Beyond Competitive Devaluations:
The Monetary Dimensions of Comparative Advantage

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Abstract

Motivated by the long-standing debate on the pros and cons of competitive devaluation, we propose a new perspective on how monetary and exchange rate policies can contribute to a country's international competitiveness. We refocus the analysis on the implications of monetary stabilization for a country's comparative advantage. We develop a two-country New-Keynesian model allowing for two tradable sectors in each country: while one sector is perfectly competitive, firms in the other sector produce differentiated goods under monopolistic competition subject to sunk entry costs and nominal rigidities, hence their performance is more sensitive to macroeconomic uncertainty. We show that, by stabilizing markups, monetary policy can foster the competitiveness of these firms, encouraging investment and entry in the differentiated goods sector, and ultimately affecting the composition of domestic output and exports.

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1. Introduction

This paper offers a new perspective on how monetary and exchange rate policy can strengthen a country's international competitiveness. Conventional policy models emphasize the competitive gains from currency devaluation, which lowers the relative cost of producing in a country over the time span that domestic wages and prices are sticky in local currency. In modern monetary theory and central bank practice, however, the resort to competitive devaluation is not viewed as a viable policy recommendation, as it invites retaliation and currency wars, and furthermore, is bound to worsen the short-run trade-offs between inflation and unemployment. Conversely, recent contributions to the New Open Economy Macro (NOEM) and New-Keynesian (NK) tradition stress that monetary policymakers can exploit a country's monopoly on its terms of trade. As this typically means pursuing a higher international price of home goods, the implied policy goal appears to be the opposite of improving competitiveness.[1] In this paper, we take a different perspective, and explore the relevance of monetary and exchange rate regimes for a country's comparative advantage.

We motivate our analysis with the observation that monetary policy aimed at stabilizing marginal costs and demand conditions at an aggregate level (weakening or strengthening the exchange rate in response to cyclical disturbances) is likely to have asymmetric effects across sectors. Stabilization policy can be expected to be more consequential in industries where firms face higher nominal rigidities together with significant up-front investment to enter the market and price products---features typically associated with differentiated manufacturing goods. To the extent that monetary policy ensures domestic macroeconomic stability, it creates favorable conditions for firms' entry in such industries, with potentially long-lasting effects on their competitiveness, and thus on the weight of their production in domestic output and exports.

[1] In virtually all contributions to the new-open economy macroeconomics and New-Keynesian literature, the trade-off between output gap and exchange rate stabilization is mainly modeled emphasizing a terms-of-trade externality (see Obstfeld and Rogoff (2000) and Corsetti and Pesenti (2001, 2005), Canzoneri et al. (2005) in the NOEM literature, as well as Benigno and Benigno (2003), and Corsetti et al. (2010) in the New-Keynesian literature, among others). Provided the demand for exports and imports is relatively elastic, an appreciation of the terms of trade of manufacturing allows consumers to substitute manufacturing imports for domestic manufacturing goods, without appreciable effects in the marginal utility of consumption, while reducing the disutility of labor. The opposite is true if the trade elasticity is low.

To illustrate our new perspective on the subject, we specify a stochastic general-equilibrium monetary model of open economies with incomplete specialization across two tradable sectors. In one sector, conventionally identified with manufacturing, firms produce an endogenous set of differentiated varieties operating under imperfect competition; in the other sector, firms produce highly substitutable, non-differentiated goods---for simplicity we assume perfect competition. The key distinction between these sectors is that nominal rigidities are relevant only for the differentiated producers.

The key result from our model is that efficient stabilization regimes affect the *average* relative price of a country's differentiated goods in terms of its nondifferentiated goods, and, relative to the case of insufficient stabilization, confer comparative advantage in the sale of differentiated goods both at home and abroad. Underlying this result is a transmission channel at the core of modern monetary literature: in the presence of nominal rigidities, uncertainty implies the analog of a risk premium in a firm's prices, depending on the covariance of demand and marginal costs (See Obstfeld and Rogoff 2000, Corsetti and Pesenti 2005 and more recently Fernandez-Villaverde et al. 2011). We show that, by impinging on this covariance, and thus on the variability of the ex-post markups, optimal monetary policy contributes to manufacturing firms setting efficiently low, competitive prices *on average,* with a positive demand externality affecting the size of the market. A large market in turn strengthens the incentive for new manufacturing firms to enter, see e.g., Bergin and Corsetti (2008) and Bilbiie, Ghironi and Melitz (2008). An implication of the theory that is relevant for empirical and policy-related research is that, everything else equal, countries with a reduced ability to stabilize macro shocks will tend to specialize away from differentiated manufacturing goods, relative to the countries that use their independent monetary policy to pursue inflation and output gap stabilization.

We calibrate our model encompassing a number of shocks discussed by the literature, including TFP shocks based on novel estimates of the TFP process for differentiated and non-differentiated sectors in the US vis-à-vis an aggregate of European countries. In the calibrated model we find that the unconditional mean of the share of a country's exports in differentiated goods substantially falls if a country replaces optimal monetary rules with a unilateral peg implying insufficient output gap stabilization. The size of the contraction, between one and two percent in most calibrations, is consistent with the presumption that monetary policy regimes may be expected to have a moderate impact on real allocation, but we also show economies in which the contraction is as high as 9 percent.

Our model is related to closed-economy literature analyzing stabilization in multi-sector economy (such as Bodenstein, et al., 2008), with a key difference. Via market dynamics, trade costs create an externality that amplifies the implications of firm entry and changes in the sectoral composition of national output. This externality markedly differentiates the present paper from earlier work of ours, also analyzing the relevance of monetary policy for market dynamics. From the perspective of trade theory, our analysis is related to leading work on tariffs by Ossa (2011), which nonetheless abstracts from nominal rigidities and other distortions that motivate our focus on stabilization policy. Ossa's paper, like ours, models a country's comparative advantage drawing on the literature on the 'home market effect' after Krugman (1980), implying production relocation externalities associated with the expansion of manufacturing.[2]

The mechanisms by which monetary policy may influence comparative advantage are of course relevant also for stabilization policies relying on fiscal and financial instruments. Taxes and subsidies may contribute to demand and markup stabilization, containing the distortions due to nominal price stickiness and thus, according to our core argument, misallocation across sectors. While, everything else equal, inefficient monetary stabilization (e.g., deriving from adopting a fixed exchange) may hamper comparative advantage in manufacturing, substitution among policy instruments may make up for constraints on

[2] According to the 'home market effect,' the size of the market (i.e. a high demand) is a source of comparative advantage in manufacturing. In this literature, the social benefits from gaining comparative advantage in the manufacturing sector stem from a 'production relocation externality.' In the presence of such an externality, acquiring a larger share of the world production of differentiated goods produces welfare gains due to savings on trade costs. Our work is also related to Corsetti et al. (2007), which considers the role of the home market effect in a real trade model, as well as Ghironi and Melitz (2005). We differ in modeling economies with two tradable sectors, as well as considering the implications of price stickiness and monetary policy.

monetary policy. Our analysis shows a specific reason why exploiting a wide range of stabilization instruments is particularly valuable.

The text is structured as follows. The next section describes the model, and section 3 derives analytical results for a simplified version. Section 4 uses stochastic simulations to demonstrate a broader set of implications. Section 5 concludes.

2. Model

In what follows, we develop a two-country monetary model, introducing a key novel element in the way we specify the goods market structure. Namely, each country—home and foreign--- produces two types of tradable goods. The first type comes in differentiated varieties produced under monopolistic competition. In this market, firms face entry costs and nominal rigidities. The second type of good is produced by perfectly competitive firms, and is modeled according to the standard specification in real business cycle models. For this good, there is perfect substitutability among producers within a country (indeed, the good is produced under perfect competition), but imperfect substitutability across countries, as summarized by an Armington elasticity.

2.1. Goods market structure

Households consume goods from two sectors. The *D* sector consists of differentiated varieties of manufacturing good, which are produced by n and n^* monopolistically competitive firms in the home and foreign country, respectively (from now on, foreign variables will be denoted with an asterisk). Each variety in the *D* sector is an imperfect substitute for any other variety in this sector, either of home or foreign origin, with elasticity ϕ. The *N* sector consists of non-differentiated goods, produced by perfectly competitive firms. The home and foreign versions of the *N* good are imperfect substitutes for each other, with elasticity η. For convenience, hereafter we may refer to the first sector as 'manufacturing.'

The overall consumption index is specified:

$$C_t \equiv C_{D,t}^{\theta} C_{N,t}^{1-\theta},$$

where

$$C_{D,t} \equiv \left(\int_0^{n_t} c_t(h)^{\frac{\phi-1}{\phi}} dh + \int_0^{n_t^*} c_t(f)^{\frac{\phi-1}{\phi}} df \right)^{\frac{\phi}{\phi-1}}$$

is the index over the home and foreign varieties of manufacturing good, $c(h)$ and $c(f)$, and

$$C_{N,t} \equiv \left(\nu^{\frac{1}{\eta}} C_{H,t}^{\frac{\eta-1}{\eta}} + (1-\nu)^{\frac{1}{\eta}} C_{F,t}^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}}$$

is the index over goods differentiated only by country of origin, with ν accounting for the weight on domestic goods. The corresponding consumption price index is

$$P_t \equiv \frac{P_{D,t}^{\theta} P_{N,t}^{1-\theta}}{\theta^{\theta}(1-\theta)^{1-\theta}}, \tag{1}$$

where

$$P_{D,t} = \left(n_t p_t(h)^{1-\phi} + n_t^* p_t(f)^{1-\phi} \right)^{\frac{1}{1-\phi}} \tag{2}$$

is the index over the prices of all varieties of home and foreign manufacturing goods, and

$$P_{N,t} = \left(\nu P_{H,t}{}^{1-\eta} + (1-\nu) P,_{Ft}{}^{1-\eta} \right)^{\frac{1}{1-\eta}} \tag{3}$$

is the index over the prices of home and foreign non-differentiated goods.

These definitions imply relative demand functions for domestic residents:

$$c_t(h) = \left(p_t(h) / P_{D,t} \right)^{-\phi} C_{D,t} \tag{4}$$

$$c_t(f) = \left(p_t(f) / P_{D,t} \right)^{-\phi} C_{D,t} \tag{5}$$

$$C_{D,t} = \theta P_t C_t / P_{D,t} \tag{6}$$

$$C_{N,t} = (1-\theta) P_t C_t / P_{N,t} \tag{7}$$

$$C_{H,t} = \nu \left(P_{H,t} / P_{N,t} \right)^{-\eta} C_{N,t} \tag{8}$$

$$C_{F,t} = (1-\nu) \left(P_{F,t} / P_{N,t} \right)^{-\eta} C_{N,t}. \tag{9}$$

2.2. Home household problem

The representative home household derives utility from consumption (C), and from holding real money balances (M/P); it derives disutility from labor (l). The household derives income by selling labor at the nominal wage rate (W); it receives real profits $\left(\Pi_t\right)$ from home firms as defined below, and interest income (iB) on holding domestically traded bonds, which are in zero net supply. It pays lump-sum taxes (T).

Household optimization for the home country may be written:

$$\max E_0 \sum_{t=0}^{\infty} \beta^t U\left(C_t, l_t, \frac{M_t}{P_t}\right)$$

where utility is defined by

$$U_t = \frac{1}{1-\sigma} C_t^{1-\sigma} + \ln \frac{M_t}{P_t} - \frac{1}{1+\psi} l_t^{1+\psi},$$

subject to the budget constraint:

$$P_t C_t + \left(M_t - M_{t-1}\right) + \left(B_t - \left(1 + i_{t-1}\right) B_{t-1}\right) = W_t l_t + \Pi_t - T_t.$$

Above, σ denotes risk aversion and ψ the inverse of the Frisch elasticity. Defining $\mu_t = P_t C_t^{\sigma}$, optimization implies an intertemporal Euler equation:

$$\frac{1}{\mu_t} = \beta\left(1 + i_t\right) E_t\left[\frac{1}{\mu_{t+1}}\right] \tag{10}$$

a labor supply condition:

$$W_t = l_t^{\psi} \mu_t \tag{11}$$

and a money demand condition:

$$M_t = \mu_t \left(\frac{1 + i_t}{i_t}\right). \tag{12}$$

The problem and first order conditions for the foreign household are analogous.

