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. Welfare implications of alternative monetary policy rules that shift comparative advantage are found to be substantial in a calibrated version of the model.

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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, reliance on devaluation to boost competitiveness is not viewed as a viable policy recommendation on two accounts. First, it may be interpreted as a strategic beggar-thy-neighbor measure, inviting retaliation up to causing currency wars, and second, it 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 for a country's comparative advantage of adopting monetary and exchange rate *regimes* which may or may not deliver efficient macroeconomic stabilization.

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

[1] In virtually all contributions to the new-open economy macroeconomics and New-Keynesian literature, the trade-off between output gap, defined as the difference between equilibrium output in the model with distortions and its first-best level in a world without distortions, 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.

in such industries, with potentially long-lasting effects on their competitiveness, and thus on the weight of their production in domestic output and exports.

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 differentiated goods producers face a combination of nominal rigidities and sunk entry costs that make them more sensitive to macroeconomic uncertainty.

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 non-differentiated 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 optimal prices, depending on the covariance of demand and marginal costs (See Obstfeld and Rogoff 2000, Corsetti and Pesenti 2005 and 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 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.

Numerical simulations are conducted on a calibrated version of the model, including TFP shocks calibrated to novel estimates of the TFP process for differentiated and non-differentiated sectors in the U.S. Results indicate that a policy where both countries fully stabilize inflation specific to the differentiated goods sector delivers welfare that is close to the Ramsey optimal policy. More importantly, when one country replaces a policy of full inflation stabilization with a unilateral exchange rate peg implying insufficient inflation stabilization, this substantially shifts comparative advantage in the differentiated goods sector to the stabilizing country. Compared to the symmetric Ramsey solution, the share of the pegging country's exports in differentiated goods falls by 4.5 percentage points, with a similar rise in the share for the stabilizing country. Associated with this relocation of exports and production across countries is a substantial shift in firm entry: there is a 7% drop in the number of firms in the differentiated goods sector in the pegging country, with a corresponding rise in the stabilizing country. Due to the drop in firm entry, the pegging country thus accounts for a smaller share of the range of varieties of differentiated goods available to consumers in both countries.

The shift in comparative advantage and production relocation imply substantial welfare implications in our model: welfare of the pegging country falls 1.8% relative to the Ramsey policy, and the welfare of the stabilizing country rises above the cooperative Ramsey policy by 1.4%. One reason the effects on real allocations and welfare are large by the standards of monetary policy literature is that the interaction of comparative advantage with asymmetric policies means that one country's loss is another country's gain. So even if world aggregate welfare implications are modest, the implications for individual county levels can be large.

The presence of two traded sectors and the shift in comparative advantage between them appears to be an essential element in generating the welfare gains and losses noted above. Scenarios of the model that either assume the non-differentiated sector does not exist or that it exists but is nontraded greatly reduce the asymmetric effect of the peg on welfare in both countries. In either scenario comparative advantage cannot arise, because one country cannot balance exports in the differentiated sector with imports in the non-differentiated. Similarly, the shift in firm entry margin appears to be an essential propagation mechanism generating large quantitative results. A version of the model that exogenously holds constant the number of firms in each country greatly reduces the asymmetric effect of the foreign peg on production location and welfare.

This paper is related to a large open economy macro literature studying optimal exchange rate and macroeconomic stabilization policy. We differ in studying how this policy affects endogenous specialization among multiple traded sectors, whereas the vast majority of the macro literature focuses on environments with one traded sector. Even in the small set of papers with more than one traded sector, only one sector tends to be exportable, which still rules out the question of endogenous comparative advantage. For example, even while Lombardo and Ravenna (2014) allow for imports of both intermediates and final goods, only final goods are exportable. While they characterize their contribution as studying how the exogenous composition of trade affects optimal exchange rate stabilization, we characterize our contribution as showing how exchange rate policy affects a composition of trade that is endogenous.

