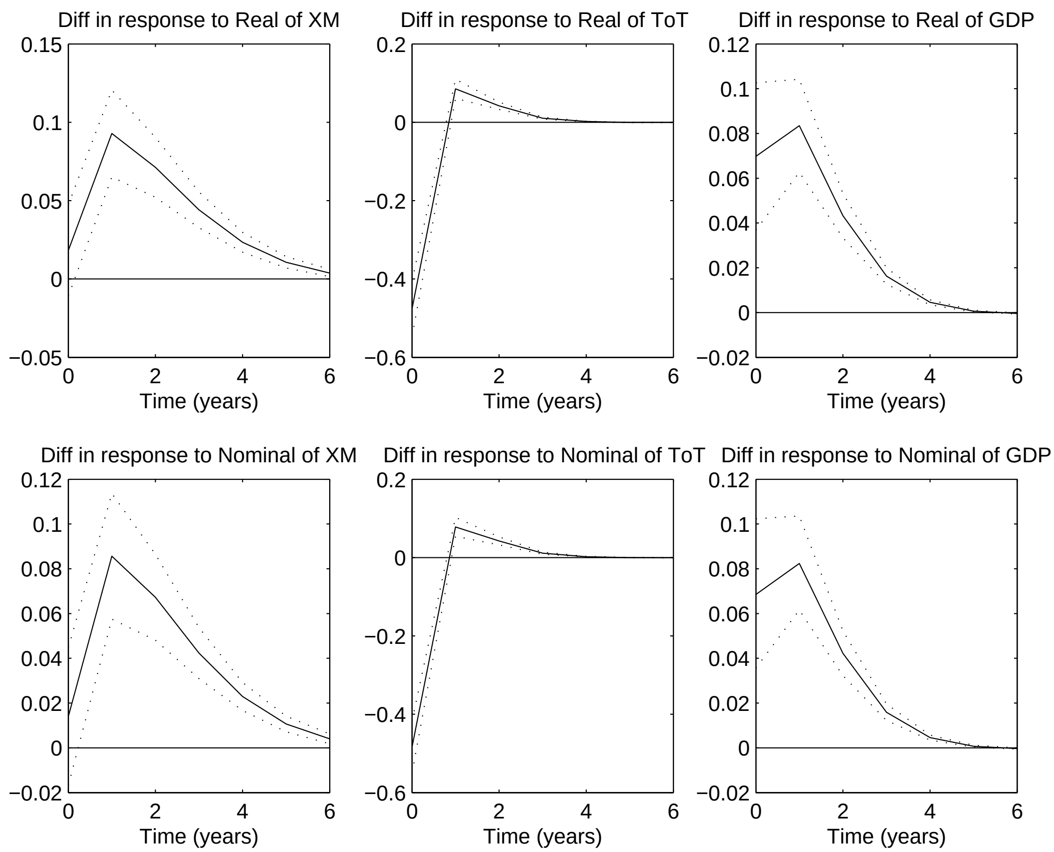

Figure 6: Difference in the mean responses of peggers and floaters in the model with extensive margins.