2.3. Home firm problem and entry condition

In the differentiated goods sector, production is linear in labor:

$$y_t\left(h\right) = \alpha_{D,t} l_t\left(h\right), \tag{13}$$

where $l(h)$ is the labor employed by firm h, and α_D is stochastic technology common to all differentiated goods producers in the country. Exports involve an iceberg trade cost, τ_D, so that

$$y_t(h) = d_t(h) + (1+\tau_D) d_t^*(h), \tag{14}$$

where $d_t(h) = c_t(h) + d_{AC,t}(h) + d_{K,t}(h)$ is total demand for the product in the home country, for use in consumption, adjustment costs, and entry costs, respectively; $d_t^*(h)$ is the corresponding demand for home goods abroad. Firm profits are computed as:

$$\pi_t(h) = p_t(h) d_t(h) + e_t p_t^*(h) d_t^*(h) - W_t y_t(h)/\alpha_t - AC_{p,t}(h). \tag{15}$$

There is free entry into the sector. To set up a firm, managers incur a one-time sunk cost, K, and production starts with a one-period lag. In each period, firms face an exogenous probability of exit δ, so that a fraction δ of all firms exogenously stop operating each period. Let n_t represent the number of firms, and define new entrants to the export market, ne_t. The stock of firms at each point in time is:

$$n_{t+1} = (1-\delta)(n_t + ne_t). \tag{16}$$

The value function of firms that enter period t may be represented as the discounted sum of profits of domestic sales and export sales,

$$v_t(h) = E_t\left\{\sum_{s=0}^{\infty} (\beta(1-\delta))^s \frac{\mu_{t+s}}{\mu_t} \pi_{t+s}(h)\right\}.$$

Firms enter until the point that a firm's value equals the entry sunk cost. This entry cost includes a congestion externality, represented as an adjustment cost that is a function of the number of new firms.

$$K_t = \left(\frac{ne_t}{ne_{t-1}}\right)^{\lambda} \overline{K}.$$

The congestion externality plays a similar role as the adjustment cost for capital standard in business cycle models, which moderates the response of investment to match dynamics in data. In a similar vein, we calibrate the adjustment cost to match data on the dynamics of new firm entry. We generally specify entry costs as consisting of labor units and/or investment in differentiated goods units. The entry condition may be written

$$v_t(h) = \left(\theta_K W_t + (1-\theta_K) P_{Dt}\right) K_t, \tag{17}$$

where θ_K =1 is the case of entry costs in labor units, and θ_K =0 is the case of goods units. The goods component of the entry cost falls on both domestically produced and imported goods, in similar proportion as consumption:

$$d_{K,t}(h) = \left(p_t\left(h\right)/P_{D,t}\right)^{-\phi}\left(1-\theta_K\right)ne_tK_t \tag{18}$$

$$d_{K,t}(f) = \left(p_t\left(f\right)/P_{D,t}\right)^{-\phi}\left(1-\theta_K\right)ne_tK_t. \tag{19}$$

The home firm h sets a price $p(h)$ in domestic currency units for domestic sales. Under the assumption of producer currency pricing, this implies a foreign currency price

$$p^*{}_t\left(h\right) = \left(1+\tau_D\right)p_t\left(h\right)/e_t, \tag{20}$$

where the nominal exchange rate, e, is defined as home currency units per foreign currency unit. Firms face a nominal cost of adjusting prices

$$AC_t\left(h\right) = \frac{\psi_P}{2}\left(\frac{p_t\left(h\right)}{p_{t-1}\left(h\right)}-1\right)^2 p_t\left(h\right)y_t\left(h\right). \tag{21}$$

For the sake of tractability, we follow Bilbiie et al. (2008) in assuming that new entrants inherit from the price history of incumbents the same price adjustment cost, and so make the same price setting decision. The aggregate value of the price adjustment costs is:

$$AC_t\left(h\right) = n_tAC_t\left(h\right). \tag{22}$$

To adjust their price, firms use final goods according to:

$$d_{AC,t}(h) = \left(p_t\left(h\right)/P_{M,t}\right)^{-\phi}D_{AC,D,t} \tag{23}$$

$$d_{AC,t}(f) = \left(p_t\left(f\right)/P_{M,t}\right)^{-\phi}D_{AC,D,t} \tag{24}$$

$$D_{AC,D,t} = \theta P_tAC_t/P_{D,t} \tag{25}$$

$$D_{AC,N,t} = \left(1-\theta\right)P_tAC_t/P_{N,t} \tag{26}$$

$$D_{AC,H,t} = \nu\left(P_{H,t}/P_{N,t}\right)^{-\eta}D_{AC,N,t} \tag{27}$$

$$D_{AC,F,t} = \left(1-\nu\right)\left(P_{F,t}/P_{N,t}\right)^{-\eta}D_{AC,N,t}. \tag{28}$$

similar to the composition of equations (4)-(9).

Maximizing firm value subject to the constraints above leads to the price setting equation:

$$p_t(h) = \frac{\phi}{\phi-1}\frac{W_t}{\alpha_t} + \frac{\psi_P}{2}\left(\frac{p_t(h)}{p_{t-1}(h)} - 1\right)^2 p_t(h) - \psi_P \frac{1}{\phi-1}\left(\frac{p_t(h)}{p_{t-1}(h)} - 1\right)\frac{p_t(h)^2}{p_{t-1}(h)}$$
$$+ \frac{\psi_P}{\phi-1} E_t\left[\beta\frac{\Omega_{t+1}}{\Omega_t}\left(\frac{p_{t+1}(h)}{p_t(h)} - 1\right)\frac{p_{t+1}(h)^2}{p_t(h)}\right] \tag{29}$$

where the optimal pricing is a function of the stochastically discounted demand faced by producers of domestic differentiated goods,

$$\Omega_t = \left[\left(\frac{p_t(h)}{P_{M,t}}\right)^{-\phi}\left(C_{D,t} + D_{AC,D,t} + (1-\theta_K)ne_{t-1}K_{t-1}\right)\right.$$
$$\left.+\left(\frac{(1+\tau_D)p_t(h)}{e_t P^*_{M,t}}\right)^{-\phi}(1+\tau_D)\left(C^*_{D,t} + D^*_{AC,D,t} + (1-\theta_K)ne^*_{t-1}K^*_{t-1}\right)\right]\Big/\mu_t .$$

Note that, since households own firms, they receive firm profits but also finance the creation of new firms. In the household budget, the net income from firms may be written:

$$\Pi_t = n_t\pi_t(h) - ne_t v_t(h).$$

In the second sector firms are assumed to be perfectly competitive in producing a good differentiated only by country of origin. The production function for the home non-differentiated good is linear in labor:

$$y_{H,t} = \alpha_{H,t} l_{H,t}, \tag{30}$$

where $\alpha_{H,t}$ is subject to shocks. It follows that the price of the homogeneous goods in the home market is equal to marginal costs:

$$p_{H,t} = W_t / \alpha_{H,t}. \tag{31}$$

An iceberg trade cost specific to the non-differentiated sector implies prices of the home good abroad are

$$p^*_{H,t} = p^*_{H,t}(1+\tau_N)/e_t. \tag{32}$$

Analogous conditions apply to the foreign non-differentiated sector.

2.4. Government

The model abstracts from public consumption expenditure, so that the government uses seigniorage revenues and taxes to finance transfers, assumed to be lump sum. The home government faces the budget constraint:

$$M_t - M_{t-1} + T_t = 0 . \tag{33}$$

In the home country, monetary authorities are assumed to pursue an independent monetary policy, approximated by the following Taylor rule:

$$1 + i_t = \left(1 + \bar{i}\right)\left(\frac{p_t\left(h\right)}{p_{t-1}\left(h\right)}\right)^{\gamma_p}\left(\frac{Y_t}{\bar{Y}}\right)^{\gamma_Y} . \tag{34}$$

In this rule, inflation is defined in terms of differentiated goods producer prices, while Y is a measure of output defined as:

$$Y_t = \left(\int_0^{n_t} p_t\left(h\right) y_t\left(h\right) dh + p_{Ht} y_{H,t}\right) / P_t .$$

In running the model, we will use either the above or a narrower definition of output, including only manufacturing. Given our calibration of the Taylor rule, with a high coefficient on inflation, this will be immaterial for our results. In the foreign country, monetary authorities are assumed to pursue either a Taylor rule similar to (34) or, alternatively, an exchange rate peg:

$$e_t = \bar{e} . \tag{35}$$

2.5. Market clearing

The market clearing condition for the manufacturing goods market is given in equation (14) above. Market clearing for the non-differentiated goods market requires:

$$y_{H,t} = C_{H,t} + D_{AC,H,t} + \left(1 + \tau_N\right)\left(C^*_{H,t} + D^*_{AC,H,t}\right) \tag{36}$$

$$y_{F,t} = C_{F,t} + D_{AC,F,t} + \left(1 + \tau^*_N\right)\left(C^*_{F,t} + D^*_{AC,F,t}\right). \tag{37}$$

Labor market clearing requires:

$$\int_0^{n_t} l_t\left(h\right) dh + l_{H,t} + \theta_K n e_t K_t = l_t . \tag{38}$$

Bond market clearing requires:

$$B_t = 0 . \tag{39}$$

Under the assumption of no international trade in assets, international trade in goods must be balanced period by period:

$$\begin{aligned}&\int_0^{n_t} p_t^*(h)\left(c^*_t(h) + d^*_{Kt}(h) + d^*_{AC,t}(h)\right)dh - \int_0^{n^*_t} p_t(f)\left(c_t(f) + d_{Kt}(f) + d_{AC,t}(f)\right)df \\ &+ P^*_{Ht}\left(C^*_{Ht} + D^*_{AC,H,t}\right) - P_{Ft}\left(C_{Ft} + D_{AC,F,t}\right) = 0.\end{aligned} \tag{40}$$

2.6. Shocks process and equilibrium definition

We experiment with a number of shocks studied in the literature, including shocks to intertemporal preferences, tastes (affecting the share of differentiated goods in consumption), monetary and fiscal policy, and productivity. Given the structure of our economy, shocks are assumed to follow joint log normal distributions. In the case of productivity, for instance, we can write:

$$\begin{bmatrix} \log\alpha_{Dt} - \log\overline{\alpha_D} \\ \log\alpha_{Dt}^* - \log\overline{\alpha_D}^* \\ \log\alpha_{Ht} - \log\overline{\alpha_H} \\ \log\alpha_{Ft} - \log\overline{\alpha_F} \end{bmatrix} = \rho \begin{bmatrix} \log\alpha_{Dt-1} - \log\overline{\alpha_D} \\ \log\alpha_{Dt-1}^* - \log\overline{\alpha_D}^* \\ \log\alpha_{Ht-1} - \log\overline{\alpha_H} \\ \log\alpha_{Ft-1} - \log\overline{\alpha_F} \end{bmatrix} + \varepsilon_t$$

with the covariance matrix $E\left[\varepsilon_t \varepsilon_t^{'}\right]$.

A competitive equilibrium for the world economy presented above is defined along the usual lines, as a set of processes for quantities and prices in the Home and Foreign country satisfying: (i) the household and firms optimality conditions; (ii) the market clearing conditions for each good and asset, including money; (iii) the resource constraints—whose specification can be easily derived from the above and is omitted to save space.