The part of the open economy monetary literature most closely related to our work are studies of oil price shocks, inasmuch as they develop models that include a tradable commodity sector in addition to the usual sticky price differentiated goods sector. However, there are obvious differences that preclude this literature from studying the comparative advantage and production relocation driving our results, mainly the fact that status as an oil exporter is determined largely by exogenous endowment. Bodenstein et al. (2012) simplifies the supply side of the oil sector by assuming an exogenous endowment, which is reasonable for studying the oil market, but rules out endogenous specialization. Nakov and Pescatori (2010a,b) endogenize production of oil, in order to study how a monopolistic oil sector leads optimal monetary policy to deviate from perfect inflation targeting. But they assume a dominant oil exporter (OPEC) that exogenously specializes and exports from the oil sector, again ruling out the effect of monetary policy on endogenous specialization.

From the perspective of trade theory, our analysis is related to 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] This relationship also applies to recent work by Epifani and

[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

Gancia (2017), who revisit the 'transfer problem' of trade in the context of production relocation externalities; again, they do not study monetary policy or consider an environment with nominal rigidities.

Our work is also related to the trade literature studying how various institutions and policies, such as labor market regulation or legal frameworks, affect comparative advantage between multiple traded sectors. Cunat and Melitz (2012) and Nunn (2007) are two examples. With respect to this international trade literature, our paper's novel contribution is to posit that the conduct of monetary policy is another, previously unstudied, institutional feature that should be added to the list of those that affect comparative advantage.

Finally, we note that 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 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. Section 3 develops intuition by deriving analytical results for a simplified version of the model. Section 4 uses stochastic simulations to demonstrate a broader set of implications, and explore the mechanism. 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, the home and foreign countries each produce two types of tradable goods. The first type comes in

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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.

differentiated varieties produced under monopolistic competition. In this market, firms face entry costs and nominal rigidities, and production requires intermediates in a round-about production structure. 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.

In the text we present the households' and firms' problems as well as the monetary and fiscal policy rules from the vantage point of the home economy, with the understanding that similar expressions and considerations apply to the foreign economy---foreign variables are denoted with a "*".

2.1. Goods consumption demand and price indexes

Households consume goods from two sectors. The first sector consists of differentiated varieties of a manufacturing good, which are produced by a time-varying number of monopolistically competitive firms in the home and foreign country, n_t and n_t* respectively. Each variety in this sector is an imperfect substitute for any other variety in this sector, either of home or foreign origin, with elasticity ϕ. The second sector consists of goods that are non-differentiated, in that all goods produced by firms within a given country are perfectly substitutable and are produced in a perfectly competitive environment. However, the home and foreign versions of the good are imperfect substitutes for each other, with elasticity η. We will refer to the differentiated sector as "manufacturing," and denote this sector with a *D*; we will denote the non-differentiated sector with a *N*.

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 the differentiated manufacturing good,

$c_t(h)$ and $c_t(f)$, 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, $C_{H,t}$ and $C_{F,t}$ with $\nu \in [0,1]$ accounting for the weight on domestic goods. For clarity, Figure 1 illustrates the aggregation of goods for consumption. 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, $p_t(h)$ and $p_t(f)$, and

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

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

These definitions imply relative demand functions for domestic residents:

$$C_{D,t} = \theta P_t C_t / P_{D,t} \qquad C_{N,t} = (1-\theta) P_t C_t / P_{N,t} \tag{4,5}$$

$$c_t(h) = \left(p_t(h) / P_{D,t} \right)^{-\phi} C_{D,t} \qquad c_t(f) = \left(p_t(f) / P_{D,t} \right)^{-\phi} C_{D,t} \tag{6,7}$$

$$C_{H,t} = \nu \left(P_{H,t} / P_{N,t} \right)^{-\eta} C_{N,t} \qquad C_{F,t} = (1-\nu) \left(P_{F,t} / P_{N,t} \right)^{-\eta} C_{N,t} \tag{8,9}$$

2.2. Home households' problem

The representative home household derives utility from consumption (C_t), and from holding real money balances (M_t/P_t); it derives disutility from labor (l_t). The household derives income by selling labor at the nominal wage rate (W_t); it receives real profits (Π_t) from home firms as defined below, and interest income on bonds in home currency ($i_{t-1}B_{H,t-1}$) and foreign currency ($i_{t-1}^* B_{F,t-1}$), where e_t is the nominal exchange rate in units of home currency per foreign. It pays lump-sum taxes (T_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