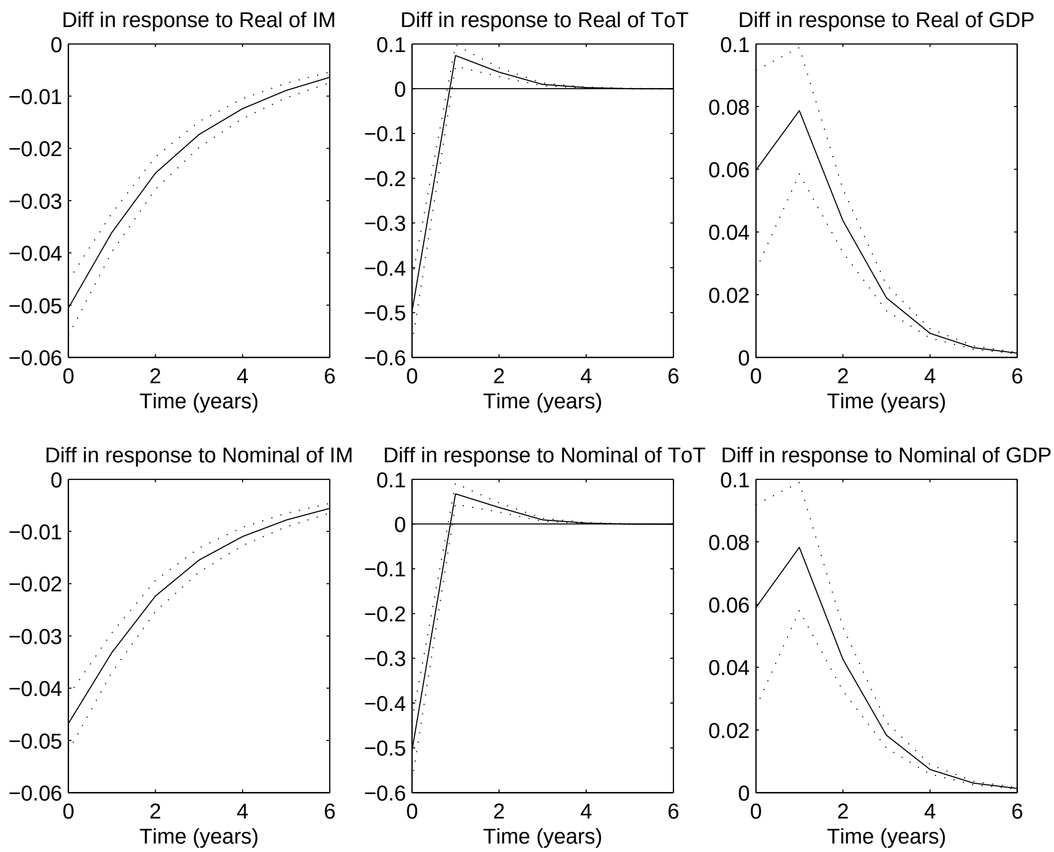

Figure 7: Mean responses to nominal shocks.

Model with extensive margins in the sample of peggers (first row) and in the sample of floaters (second row).

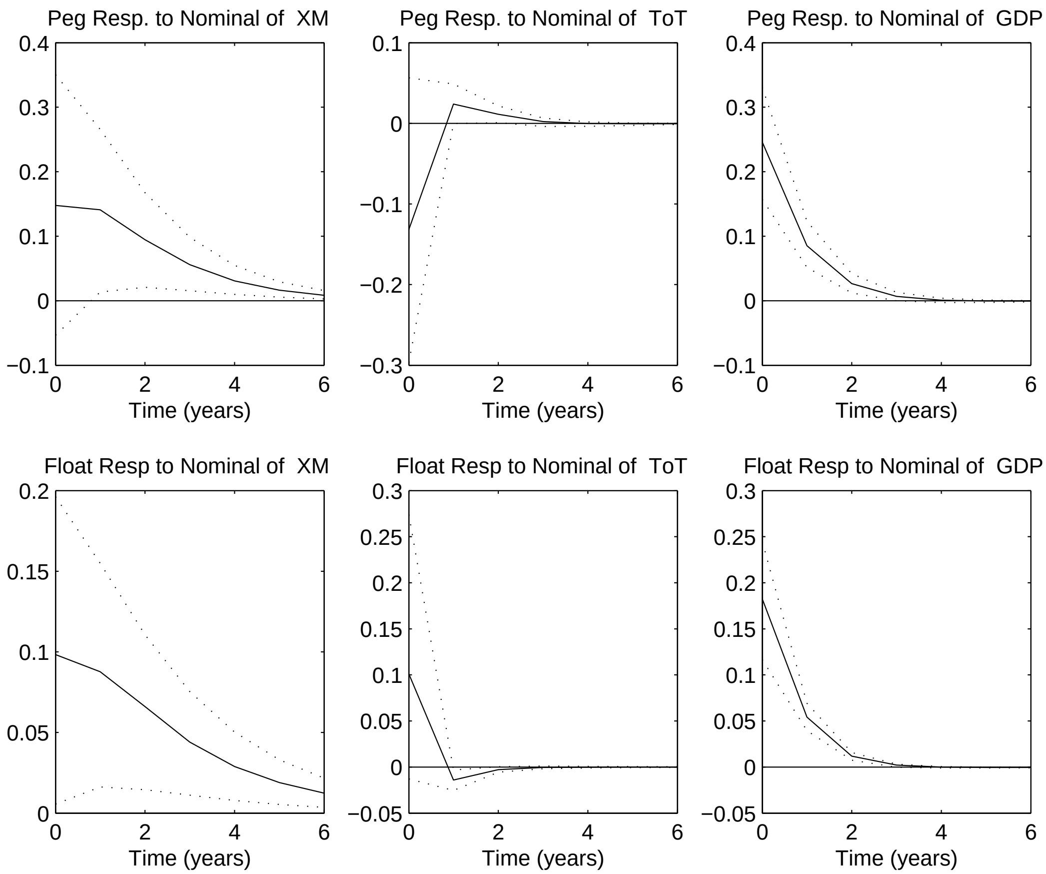

Figure 8: Mean responses to nominal shocks.

Model with intensive margins in the sample of peggers (first row) and in the sample of floaters (second row).