2.7. Relative price and export share measures

Along with the *real exchange rate* ($e_t P_t^* / P_t$), we report two alternative measures of international prices. First, as is common practice in the production of statistics on international relative prices, we compute the terms of trade weighting goods with their respective expenditure shares:

$$TOTS_t \equiv \frac{\omega_{Ht} p(h)_t + \left(1-\omega_{Ht}\right) p_{H,t}}{\omega_{Ft} e_t p^*(f)_t + \left(1-\omega_{Ft}\right) e_t p^*_{F,t}}, \tag{41}$$

where the weight ω_{Ht} measures the share of differentiated goods in the home country's overall exports:

$$\omega_{Ht} \equiv \frac{p^*{}_t(h) n_{t-1}\left(c^*{}_t\left(h\right) + d^*{}_{Kt}\left(h\right) + d^*{}_{AC,t}\left(h\right)\right)}{p_t^*(h) n_{t-1}\left(c^*{}_t\left(h\right) + d^*{}_{Kt}\left(h\right) + d^*{}_{AC,t}\left(h\right)\right) + P^*{}_{Ht}\left(C^*{}_{Ht} + D^*{}_{AC,H,t}\right)}, \tag{41a}$$

and ω_{Ft} measures the counterpart for the foreign country:

$$\omega_{Ft} \equiv \frac{p_t(f) n^*_{t-1}\left(c_t\left(f\right) + d_{Kt}\left(f\right) + d_{AC,t}\left(f\right)\right)}{p_t(f) n^*_{t-1}\left(c_t\left(f\right) + d_{Kt}\left(f\right) + d_{AC,t}\left(f\right)\right) + P_{Ft}\left(C_{Ft} + D_{AC,F,t}\right)}. \tag{41b}$$

Since the share of differentiated goods in a country's overall exports is readily available in data, we will report values for ω_{Ht} and ω_{Ft} generated in our simulations, as they provide a useful means for comparing model implications to data. Following the trade literature, we also compute the terms of trade as the ratio of ex-factory prices set by home firms relative to foreign firms in the manufacturing sector: $TOTM_t \equiv p_t(h)/\left(e_t p_t^*(f)\right)$.[3] The latter measure ignores the non-differentiated good sector.

3. Analytical Insights from a Simple Version of the Model

In this section, we provide a close up analysis of the mechanism by which monetary policy impinges on pricing by differentiated good manufactures, ultimately determining the country's comparative advantage in the sector. To be as clear as possible, we work out a simplified version of the model that is amenable to analytical results. Despite a number of assumptions needed to make the model tractable, the key predictions of the simplified model will be confirmed in our full-fledged version of the model.

[3] This is the same definition used in Ossa (2011), though in our case it does not imply the terms of trade are constant at unity, because monetary policy does affect factory prices. See also Helpman and Krugman (1989), and Campolmi et al. (2014).

We specialize our model as follows. First, we posit that entry costs are in labor units, i.e., $\theta_K = 1$, and manufacturing firms operate for one period only (implying $\delta = 1$ in the entry condition), and symmetrically preset prices over the same horizon. Second, we simplify the non-differentiated good by setting its trade costs to zero ($\tau_N = 0$) and let the elasticity of substitution between home and foreign goods approach infinity ($\eta \to \infty$). This implies that the sector produces a homogeneous good, an assumption frequently made in the trade literature.[4] Third, we restrict productivity shocks to be i.i.d., and only occur in the differentiated good sector (we abstract from productivity shocks in the non-differentiated good sector). Fourth, utility is log in consumption and linear in leisure ($\psi = 0$). Finally, drawing on the NOEM literature (see Corsetti and Pesenti 2005, and Bergin and Corsetti 2008), we carry out our analysis of stabilization policy by defining a country's monetary stance as $\mu = PC$, under the control of monetary authorities via their ability to set the interest rate. Following this approach, we therefore study monetary policy in terms of μ (and μ^* for the foreign country), instead of the interest rate rule (34).

Under these assumptions, the firms' problem becomes

$$\max_{p_{t+1}(h)} = E_t\left[\beta \frac{\mu_t}{\mu_{t+1}} \pi_{t+1}(h)\right].$$

where $\mu_t = P_t C_t$. The optimal preset price in the domestic market is:

$$p_{t+1}(h) = \frac{\phi}{\phi - 1} \frac{E_t\left[\Omega_{t+1}\left(\frac{W_{t+1}}{\alpha_{t+1}}\right)\right]}{E_t\left[\Omega_{t+1}\right]}, \tag{42}$$

where $W_{t+1}/\alpha_{t+1} = \mu_{t+1}/\alpha_{t+1}$ is the firm's marginal costs, that is, the ratio of nominal wages to labor productivity. In this simplified model setting, the stochastically discounted value of future demand facing the firm for its good in both markets, Ω_{t+1}, becomes:

[4] Different from the trade literature, however, we do treat this sector as an integral part of the (general) equilibrium allocation, e.g., exports/imports of the homogeneous good sector enters the terms of trade of the country.

$$\Omega_{t+1} = \left(c_{t+1}(h) + (1+\tau)c^*_{t+1}(h)\right) / \mu_{t+1}.$$[5]

The home entry condition is a function of price setting and the exchange rate:

$$\frac{K_t}{\beta\theta} = E_t\left[\left(p_{t+1}(h) - \frac{\mu_{t+1}}{\alpha_{t+1}}\right) p_{t+1}(h)^{-\phi}\,\Omega_{t+1}\right]. \tag{43}$$

Provided that the price setting rules can be expressed as functions of the exogenous shocks and the monetary stance, the home and foreign equilibrium entry conditions along with the exchange rate solution above comprise a three equation system in the three variables: *e*, *n* and *n**. This system admits analytical solutions for several configurations of the policy rules.

A notable property of the simplified version of the model is as follows. Since both economies produce the same homogeneous good with identical technology under perfect competition, and this good is traded costlessly across borders, arbitrage ensures that $P_{Dt} = e_t P^*_{Dt}$. The exchange rate can then be expressed as:

$$e_t = \frac{p_{Dt}}{p^*_{Dt}} = \frac{W_t}{W^*_t} = \frac{P_t C_t}{P^*_t C^*_t} = \frac{\mu_t}{\mu^*_t}, \tag{44}$$

where we have used the labor supply condition (11) imposing linear preferences in leisure ($\psi = 0$). Given symmetric technology in labor input only, the law of one price implies that nominal wages are equalized (once expressed in a common currency) across the border. By the equilibrium condition in the labor market with an infinite labor supply elasticity, then, the exchange rate is a function of the ratio of nominal consumption demands, hence of monetary policy stances.[6]

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[5] Upon appropriate substitutions and cancellations, equation (42) may also be written with Ω_{t+1} defined as
$$\Omega_{t+1} = \left(n_{t+1}p_{t+1}(h)^{1-\phi} + n^*_{t+1}p^*{}_{t+1}(f)^{1-\phi}e_{t+1}{}^{1-\phi}(1+\tau)^{1-\phi}\right)^{-1} + \left(n_{t+1}p_{t+1}(h)^{1-\phi} + n^*_{t+1}p^*{}_{t+1}(f)^{1-\phi}e_{t+1}{}^{1-\phi}(1+\tau)^{\phi-1}\right)^{-1}.$$

[6] A special implication of nominal wage equalization (due to trade in a single homogenous good whose production is not subject to shocks), is that production risk is efficiently shared, even in the absence of trade in financial assets, and independently of the way production and trade are specified in the other sector. To see this, just rewrite equation (44) as the standard perfect risk sharing condition:
$$\frac{e_t P^*_t}{P_t} = rer_t = \frac{C_t}{C^*_t}.$$
Home consumption rises relative to foreign consumption only in those states of the world in which its relative price (i.e. the real exchange rate) is weak.

3.1. The equilibrium consequences of nominal rigidities

To gain insight into the transmission mechanism underlying our results, we rewrite (42) as follows:

$$p_{t+1}(h)=\frac{\phi}{\phi-1}\left\{E_t\left[\left(\frac{W_{t+1}}{\alpha_{t+1}}\right)\right]+\frac{Cov_t\left[\Omega_{t+1}\left(\frac{W_{t+1}}{\alpha_{t+1}}\right)\right]}{E_t\left[\Omega'_{t+1}\right]}\right\} \tag{42'}$$

By the covariance term on the right-hand side of this expression, the optimal preset pricing depends on the comovements of a firm's marginal costs ($W_{t+1}/\alpha_{t+1}=\mu_{t+1}/\alpha_{t+1}$), and overall world demand for the firm's good, Ω_{t+1}. Since both marginal costs and overall demand are functions of monetary stances, policy rules critically impinge on pricing (and thus on entry) via their effects on the covariance term. To wit: assume no monetary stabilization, i.e., posit that the monetary stance is constant in either country ($\mu_t=\mu_t^*=1$), implying a constant nominal exchange rate at $e_t=\mu_t/\mu_t^*=1$. Since, with i.i.d. shocks, there are no dynamics in predetermined variables such as prices and numbers of firms, the optimal preset prices (42') simplify to

$$p_{t+1}^{no\,stab}(h)=\frac{\phi}{\phi-1}E_t\left[\frac{1}{\alpha_{t+1}}\right] \qquad p_{t+1}^{*no\,stab}(f)=\frac{\phi}{\phi-1}E_t\left[\frac{1}{\alpha^*_{t+1}}\right],$$

that is, prices are equal to the expected marginal costs (coinciding with the inverse of productivity) augmented by the equilibrium markup. Most critically, under a constant monetary stance, these optimal pricing decisions do not depend on the term Ω' (hence do not vary with trade costs and firms entry), as they do in the general case. The number of firms can be computed by substituting these prices into the entry condition (43), so to obtain:

$$n_{t+1}^{no\,stab}=n_{t+1}^{*no\,stab}=\frac{\beta\theta}{q\phi}.$$

Intuitively, for given monetary stances, there is no change in the exchange rate. With preset prices, a shock to productivity will have no effect on the terms of trade, the real exchange rate and consumption demands, hence there will be no change in the level of production in either type of good. With no monetary response, an i.i.d. shock raising productivity in the home manufacturing sector necessarily leads to a fall in the level of employment in the same sector (not compensated by a change in employment in the other sectors of the economy). Firms end up producing at low marginal costs and thus suboptimally high markups, since nominal rigidities prevent firms from re-pricing and scaling down production. Conversely, given nominal prices and demand, a drop in productivity will cause firms to produce too much at high marginal costs, hence at suboptimally low markups.

So, in a regime of no monetary stabilization, firms face random realizations of inefficiently high and inefficiently low levels of production and markup. When presetting prices, managers maximize the value of their firm by trading off higher markups in the low productivity state, with lower markups in the high productivity states. In our model above, they weigh more the risk of producing too much at high marginal costs: it is easy to see that preset prices are increasing in the variance of productivity shocks (by Jensen's inequality, $E_t\left[\frac{1}{\alpha_{t+1}}\right] > \frac{1}{E_t\left[\alpha_{t+1}\right]} = 1$).[7] The implications of this result for our argument are detailed next.

3.2. Prices and firm dynamics under efficient and inefficient stabilization of output gaps

Since the model posits that the homogenous good sector operates under perfect competition and flexible prices, there is no trade-off in stabilizing output across different sectors. It is therefore possible to replicate the flex-price allocation under a simple contingent monetary policy rule: the monetary stance in each country moves in proportion to productivity in the differentiated good sector: $\mu_t = \alpha_t, \quad \mu_t^* = \alpha_t^*$. The exchange rate in this case is not constant, but contingent on productivity differentials. Namely, the home currency depreciates in response to an asymmetric rise in home productivity:

[7] As discussed in Corsetti and Pesenti (2005) and Bergin and Corsetti (2008) in a closed economy context, given nominal demand, high preset prices allow firms to contain overproduction when low productivity squeezes markups, rebalancing demand across states of nature. High average markups, in turn, exacerbate monopolistic distortions and tend to reduce demand, production and employment on average, discouraging entry.

$$e_t = \frac{\alpha_t}{\alpha_t^*}.$$

The active monetary policy just described affects optimal pricing by firms. By ensuring that the nominal marginal costs μ/α remain constant, the above policy ensures that the covariance term in (see (42')) is zero, thus insulating the ex-post markup charged by home manufacturing firms from uncertainty about productivity.[8] Note that, to the extent that monetary policy stabilizes marginal costs completely, it also stabilizes markups at their flex-price equilibrium level. It follows that the price firms preset is lower than in an economy with no stabilization:

$$p_{t+1}^{stab}(h) = \frac{\phi}{\phi - 1} < p_{t+1}^{no\,stab}(h) = \frac{\phi}{\phi - 1} E_t\left[\frac{1}{\alpha_{t+1}}\right].$$

In a multi-sector context, a key effect of monetary stabilization is that of reducing a country's differentiated goods' price in terms of domestic nondifferentiated goods, redirecting demand across sectors. This rise in demand for differentiated goods supports the entry of additional manufacturing firms. As shown in the appendix, the number of manufacturing firms is:[9]

$$n_{t+1}^{stab} = \frac{\beta\theta}{q\phi} E_t\left[\frac{2 + \left(\frac{\alpha_{t+1}}{\alpha_t^*}\right)^{1-\phi}\left(\left(1+\tau\right)^{1-\phi} + \left(1+\tau\right)^{\phi-1}\right)\left(1+\tau\right)^{1-\phi}}{1 + \left(\frac{\alpha_{t+1}}{\alpha_t^*}\right)^{1-\phi}\left(\left(1+\tau\right)^{1-\phi} + \left(1+\tau\right)^{\phi-1}\right)\left(1+\tau\right)^{1-\phi} + \left(\frac{\alpha_{t+1}}{\alpha_{t+1}^*}\right)^{2(1-\phi)}}\right]$$

the same as under flexible prices. The above generalizes to our setup a familiar result of the classical NOEM literature (without entry) assuming that prices are sticky in the currency of the producers (Corsetti and Pesenti (2001, 2005) and Devereux and Engel (2003), among others):

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[8] As is well understood, the policy works as follows: in response to an incipient fall in domestic marginal costs domestic demand and a real depreciation boost foreign demand for domestic product. As nominal wages rise with aggregate demand, marginal costs are completely stabilized at a higher level of production. Vice versa, by curbing domestic demand and appreciating the currency when marginal costs are rising, monetary policy can prevent overheating, driving down demand and nominal wages. Again, marginal costs are completely stabilized as a result.