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

subject to the budget constraint:

$$P_t C_t + \left(M_t - M_{t-1}\right) + \left(B_{Ht} - B_{Ht-1}\right) + e_t \left(B_{Ft} - B_{Ft-1}\right) = W_t l_t + \Pi_t + i_{t-1} B_{Ht-1} + i_{t-1}^* B_{Ft-1} - P_t AC_{Bt} - T_t .$$

The constraint includes a small cost to holding foreign bonds

$$AC_{Bt} = \frac{\psi_B \left(e_t B_{Ft}\right)^2}{2 P_t p_{Ht} y_{Ht}} ,$$

scaled by ψ_B, which is a common device to assure long run stationarity in the net foreign asset position, and resolve indeterminacy in the composition of the home bond portfolio. The parameter σ denotes risk aversion and ψ is the inverse of the Frisch elasticity. The bond adjustment cost is a composite of goods that mirrors the consumption index, with analogous demand conditions to equation (4)-(9).[3]

Defining $\mu_t = P_t C_t^{\sigma}$, household 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:

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

a money demand condition:

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

and a home interest rate parity condition:

[3] See the appendix for the full set of demand equations. We cannot simply specify an index for final goods common to all components of demand, since some components of demand, namely intermediate inputs and sunk entry costs, involve only goods from the differentiated goods sector. Nonetheless, all components of demand for differentiated goods follow the same CES index over available varieties with the same elasticity of substitution.

$$\mathrm{E_t}\left[\frac{\mu_t}{\mu_{t+1}}\frac{e_{t+1}}{e_t}\left(1+\mathrm{i}_t^*\right)\left(1+\psi_B\left(\frac{e_t B_{ft}}{p_{Ht} y_{Ht}}\right)\right)\right]=\mathrm{E_t}\left[\frac{\mu_t}{\mu_{t+1}}\left(1+\mathrm{i}_t\right)\right]. \tag{13}$$

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 of each differentiated variety follows

$$y_t(h)=\alpha_{D,t}\left[G_t(h)\right]^{\zeta}\left[l_t(h)\right]^{1-\zeta}, \tag{14}$$

where $\alpha_{D,t}$ is a productivity shock specific to the differentiated goods sector but common to all firms within that sector, $l_t(h)$ is the labor employed by firm h, and $G_t(h)$ is a composite of differentiated goods used by firm h as an intermediate input. $G_t(h)$ is specified as an index of home and foreign differentiated varieties that mirrors the consumption index specific to differentiated goods ($C_{D,t}$). If we sum across firms, $G_t = n_t G_t(h)$ represents economy-wide demand for differentiated goods as intermediate inputs, and given that the index is the same as for consumption, this implies demands for differentiated goods varieties analogous to equations (6)–(7).

$$d_{G,t}(h)=\left(p_t(h)/P_{D,t}\right)^{-\phi}G_t \qquad d_{G,t}(f)=\left(p_t(f)/P_{D,t}\right)^{-\phi}G_t \tag{15, 16}$$

Differentiated goods firms set prices $p_t(h)$ subject to an adjustment cost:

$$AC_{P,t}(h)=\frac{\psi_P}{2}\left(\frac{p_t(h)}{p_{t-1}(h)}-1\right)^2\frac{p_t(h)y_t(h)}{P_t}, \tag{17}$$

where ψ_P is a calibrated parameter governing the degree of price stickiness. 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.[4]

[4] The price adjustment cost is an index of goods identical to the overall consumption index, implying demands analogous to those for consumption in equations (4)-(9). See the supplementary online appendix for the full list of equations.