[9] As discussed in the appendix, it is not possible to determine analytically whether symmetric stabilization policies raise the number of firms compared to the no stabilization case. Model simulations suggest that there is no positive effect for log utility, and a small positive effect for CES utility with a higher elasticity of substitution. Nonetheless, we are able to provide below an analytical demonstration of asymmetric stabilization, which is our main objective.

despite nominal rigidities, policymakers are able to stabilize the output gap relative to the natural-rate, flex-price allocation.

Consider instead the case in which the home government fully stabilizes its output gap, while the foreign country maintains its exchange rate fixed against the home currency:

$$\mu_t = \alpha_t \text{ and } e_t = 1, \text{ so that } \mu_t^* = \mu_t = \alpha_t .$$[10]

Under the policy scenario just described, the optimally preset prices of domestically and foreign produced differentiated goods are, respectively:

$$p_{t+1}(h) = \frac{\phi}{\phi - 1}, \qquad p_{t+1}^*(f) = \frac{\phi}{\phi - 1} E_t\left[\frac{\alpha_{t+1}}{\alpha^*_{t+1}}\right].$$

While the home policy makers manage to stabilize the markup of manufacturing firms completely, the foreign firms producing under the peg regime face stochastic marginal costs/markups driven by shocks to productivity, both domestically and abroad. With i.i.d. shocks, preset prices will be increasing in the term $E_t(1/\alpha^*_{t+1})$, as in the no stabilization case. While it is not possible to solve for the number of firms in closed form, as shown in the appendix it is possible to prove that

$$n > n^{flex} > n^*$$

Other things equal, the constraint on macroeconomic stabilization implied by a currency peg tends to reduce the size of the manufacturing sector in the foreign country: there are fewer firms, each charging a higher price. The home country's manufacturing sector correspondingly expands. In other words, the country pegging its currency tends to specialize in the homogeneous good sector.

To fix ideas: insofar as a peg results in higher markups and exacerbates monopolistic distortions in the foreign manufacturing sector, inefficient stabilization redirects demand towards the (now relatively cheaper) non-differentiated good sector. Most crucially, as the ratio of the country's differentiated goods prices to nondifferentiated goods prices rises compared to the home country, the foreign comparative advantage in the sector weakens: domestic demand shifts towards differentiated imports from the home country. Because of higher monopolistic

[10] A related exercise consists of assuming that the foreign country keeps its money growth constant ($\mu_t^* = 1$) while home carries out its stabilization policy as above.

distortions and the higher trade costs in imports of differentiated goods, foreign consumption falls overall (in line with the predictions from the closed economy one-sector counterpart of our model, e.g., Bergin and Corsetti 2008). All these effects combined reduce the incentive for foreign firms to enter in the differentiated good sector. The country's loss of competitiveness is mirrored by a trend appreciation of its welfare-relevant real exchange rate, mainly due to the fall in varieties available to the consumers. But real appreciation is actually associated with weaker, not stronger, terms of trade. Weaker terms of trade follow from the change in the composition of foreign production and exports, with more weight attached to low value added non-differentiated goods.

The consequences of a foreign peg on the home economy are specular. The home country experiences a surge of world demand for its differentiated good production, while stronger terms of trade boost domestic consumption. More firms enter the manufacturing sector, leading to a shift in the composition of its production and exports in favor of this sector.

As a result, with a foreign country passively pegging its currency, there are extra benefits for the home country from being able to pursue stabilization policies. The home manufacturing sector expands driven by higher home demand overall, and fills part of the gap in manufacturing production no longer supplied by foreign firms. At the same time, the shifting pattern of specialization ensures that the home demand for the homogeneous good is satisfied via additional imports from the foreign country.

4. Numerical simulations

In this section, we evaluate the quantitative implications of our full model, by conducting stochastic simulations. Despite the many differences between the simplified and the full version of our model, we will show that key results from the former continue to hold in the latter. Namely, in our general specification it will still be true that, if the foreign country moves from efficient stabilization to a peg, while the home country sticks to efficient stabilization rules, (a) the foreign average markups in manufacturing will tend to increase and (b) there will be production relocation---firm entry in the foreign country will fall on average, while entry in the home country will rise on average. Correspondingly, average consumption will rise at home relative to foreign. We will also show that this relocation will be associated with an average improvement in the home terms of trade (while the home welfare-relevant real exchange rate depreciates).

We first discuss our calibration of the model, then present our main results.

4.1. Parameter values

Parameter values are chosen to be consistent with an annual frequency, to match the frequency of the data available for sectoral productivity. We set time preferences at $\beta = 0.96$; risk aversion at $\sigma = 2$; labor supply elasticity at $1/\psi = 1.9$, from Hall (2009).

The price stickiness parameter is set at $\psi_p = 8.7$, a modest value which in a Calvo setting would correspond to half of firms resetting price on impact of a shock, with 75 percent resetting their price after one year.[11] The death rate is set at $\delta = 0.1$, which is four times the standard rate of 0.025 to reflect the annual frequency. The sunk cost of entry is normalized to the value 1.

To choose parameters for the differentiated and non-differentiated sectors we draw on Rauch (1999). We choose θ so that differentiated goods represent 57 percent of U.S. trade in value.[12] The home share of non-differentiated goods is set at $\nu = 0.5$, which implies a trade share of about 30%, given the trade costs and elasticities below. To set the elasticities of substitution for the differentiated and non-differentiated goods we draw on the estimates by

[11] As is well understood, a log-linearized Calvo price-setting model implies stochastic difference equation for inflation of the form $\pi_t = \beta E_t \pi_{t+1} + \lambda mc_t$, where *mc* is the firm's real marginal cost of production, and where $\lambda = (1-q)(1-\beta q)/q$, with q is the constant probability that firm must keep its price unchanged in any given period. The Rotemberg adjustment cost model used here gives a similar log-linearized difference equation for inflation, but with $\lambda = (\phi - 1)/\kappa$. Under our parameterization, a Calvo probability of $q = 0.5$ implies an adjustment cost parameter of $\kappa = 8.7$. This computation is confirmed by a stochastic simulation of a permanent shock raising home differentiated goods productivity without international spillovers, which implies that price adjusts 50% of the way to its long run value immediately on impact of the shock, and 75% at one period (year in our case) after the shock.

[12] Values vary by year and by whether a conservative or liberal aggregation is used. Taking an average over the three sample years and the two aggregation methods reported in Table 2 of Rauch (1999) produces an average of 0.57. Replicating this value in our steady state requires a calibration of the consumption share at θ =0.38, which compensates for the fact that trade for investment purposes (sunk cost) involves differentiated goods only.

Broda and Weinstein (2006), classified by sectors based on Rauch (1999). The Broda and Weinstein (2006) estimate of the elasticity of substitution between differentiated goods varieties is ϕ=5.2 (the sample period is 1972-1988). The corresponding elasticity of substitution for nondifferentiated commodities is η= 15.3.

To set trade costs, we need to think beyond costs associated with just transportation. These are often thought to be higher for commodities than for high-value differentiated goods. As Rauch (1999) points out, differentiated goods involve search and matching costs, whereas commodities and goods traded on an organized exchange with a published reference price avoid such costs. Estimates are available for the tariff equivalent of language costs, with a value of 11% in Hummels (1999) or 6% in Anderson and van Wincoop (2004), so we use 8% in between. Since Obstfeld and Rogoff (2000) recommend a calibration of total trade costs at 16%, our calibration implies that half of this is due to language and matching costs, and the other half due to transportation. This implies a calibration of τ_D= 0.16 for differentiated goods, and τ_N =0.08 for non-differentiated goods.

The parameters in the home monetary policy rule are determined by the values that maximize home utility. As typically found, the optimal weight on inflation is the maximum value considered in the grid search (γ_P =1000), and the optimal value on output is γ_Y =0. The foreign country is assumed to peg its exchange rate at parity with the home country: *e*=1.

To our knowledge, no one else has calibrated a DSGE model with sectoral shocks distinct to differentiated and nondifferentiated goods. Annual time series of sectoral productivities are available from the Groningen Growth and Development Centre (GGDC), for the period 1980-2007. Data for the U.S. is used to parameterize shocks to the home country, and an aggregate of the EU 10 for the foreign country.[13] TFP is calculated on a value-added basis. For each country, the differentiated goods sector comprises total manufacturing excluding wood, chemical, minerals, and basic metals; the non-differentiated goods sector comprises agriculture, mining, and subcategories of manufacturing excluded from the

[13] These EU 10 countries are AUT, BEL, DNK, ESP, FIN, FRA, GER, ITA, NLD and the UK. See http://www.euklems.net/euk08i.shtml.

differentiated sector. To calculate the weight of each subsector within the differentiated (or non-differentiated) sector, we use the 1995 gross value added (at current prices) of each subsector divided by the total value added for the differentiated (or non-differentiated) sector. After taking logs of the weighted series, we de-trend each series using the HP filter. Parameters ρ and Ω, reported in Table 1, are obtained from running a VAR(1) on the four de-trended series.

The benchmark simulation model specifies entry costs in units of goods (θ_K =0) but we will also report results for entry costs in labor units in our sensitivity analysis (see the discussion in Cavallari 2013). The adjustment cost parameter for new firm entry, λ, is chosen to match the standard deviation of new firm entry in the benchmark simulation to that in data. The World Bank's Entrepreneurship Survey and data base provides a count of new businesses registered during a calendar year, for the period 2004 to 2012 for selected countries. We use the data available for France, Germany, Italy and the U.K. to represent the foreign country in our model. Data for the U.S. on establishment entry are available from the Longitudinal Business Database. Standard deviations for logged and HP-filtered series are reported as ratios to the standard deviation of GDP for the same period: the value for the U.S. is 5.53, and the European average is 3.01. A value of λ = 0.25 in the simulation model, with the remaining parameters and shocks as described above, generates standard deviations of new firm entry close to these values. (See Table 2b.)

4.2. Simulation results

This section first illustrates the properties of the model, looking at the impulse responses generated by fluctuations in manufacturing productivity. It then discusses results for the unconditional means of variables, drawn from stochastic simulations of a second order approximation of the model.

4.2.1. Impulse responses

In Figure 1 we report the dynamics of the benchmark model in response to a one standard deviation positive shock to productivity in the differentiated goods sector of the home country, where both countries employ efficient stabilization policy. The Figure plots the percentage deviation from the unconditional mean of key variables of interest. As home policymakers fully stabilize the markup, they react to the shock by expanding domestic demand and depreciating the exchange rate. This policy reaction boosts production in the differentiated sector, in line with its enhanced productivity. The number of firms in the sector rises, and production shifts in favor of home differentiated goods, away from nondifferentiated goods. In the foreign country, the shift in production pattern partly reflects the cross-country autocorrelation of shocks in the calibration. Since the foreign country also experiences a rise in differentiated goods productivity, the number of firms and the volume of differentiated output also rise in this country, though by a smaller magnitude than at home where the shock originated, and with a one period lag.

To further clarify the role of the cross-country correlation of shocks, in Figure 2 we simplify the analysis by setting the cross-country elements of the shock autorcorrelation matrix equal to zero. This figure thus shows the effects of a rise in the differentiated goods productivity at home that remains asymmetric. Foreign production of differentiated goods falls (while it rises at home); conversely foreign production of nondifferentiated goods rises (while it falls at home).

The case of asymmetric policies---with the foreign country pegging its exchange rate, and the home country employing efficient stabilization policy---is shown in the next two figures. In response to a favorable shock to home differentiated-goods productivity, the behavior of home variables in Figure 3 is very similar to Figure 1. But in Figure 3, the response of the foreign variables closely resembles those of the home variables. The commitment to exchange rate stability causes the foreign monetary authorities to expand money supply and demand by more, in step with the home country, providing extra stimulus to the foreign differentiated goods sector at the expense of the nondifferentiated goods sector.

Figure 4 shows the effects of a productivity shock to the differentiated goods sector in the country pursuing a peg (that is, foreign). It differs noticeably from the other figures. In the absence of a stabilizing policy response, manufacturing entry in the foreign economy, while positive, is an order of magnitude smaller compared to entry in the home economy in the previous figures. Likewise, the rise in foreign production of differentiated goods is much smaller and much shorter lived.

4.2.2. Unconditional means

Table 2a reports the unconditional means of key variables obtained from stochastic simulations of a second order approximation of the benchmark model, and Table 2b reports standard deviations. In Column (1) of Table 2a both countries use stabilization policy, while in column (2) the foreign country adopts an exchange rate peg. Column (3) reports the percent change between the previous columns, hence accounting for changes when the foreign country pursues a peg instead of inflation stabilization. Note that country means in column (1) are not completely symmetric despite symmetric policies, due to the cross-border differences in the estimated TFP shock process.

The simulation results fully confirm the main analytical insights from the previous section. When the foreign country pegs, average production of the differentiated good shifts away from the foreign country and toward the home country; the foreign country instead has higher production of the non-differentiated good. This shift in production is reflected in a 0.73 percent fall in the number of foreign differentiated goods firms, in contrast to a 0.63 percent rise at home: the ratio of foreign firms relative to the home counterpart falls 1.4 percent. The share of differentiated goods in exports (ω_F) falls by 0.56 percent in the foreign country, while the share in the home country (ω_H) rises by 0.61 percent. This implies that the ratio of the foreign export share relative to the home counterpart falls 1.2 percent.

Also consistent with the transmission mechanism discussed in the previous section, what drives the foreign loss in the differentiated goods market share under a peg is the higher average markup charged by foreign producers of these goods. Note that the foreign price of differentiated goods rises relative to both wages and non-differentiated goods (.07 percent in both cases).

Finally, when the foreign policymaker abandons efficient stabilization policy for a peg, the foreign *terms of trade including the homogenous good, TOTS*, actually worsen (.38 percent). This stands in contrast with the movements in the (conventionally-defined) terms of trade including only differentiated goods, *TOTM*, which remains nearly unchanged (.01 percent). The different behavior of the *TOTS* and *TOTM* is due to a composition effect: the shift in foreign export share away from differentiated goods means these more expensive goods receive a smaller weight in the average price of foreign exports and a larger weight in the average price of foreign imports.

International price adjustment highlights a notable difference between the simplified and the full model. As our results in Table 2a emphasize, despite a lower markup, the terms of trade of *manufacturing* do not necessarily fall with better stabilization. This will be so because, in the full model, a high level of entry tends to raise production costs, as wages respond to a higher demand for domestic labor. To the extent that labor supply is not infinitely elastic (as assumed in the simplified model), this effect may become strong enough to prevent the international price of domestic manufacturing from falling in tandem with average markup in the sector.

Table 2b shows that the calibration of our model is in line with the volatility of output in the US and the EU-10 countries, as well as the volatilities of key variables (in ratio to the volatility of output), such as consumption, employment and net business formation.

4.2.3. Alternative model specifications

Table 3 summarizes our results under alternative model specifications. To save space, we only report the percentage change in number of firms and percent change in differentiated export share when the foreign country switches from inflation stabilization to exchange rate peg. The first column repeats for comparison the key result for the benchmark case from Table 2a. This result depends completely upon free entry of firms: Column (2) shows that the changes in differentiated export share disappear when the number of firms is held fixed exogenously. We conclude that the endogenous shift in number of firms between countries is essential for the change in monetary policy to translate into quantitatively meaningful effects on export shares.

Price stickiness in exports, whether in units of the producer or local currency, is not consequential to the effect of policy on product specialization. When the price adjustment specification of the benchmark model is replaced by the local currency version, results are nearly unchanged, as reported column (3). (See the appendix for the LCP version of Rotemberg pricing for this case.) Even if prices are inelastic to the exchange rate in the short run, they are ex-ante sensitive to the covariance of marginal costs and demand, which is the core mechanism by which monetary stabilization impinges on competitiveness.

Stickiness in wage adjustment, in contrast, can significantly magnify the effects of monetary policy on product specialization. Suppose households supply differentiated labor, indexed by j, and face a cost of adjusting wages $AC_{W,s}(j) = \frac{\kappa_w}{2}\left(W_s(j)/W_{s-1}(j) - 1\right)^2 l_s(j)$ and face a labor demand $l_t(j) = \left(W_t(j)/W_t\right)^{-\phi_L} l_t$. Utility maximization now implies a wage setting condition to replace the labor supply condition in the benchmark model:

$$\phi_L \frac{l_t^{1+\psi}}{W_t} = -\frac{1}{\mu_t}\left(\left[(1-\phi_L)\right] l_t - \frac{l_t \kappa_w}{2}\left(\left(\frac{W_t}{W_{t-1}} - 1\right)^2 (-\phi_L) + 2\left(\frac{W_t}{W_{t-1}} - 1\right)\frac{W_t}{W_{t-1}}\right)\right)$$
$$+ \beta E_t\left[\frac{1}{\mu_{t+1}}\left(W_{t+1} l_{t+1} \kappa_w \left(\frac{W_{t+1}}{W_t} - 1\right)\left(-\frac{W_{t+1}}{W_t^2}\right)\right)\right]$$

(as well as including in the labor market clearing condition the labor expended in adjusting the wage). Barattieri et al. (2014) estimate the average time to reset a wage is between 3.8 and 4.7 quarters. To match this finding we apply the logic employed above for the sticky price calibration, and compute that a value of κ_w= 32.3 in our annual model implies that half of wages have been reset one year after a shock. The substitutability between labor varieties is set to ϕ_L=6. The parameterization of the monetary policy rule is adjusted to γ_p = 3.[14]

Sticky wages significantly amplify the effect of a peg on the steady state number of firms and export shares, lowering the foreign/home ratios by 4.7% and 3.4%, respectively.

[14] No solution is possible in the model when significant wage rigidity is combined with a monetary policy that tries to hold prices nearly constant. Because prices depend primarily upon the production cost, that is, the ratio of wage to the productivity, a shock to productivity requires a similar movement in wage if prices are to remain constant. We resolve this problem by reducing the weight on inflation in the monetary policy rule, using a value of 3 based on Schmidt-Grohe and Uribe (2007).

Some intuition can be draw from equation (42') derived for the case of the simplified model. Recall that differentiated goods prices are set lower, hence encouraging greater specialization in differentiated goods, if there is a smaller covariance of nominal marginal costs (wage divided by productivity) with demand. Firms dislike a situation where they are required to produce more when production costs are high. In the benchmark simulation with only price stickiness, monetary policy assures that demand is high during positive productivity shocks that lower production costs. But this policy also has the effect of raising nominal wages, which works the opposite direction to raise production costs. Sticky wages work to prevent such a rise in wage costs, and hence maintain a low covariance of costs with demand.[15]

Another key determinant of the rise in wages and hence costs following a shock is the labor supply elasticity. Recall that the preferences assumed in the analytical model imply an infinite labor supply elasticity, in contrast with the value of 1.9 assumed in the numerical economy. There is a wide range of values for this elasticity supported in the macroeconomics literature.[16] When the labor supply elasticity is raised in the simulation model to an extreme value of 5, we obtain a stronger effect of a peg on the mean export share, but the difference is modest (see column 5).

However, the effect becomes dramatic when this calibration is combined with a change in the specification of preferences to remove the wealth effect on labor supply, as in a GHH specification. Let preferences be defined: $U_t = \left(C_t - l_t^{1+\psi}/(1+\psi)\right)^{1-\sigma} \Big/ (1-\sigma) + \ln\left(M_t/P_t\right)$, which implies a labor supply $l_t^{\psi} = W_t/P_t$ and a redefinition of $\mu_t = P_t\left(C_t - l_t^{1+\psi}/(1+\psi)\right)^{\sigma}$.

The effect of a peg on the number of firms and the differentiated export share is amplified by an order of magnitude compared to the benchmark model, as seen in column (6). The mechanism is similar to that for the sticky wage case. The preference specification removes the wealth effect in wage determination, in that consumption does not appear in the labor supply condition. Unlike the benchmark model, a rise in consumption induced by a rise in productivity does not reduce labor supply and require a rise in wage to induce workers to

[15] Implications of policy for the mean level of sticky wages have little impact on comparative advantage in our model, since, in contrast with sticky prices, the wage rate affects both sectors symmetrically.
[16] See for Example Keane and Rogerson (2012).

supply labor. Hence there is less pressure for wage to rise for a given rise in production, which serves to lower the covariance between costs and output.[17]

For completeness, we consider a case where entry costs are specified in labor units (θ_K =1), as assumed in the analytical model. The effect of stabilization policy on the mean level of wages now has strong implications for the mean level of entry. Recall from the benchmark case in Table (2a) that a stabilizing country has a higher mean wage compared to the nonstabilizing country. When entry cost is specified in labor units this can strongly dampen entry in the stabilization country, and as a result, we find that policy has a trivial effect on the mean level of firm entry under the benchmark preference specification (not reported in Table 3). Column (7) reports a modified simulation where this rise in mean wage is moderated by assuming the preferences used for the preceding column (6). Stabilization policy then has a significant effect to raise entry and export share, albeit still less than in the case with entry costs specified in goods units.

In addition to wage movements, another feature of the benchmark model that could limit the effect of a peg is the correlation of exogenous shocks across countries. The fairly high shock correlations in the benchmark calibration reflect the close relationship between the U.S. and the EU-10 countries in the data used for calibration. But this high correlation might not apply to other countries. Column (8) of Table 3 shows that if the calibration assumes zero contemporaneous correlations across all shocks, the effect of the peg on entry and export shares doubles compared to the benchmark calibration.

Finally, as a complement to productivity shocks, we study a fiscal shock. Letting T_{Dt} represent the fraction of differentiated good production that is surrendered to the government, the differentiated goods market clearing condition becomes:
$\left(1-T_{Dt}\right)y\left(h\right)=d_t\left(h\right)+\left(1+\tau_D\right)d_t^*\left(h\right)$. Similarly for a tax on nondifferentiated goods production, T_{Nt}, market clearing becomes $\left(1-T_{Nt}\right)y_{H,t}=C_{H,t}+D_{AC,H,t}+\left(1+\tau_N\right)\left(C_{H,t}^*+D_{AC,H,t}^*\right)$.

[17] We also investigated a version of the model with complementarity between consumption and labor, as advocated in Hall and Milgrom (2008). While this specification did dampen the rise in wage during a rise in output and hence raise the mean share of differentiated goods in exports, the effect was small, and this case is not reported in our table of results.

It is assumed that the goods surrendered to the government as tax payments are consumed directly by the government, and this yields no household utility. This implies pricing equations for the two types of goods:

$$p_t(h) = \frac{\phi}{\phi - 1}\frac{W_t}{\alpha_t(1 - T_{Dt})} + \frac{\psi_P}{2}\left(\frac{p_t(h)}{p_{t-1}(h)} - 1\right)^2 p_t(h) - \psi_P \frac{1}{\phi - 1}\left(\frac{p_t(h)}{p_{t-1}(h)} - 1\right)\frac{p_t(h)^2}{p_{t-1}(h)}$$
$$+ \frac{\beta \psi_P}{\phi - 1} E_t\left[\frac{\mu_t}{\mu_{t+1}}\frac{\Omega_{t+1}}{\Omega_t}\left(\frac{p_{t+1}(h)}{p_t(h)} - 1\right)\frac{p_{t+1}(h)^2}{p_t(h)}\right]$$

and $$p_{H,t} = \frac{W_t}{\alpha_{H,t}(1 - T_{Nt})}.$$

Note that from the firm perspective this tax shock is very similar to a negative productivity shock. The tax shocks are assumed to follow autoregressive processes in log deviations from steady state, where the calibration of the shock is taken from the estimations of Leeper et al. (2010).[18]

Results reported in column (9) of Table 3 show that this simple tax shock acts much like a productivity shock. The addition of this new shock essentially doubles the effect of monetary stabilization on the mean number of firms and the share of differentiated goods in exports, as compared to the case in column (1) with productivity shocks alone. We also studied the effects of shocks to tastes, both intertemporally and between sectors, as well as money supply and money demand shocks, and shocks to government spending. These shocks did not have significant implications for the steady state share of allocation of production between sectors.

5. Conclusion

According to a widespread view in policy and academic circles, monetary and exchange rate policy has the power to benefit or hinder the competitiveness of the domestic

[18] The process estimated by Leeper et al (2010) for capital tax shocks is converted from a quarterly frequency to an annual frequency by stochastic simulation of the process and then fitting an annual sampling of the artificial data to a first order autoregression. The resulting autoregressive parameter of 0.741 and standard deviation of shocks of 0.0790 are applied to tax shocks in each country and each sector. These shocks are assumed to be orthogonal to each other. The mean level of this tax, 0.184, is also taken from Leeper et al (2010).

manufacturing sector. This paper revisits the received wisdom on this issue, exploring a new direction for open-economy monetary models and empirical research. Our argument is that macroeconomic stabilization affects the comparative advantage of a country in producing goods with the characteristics (high upfront investment, monopoly power and nominal frictions) typical of manufacturing. A stabilization regime that reduces output gap (and marginal cost) uncertainty can strengthen a country's comparative advantage in the production of these goods, beyond the short run.

To be clear, an efficient stabilization policy requires contingent expansion and contractions in response to shocks affecting the output gap, which ex post foster but may also reduce the international price competitiveness of a country. In this sense, our results suggest that monetary stabilization may affect the long-run comparative advantage of a country in a way that is separate from the competitive devaluations familiar from traditional policy models. By the same token, our analysis provides a novel important insight on conclusion of recent New Keynesian models, that monetary policy should trade off output gap stabilization with stronger terms of trade. In our model, efficient stabilization makes differentiated good manufacturing more competitive, and this results in a shift in the sectoral allocation of resources and composition of exports, in favor of high-value added goods in exports. It is this shift that improve the country overall terms of trade, even if the international price of domestic manufacturing falls. Overall, the theory developed in this paper, and the empirical evidence produced in support of its key implications, point to new promising directions for integrating trade and macro models and bring the literature closer to addressing core concerns in the policy debate.

A crucial, implication from the model is nonetheless well in line with the conventional wisdom. In our analysis, we have focused on globally efficient policies. Yet countries may be tempted to go beyond efficient stabilization, and use their policy instruments strategically, to boost competitiveness on top and above their stabilization need. But since a strategic monetary regime in a country has negative spillovers on the share of manufacturing production in another, this would invite retaliation. From our perspective, this would result in lower global welfare, associated with a contraction of global manufacturing.

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Appendix:

1. **Entry condition**:

The single-period version of the entry condition (17) is:

$$W_t K = E_t\left[\beta \frac{\mu_t}{\mu_{t+1}} \pi_{t+1}(h)\right].$$

Combine with the single-period version of the profit function (15), in which the dynamic adjustment cost ($AC_{p,t}(h)$) is set to zero, and simplify:

$$W_t K = E_t\left[\beta \frac{\mu_t}{\mu_{t+1}}\left(\left(p_{t+1}(h) - \frac{W_{t+1}}{\alpha_{t+1}}\right)c_{t+1}(h) + \left(e_{t+1}p^*_{t+1}(h) - (1+\tau)\frac{W_{t+1}}{\alpha_{t+1}}\right)c^*_t(h)\right)\right]$$

Under producer currency pricing of exports:

$$W_t K = E_t\left[\beta \frac{\mu_t}{\mu_{t+1}}\left(\left(p_{t+1}(h) - \frac{W_{t+1}}{\alpha_{t+1}}\right)c_{t+1}(h) + \left((1+\tau)p_{t+1}(h) - (1+\tau)\frac{W_{t+1}}{\alpha_{t+1}}\right)c^*_{t+1}(h)\right)\right]$$

$$W_t K = E_t\left[\beta \frac{\mu_t}{\mu_{t+1}}\left(\left(p_{t+1}(h) - \frac{W_{t+1}}{\alpha_{t+1}}\right)\left(c_{t+1}(h) + (1+\tau)c^*_{t+1}(h)\right)\right)\right]$$

Using demand equations for C_M and $c(h)$, as well as definition of P_M:

$$W_t K = E_t\left[\beta \frac{\mu_t}{\mu_{t+1}}\left(\left(p_{t+1}(h) - \frac{W_{t+1}}{\alpha_{t+1}}\right)\left(\left(\frac{p_{t+1}(h)}{P_{M,t+1}}\right)^{-\phi}\theta\left(\frac{P_{t+1}}{P_{Mt+1}}\right)C_{t+1} + (1+\tau)^{1-\phi}\left(\frac{p_{t+1}(h)/e_{t+1}}{P^*_{M,t+1}}\right)^{-\phi}\theta\left(\frac{P^*_{t+1}}{P^*_{Mt+1}}\right)C^*_t\right)\right)\right]$$

$$W_t K = E_t\left[\beta \frac{\mu_t}{\mu_{t+1}}\left(\left(p_{t+1}(h) - \frac{W_{t+1}}{\alpha_{t+1}}\right)p_{t+1}(h)^{-\phi}\theta\begin{pmatrix}\left(n_{t+1}p_{t+1}(h)^{1-\phi} + n^*_{t+1}p_{t+1}(f)^{1-\phi}\right)^{-1}P_{t+1}C_{t+1} \\ +(1+\tau)^{1-\phi}e_{t+1}^{\phi}\left(n_{t+1}p^*_{t+1}(h)^{1-\phi} + n^*_{t+1}p^*_{t+1}(f)^{1-\phi}\right)^{-1}P^*_{t+1}C^*_t\end{pmatrix}\right)\right]$$

Under log utility, where $W_t = \mu_t$ and $P_tC_t = \mu_t$, this becomes equation (43).

2. Entry under full stabilization

Substitute prices, $p_{t+1}(h) = p^*_{t+1}(f)\left(\phi/(\phi-1)\right)$, and policy rules ($\mu = \alpha, \quad \mu^* = \alpha^*$) into (43) and simplify:

$$\frac{K\phi}{\beta\theta} = E_t\left[\left(n_{t+1} + n^*_{t+1}\left(\frac{\alpha_{t+1}}{\alpha^*_{t+1}}\right)^{1-\phi}(1+\tau)^{1-\phi}\right)^{-1} + (1+\tau)^{1-\phi}\left(\frac{\alpha_{t+1}}{\alpha^*_{t+1}}\right)^{\phi-1}\left(n_{t+1}\left(\frac{\alpha_{t+1}}{\alpha^*_{t+1}}\right)^{\phi-1}(1+\tau)^{1-\phi} + n^*_{t+1}\right)^{-1}\right]$$

Impose symmetry across countries:

$$n_{t+1} = \frac{\beta\theta}{K\phi}E_t\left[\left(1 + \left(\frac{\alpha_{t+1}}{\alpha^*_{t+1}}\right)^{1-\phi}(1+\tau)^{1-\phi}\right)^{-1} + (1+\tau)^{1-\phi}\left(\frac{\alpha_{t+1}}{\alpha^*_{t+1}}\right)^{\phi-1}\left(\left(\frac{\alpha_{t+1}}{\alpha^*_{t+1}}\right)^{\phi-1}(1+\tau)^{1-\phi} + 1\right)^{-1}\right]$$

$$n_{t+1}=\frac{\beta\theta}{K\phi}E_t\left[\frac{2+\left(\frac{\alpha_{t+1}}{\alpha^*{}_{t+1}}\right)^{1-\phi}\left((1+\tau)^{\phi-1}+(1+\tau)^{1-\phi}\right)}{1+\left(\frac{\alpha_{t+1}}{\alpha^*{}_{t+1}}\right)^{1-\phi}\left((1+\tau)^{\phi-1}+(1+\tau)^{1-\phi}\right)+\left(\frac{\alpha_{t+1}}{\alpha^*{}_{t+1}}\right)^{2(1-\phi)}}\right]$$

Which is the same as for the flexible price case.

To compare to the no stabilization case, write this as

$$n_{t+1}^{stab}=n_{t+1}^{no\,stab}E_t\Gamma_{t+1}$$

$$\text{where }\Gamma=\frac{2+\left(\frac{\alpha_{t+1}}{\alpha^*{}_{t+1}}\right)^{1-\phi}\left((1+\tau)^{\phi-1}+(1+\tau)^{1-\phi}\right)}{1+\left(\frac{\alpha_{t+1}}{\alpha^*{}_{t+1}}\right)^{1-\phi}\left((1+\tau)^{\phi-1}+(1+\tau)^{1-\phi}\right)+\left(\frac{\alpha_{t+1}}{\alpha^*{}_{t+1}}\right)^{2(1-\phi)}}$$

Note that $n_{t+1}^{stab}>n_{t+1}^{no\,stab}$ if $E_t\Gamma_{t+1}>1$. However Γ_{t+1} switches from a concave function of $\alpha_{t+1}/\alpha^*{}_{t+1}$ to a convex function near the symmetric steady state value of $\alpha_{t+1}/\alpha^*{}_{t+1}=1$. Hence we cannot apply Jensen's inequality to determine whether $E_t\Gamma_{t+1}>1$. This finding reflects the fact that the effects of symmetric stabilization are small. Our analysis, nonetheless, will show that the effects of asymmetric stabilization can be large.

3. Case of fixed exchange rate rule:

Substitute prices and policy rules ($\mu=\alpha_*,\ \mu^*=\mu=\alpha\quad(\text{so } e=1)$) into (43):

$$\frac{K}{\beta\theta}=E_t\left[\left(\left(\frac{\phi}{\phi-1}-1\right)\left(\frac{\phi}{\phi-1}\right)^{-\phi}\left(\left(n_{t+1}\left(\frac{\phi}{\phi-1}\right)^{1-\phi}+n^*_{t+1}\left(\frac{\phi}{\phi-1}E_t\left[\frac{\alpha_{t+1}}{\alpha^*{}_{t+1}}\right]\right)^{1-\phi}(1+\tau)^{1-\phi}\right)^{-1}+(1+\tau)^{1-\phi}\left(n_{t+1}\left(\frac{\phi}{\phi-1}\right)^{1-\phi}(1+\tau)^{1-\phi}+n^*_{t+1}\left(\frac{\phi}{\phi-1}E_t\left[\frac{\alpha_{t+1}}{\alpha^*{}_{t+1}}\right]\right)^{1-\phi}\right)^{-1}\right)\right)\right]$$

Pass through expectations and simplify

$$\frac{K\phi}{\beta\theta}=\left(\left(n_{t+1}+n^*_{t+1}\left(E_t\left[\frac{\alpha_{t+1}}{\alpha^*{}_{t+1}}\right]\right)^{1-\phi}(1+\tau)^{1-\phi}\right)^{-1}+\left(n_{t+1}+n^*_{t+1}\left(E_t\left[\frac{\alpha_{t+1}}{\alpha^*{}_{t+1}}\right]\right)^{1-\phi}(1+\tau)^{1-\phi}\right)^{-1}\right)$$

Do the same for the foreign entry condition:

$$\frac{K\phi}{\beta\theta}=\left(E_t\left[\frac{\alpha_{t+1}}{\alpha^*{}_{t+1}}\right]\right)^{1-\phi}\left(\left(n^*{}_{t+1}\left(E_t\left[\frac{\alpha_{t+1}}{\alpha^*{}_{t+1}}\right]\right)^{1-\phi}+n_{t+1}(1+\tau)^{1-\phi}\right)^{-1}+\left(n^*{}_{t+1}\left(E_t\left[\frac{\alpha_{t+1}}{\alpha^*{}_{t+1}}\right]\right)^{1-\phi}n_{t+1}(1+\tau)^{\phi-1}\right)^{-1}\right)$$

Rewrite the home and foreign conditions as fractions:

Home: $\dfrac{K\phi}{\beta\theta} = \dfrac{1}{n_{t+1} + An^*_{t+1}} + \dfrac{1}{n_{t+1} + Bn^*_{t+1}}$

Foreign: $\dfrac{K\phi}{\beta\theta} = \dfrac{A}{n_{t+1} + An^*_{t+1}} + \dfrac{B}{n_{t+1} + Bn^*_{t+1}}$

Where we define:

$$A \equiv \left(E_t\left[\frac{\alpha_{t+1}}{\alpha^*_{t+1}}\right]\right)^{1-\phi}(1+\tau)^{1-\phi}, \quad B \equiv \left(E_t\left[\frac{\alpha_{t+1}}{\alpha^*_{t+1}}\right]\right)^{1-\phi}(1+\tau)^{\phi-1}$$

Equating across countries:

$$\frac{2n_{t+1} + (A+B)n^*_{t+1}}{\left(n_{t+1} + An^*_{t+1}\right)\left(n_{t+1} + Bn^*_{t+1}\right)} = \frac{(A+B)n_{t+1} + 2ABn^*_{t+1}}{\left(n_{t+1} + An^*_{t+1}\right)\left(n_{t+1} + Bn^*_{t+1}\right)}$$

$$\frac{n_{t+1}}{n^*_{t+1}} = \frac{2AB - A - B}{2 - A - B}$$

so $\dfrac{n_{t+1}}{n^*_{t+1}} > 1$ if $\dfrac{2AB - A - B}{2 - A - B} > 1$

Note that the denominator will be negative provided the standard deviation of shocks is small relative to the iceberg costs, which will be true for all our cases:

$$\sigma < \left(\ln\left(2/\left((1+\tau)^{1-\phi} + (1+\tau)^{\phi-1}\right)\right)/\frac{1-\phi}{2}\right)^{0.5}$$

For shocks independently log normally distributed with standard deviation σ so that $E_t\left[\dfrac{\alpha_{t+1}}{\alpha^*_{t+1}}\right] = e^{\frac{1}{2}\sigma^2}$. For example, with τ=0.1 and ϕ=6, σ must be less than 0.209. Our calibration of σ is 0.017.

So $\dfrac{n_{t+1}}{n^*_{t+1}} > 1$ if $2AB - A - B < 2 - A - B$ or $AB < 1$

$$AB = \left(E_t\left[\frac{\alpha_{t+1}}{\alpha^*_{t+1}}\right]\right)^{1-\phi}(1+\tau)^{1-\phi}\left(E_t\left[\frac{\alpha_{t+1}}{\alpha^*_{t+1}}\right]\right)^{1-\phi}(1+\tau)^{\phi-1} = \left(E_t\left[\frac{\alpha_{t+1}}{\alpha^*_{t+1}}\right]\right)^{2(1-\phi)}$$

For independent log normal distributions of productivity:

$$\left(E_t\left[\frac{\alpha_{t+1}}{\alpha^*_{t+1}}\right]\right)^{2(1-\phi)} = e^{(1-\phi)\sigma^2} < 1 \text{ since } \phi>1$$

We can conclude that $n>n^*$.

4. LCP version of price adjustment costs

Under the specification that prices for domestic sales, $p_t(h)$, and exports, $p^*_t(h)$, are set separately in the currencies of the buyers, the Rotemberg price setting equations for our model become:

$$p_t(h) = \frac{\phi}{\phi-1}\frac{W_t}{\alpha_t} + \frac{\kappa}{2}\left(\frac{p_t(h)}{p_{t-1}(h)}-1\right)^2 p_t(h) - \kappa\frac{1}{\phi-1}\left(\frac{p_t(h)}{p_{t-1}(h)}-1\right)\frac{p_t(h)^2}{p_{t-1}(h)}$$
$$+\frac{\beta\kappa}{\phi-1}E_t\left[\frac{\mu_t}{\mu_{t+1}}\frac{\Omega_{H,t+1}}{\Omega_{H,t}}\left(\frac{p_{t+1}(h)}{p_t(h)}-1\right)\frac{p_{t+1}(h)^{2-\phi}}{p_t(h)^{1-\phi}}\right]$$

and

$$p_t^*(h) = \frac{\phi}{\phi-1}\frac{W_t(1+\tau_t)}{\alpha_t e_t} + \frac{\kappa(1+\tau_t)}{2}\left(\frac{p_t^*(h)}{p_{t-1}^*(h)}-1\right)^2 p_t^*(h) - \frac{1}{\phi-1}\kappa(1+\tau_t)\left(\frac{p_t^*(h)}{p_{t-1}^*(h)}-1\right)\frac{p_t^*(h)^2}{p_{t-1}^*(h)}$$
$$+\beta\frac{\kappa}{\phi-1}E_t\left[\frac{\mu_t}{\mu_{t+1}}\frac{\Omega_{H,t+1}^*}{\Omega_{H,t}^*}\left((1+\tau_{t+1})\left(\frac{p_{t+1}^*(h)}{p_t^*(h)}-1\right)\frac{e_{t+1}}{e_t}\frac{p_{t+1}^*(h)^{2-\phi}}{p_t^*(h)^{1-\phi}}\right)\right]$$

where $\Omega_{H,s} = P_{M,s}{}^{\phi}D_{M,s}$ and $\Omega_{H,s}^* = P^*{}_{M,s}{}^{\phi}D^*{}_{M,s}$.

Table 1. Benchmark Parameter Values

Preferences	
Risk aversion	$\sigma = 2$
Time preference	$\beta = 0.96$
Labor supply elasticity	$1/\psi = 1.9$
Differentiated goods share	$\theta = 0.38$
Non-differentiated goods home bias	$\nu = 0.5$
Differentiated goods elasticity	$\phi = 5.2$
Non-differentiated elasticity	$\eta = 15.3$
Technology	
Death rate	$\delta = 0.1$
Price stickiness	$\kappa = 8.7$
Differentiated good trade cost	$\tau_D = 0.16$
Non-differentiated good trade cost	$\tau_N = 0.08$
Firm entry adjustment cost	$\lambda = 0.25$

Shocks:

$$\rho = \begin{bmatrix} 0.6665 & -0.6145 & 0.1328 & -0.2064 \\ 0.3724 & 0.0447 & 0.0360 & -0.0250 \\ 0.5194 & -1.6747 & 0.1289 & 0.6588 \\ 0.2646 & -0.4435 & -0.0474 & 0.4407 \end{bmatrix}$$

$$E\left[\varepsilon_t \varepsilon_t^{'}\right] = \begin{bmatrix} 5.11e-4 & 1.68e-4 & 9.25e-5 & 3.45e-5 \\ 1.68e-4 & 1.45e-4 & 1.82e-5 & 6.47e-5 \\ 9.25e-5 & 1.82e-5 & 6.76e-4 & 7.50e-5 \\ 3.45e-5 & 6.47e-5 & 7.50e-5 & 1.70e-4 \end{bmatrix}$$

Table 2a: Unconditional Means under Alternative Policies

	symmetric stabilization	foreign fixed exchange rate	% difference
n	1.967	1.980	0.63
*n**	1.951	1.936	-0.73
ω_H	0.573	0.576	0.61
ω_F	0.569	0.566	-0.56
ym	0.469	0.472	0.68
yd	0.606	0.604	-0.34
*ym**	0.466	0.464	-0.58
*yd**	0.608	0.612	0.53
c	0.982	0.982	0.00
*c**	0.981	0.981	-0.03
p(h)	1.186	1.193	0.60
p(f)*	1.267	1.192	-5.91
w	0.959	0.964	0.60
*w**	1.024	0.963	-5.91
p(h)/w	1.239	1.239	0.00
p(f)/w**	1.238	1.239	0.07
p(h)/pdh	1.239	1.239	0.00
p(f)/pdf**	1.238	1.239	0.07
rer	1.000	1.000	0.01
TOT-Man	1.001	1.001	0.01
TOT-total	1.000	1.002	0.38

Results come from a stochastic simulation of a second-order approximation to the model. ω_H represents the share of differentiated goods in overall exports of the home country, and it is computed

$$\omega_{Ht} \equiv \frac{p^*_t(h)n_{t-1}\left(c^*_t\left(h\right)+d^*_{Kt}\left(h\right)+d^*_{AC,t}\left(h\right)\right)}{p^*_t(h)n_{t-1}\left(c^*_t\left(h\right)+d^*_{Kt}\left(h\right)+d^*_{AC,t}\left(h\right)\right)+P^*_{Ht}\left(C^*_{Ht}+D^*_{AC,H,t}\right)};$$

ω_{Ft} represents the counterpart for the foreign country.

Table 2b: Standard deviations (percent)

	data	symmetric stabilization	peg
GDP (U.S.)	2.07	2.62	2.51
GDP(EU-10)*	1.61	1.50	1.83
As ratios to std. dev. of GDP:			
ne	5.46	4.10	4.34
*ne**	3.48	3.65	4.52
c	0.75	0.43	0.45
*c**	0.88	0.40	0.34
l	0.87	0.40	0.45
*l**	0.96	0.44	0.68

U.S. data are used for home country; an average of the EU-10 for foreign.

Table 3: Summary of implications of alternative model specifications for key variables

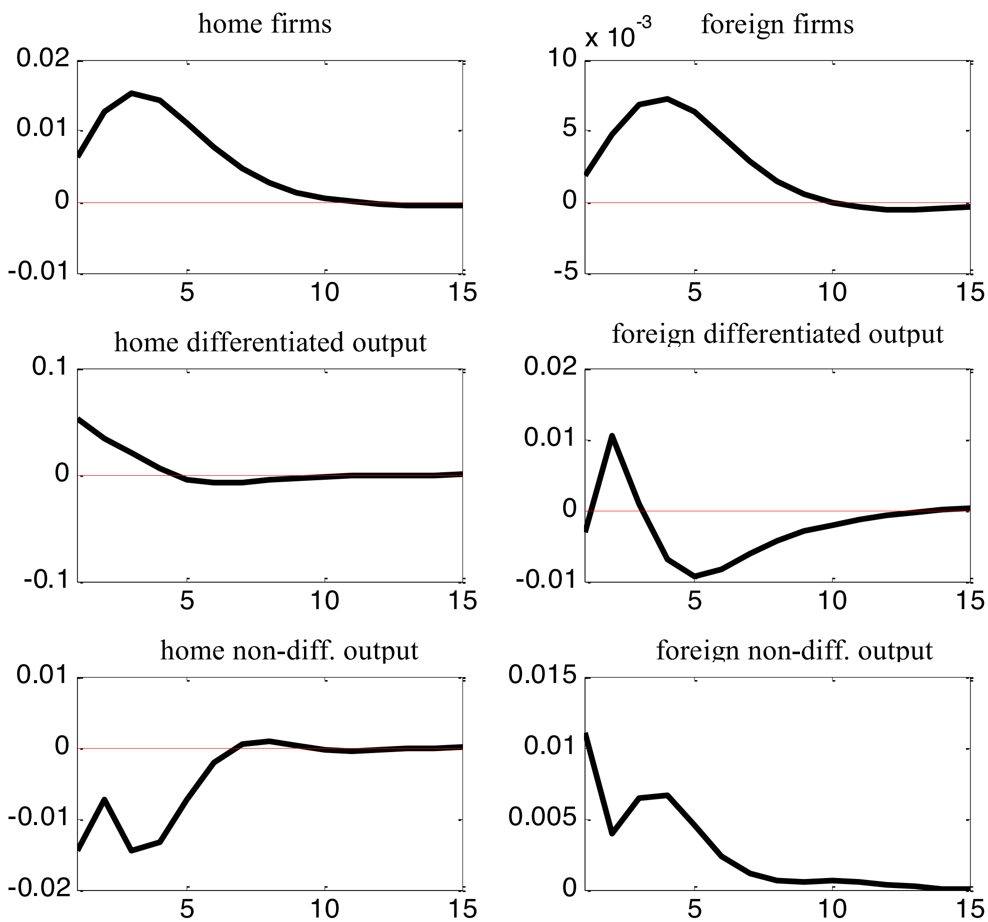
	(1) bench-mark	(2) no entry	(3) LCP	(4) sticky wage	(5) high labor elasticity	(6) GHH & high elasticity	(7) labor entry costs	(8) uncor-related shocks	(9) tax shocks
n	0.63	0.00	0.49	2.55	0.68	6.12	0.23	1.27	1.07
*n**	-0.73	0.00	-0.77	-2.14	-0.76	-7.36	-0.41	-1.45	-1.53
n-n*	-1.36	0.00	-1.25	-4.69	-1.44	-13.48	-0.64	-2.73	-2.60
diffshare	0.61	0.05	0.60	1.58	0.64	4.54	0.32	1.22	1.18
*diffshare**	-0.56	-0.02	-0.54	-1.77	-0.60	-4.78	-0.37	-1.09	-0.88
diffshare-diffshare*	-1.17	-0.06	-1.14	-3.35	-1.24	-9.32	-0.69	-2.31	-2.06

Table reports the percent change in a variable when the foreign country replaces inflation stabilization with exchange rate peg. Table also reports the difference between the home and foreign percent changes.
ω_H represents the share of differentiated goods in overall exports of the home country, and it is computed

$$\omega_{Ht} \equiv \frac{p^*_t(h)n_{t-1}\left(c^*_t(h)+d^*_{Kt}(h)+d^*_{AC,t}(h)\right)}{p^*_t(h)n_{t-1}\left(c^*_t(h)+d^*_{Kt}(h)+d^*_{AC,t}(h)\right)+P^*_{Ht}\left(C^*_{Ht}+D^*_{AC,H,t}\right)};$$

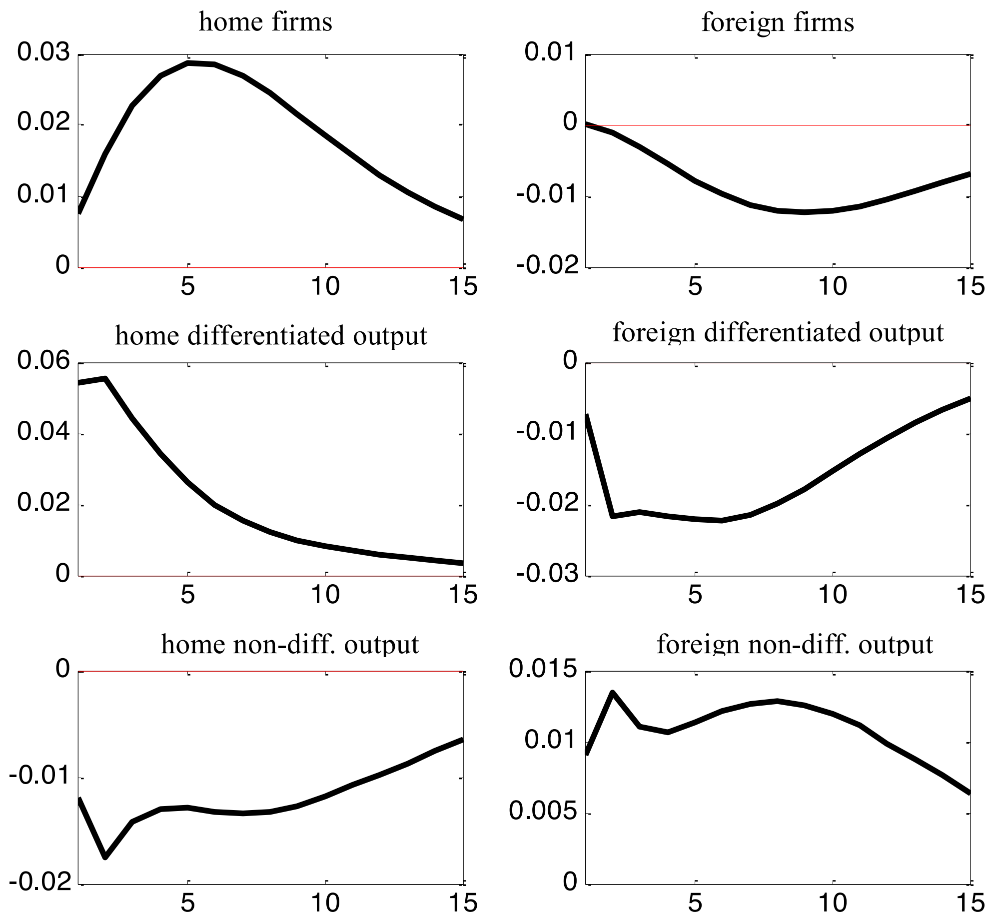
ω_F represents the counterpart for the foreign country.

Fig 1.
Responses to a 1 std dev rise in home manufacturing productivity;
both countries use efficient stabilization monetary policy



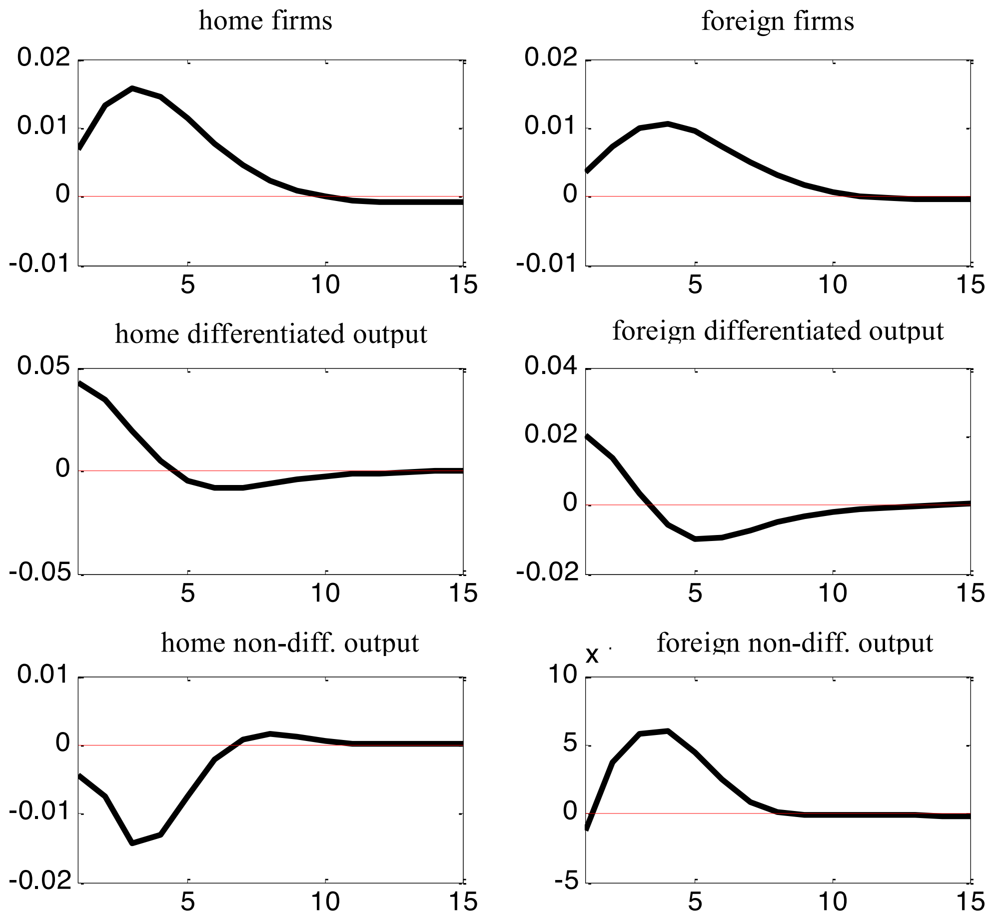
Vertical axis is percent deviation (0.01=1%) from steady state levels. Horizontal axis is tir
years).

Fig 2.
Responses to a 1 std dev rise in home manufacturing productivity;
both countries use efficient stabilization monetary policy;
No autocorrelation in shocks across countries



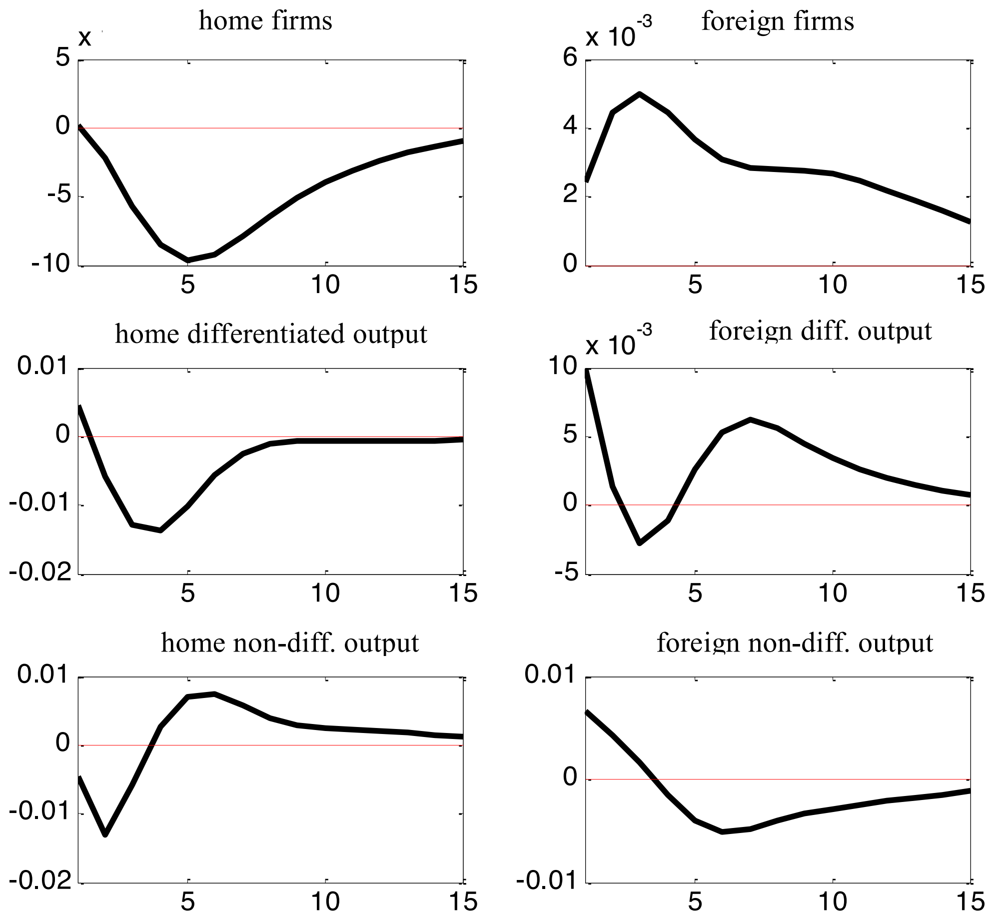
Vertical axis is percent deviation (0.01=1%) from steady state levels. Horizontal axis is time (in years).

Fig 3:
Responses to a 1 std dev rise in home manufacturing productivity;
foreign country pegs



Vertical axis is percent deviation (0.01=1%) from steady state levels. Horizontal axis is time (in years).

Fig 4.
Responses to a 1 std dev rise in foreign manufacturing productivity;
foreign country pegs



Vertical axis is percent deviation (0.01=1%) from steady state levels. Horizontal axis is time (in years).