The number of firms active in the differentiated sector, n_t, is endogenous, subject to free entry of new entrants, ne_t, and exit by an exogenous death shock. To set up a firm, managers incur a one-time sunk cost, K_t, and production starts with a one-period lag. In each period, all firms operating in the differentiated goods sector face an exogenous probability of exit δ, so that a fraction δ of all firms exogenously stop operating each period. The stock of firms at the beginning of each period is:

$$n_{t+1} = (1-\delta)(n_t + ne_t). \tag{18}$$

We include a congestion externality in the entry, represented as an adjustment cost that is a function of the number of new firms:

$$K_t = \left(\frac{ne_t}{ne_{t-1}}\right)^{\lambda} \overline{K}, \tag{19}$$

where $\overline{K}$ indicates the steady state level of entry cost, and the parameter λ indicates how much the entry cost rises with an increase in entry activity. 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 parameter, λ, to match data on the dynamics of new firm entry.[5] Entry costs are specified either in units of labor (if θ_K =1) or in units of the differentiated good (if θ_K =0). If entry costs are in units of differentiated goods, the demand is distributed analogously to demands for consumption of differentiated goods:

$$d_{K,t}(h) = \left(p_t(h)/P_{D,t}\right)^{-\phi} ne_t(1-\theta_K)K_t \tag{20}$$

$$d_{K,t}(f) = \left(p_t(f)/P_{D,t}\right)^{-\phi} ne_t(1-\theta_K)K_t. \tag{21}$$

We now can specify total demand facing a domestic differentiated goods firm:

$$d_t(h) = c_t(h) + d_{G,t}(h) + d_{K,t}(h) + d_{AC,P,t}(h) + d_{AC,B,t}(h) \tag{22}$$

which includes demand for consumption ($c_t(h)$), use as intermediate inputs ($d_{G,t}(h)$), sunk entry costs ($d_{K,t}(h)$), adjustment cost for prices ($d_{AC,P,t}(h)$), and bonds holding costs

[5] The value of steady state entry cost $\overline{K}$ has no effect on the dynamics of the model, and so will be normalized to unity.

($d_{AC,B,t}(h)$). There is an analogous demand from abroad $d_t^*(h)$. We assume iceberg trade costs τ_D for exports, which implies market clearing for this firm's variety is:

$$y_t(h) = d_t(h) + (1+\tau_D) d_t^*(h), \tag{23}$$

Firm profits are computed as:

$$\pi_t(h) = p_t(h) d_t(h) + e_t p_t^*(h) d_t^*(h) - mc_t y_t(h) - P_t AC_{p,t}(h). \tag{24}$$

where $mc_t = \zeta^{-\zeta}(1-\zeta)^{\zeta-1} P_{D,t}{}^{\zeta} W_t^{1-\zeta} / \alpha_{D,t}$ is marginal cost.

Thus the value function of firms that enter the market in period *t* may be represented as the discounted sum of profits of domestic sales and export sales:

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

where we assume firms use the discount factor of the representative household, who owns the firm, to value future profits. With free entry, new producers will invest until the point that a firm's value equals the entry sunk cost:

$$v_t(h) = \left(\theta_K W_t + (1-\theta_K) P_{D,t}\right) K_t , \tag{25}$$

where θ_K =1 is the case of entry costs in labor units, and θ_K =0 is the case of goods units.

Cost minimization implies usage of labor and intermediates depending on their costs:

$$\frac{P_{D,t} G_t(h)}{W_t l_t(h)} = \frac{\zeta}{1-\zeta}. \tag{26}$$

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

$$\begin{aligned} p_t(h) = {} & \frac{\phi}{\phi-1} mc_t + \frac{\psi_P}{2}\left(\frac{p_t(h)}{p_{t-1}(h)} - 1\right)^2 p_t(h) - \psi_P \frac{1}{\phi-1}\left(\frac{p_t(h)}{p_{t-1}(h)} - 1\right)\frac{p_t(h)^2}{p_{t-1}(h)} \\ & + \frac{\psi_P}{\phi-1} E_t\left[\beta \frac{\Omega_{t+1}}{\Omega_t}\left(\frac{p_{t+1}(h)}{p_t(h)} - 1\right)\frac{p_{t+1}(h)^2}{p_t(h)}\right] \end{aligned} \tag{27}$$

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

$$\Omega_t = \left[\left(\frac{p_t(h)}{P_{D,t}} \right)^{-\phi} \left(C_{D,t} + G_t + ne_t (1-\theta_K) K_t + AC_{P,D,t} + AC_{B,D,t} \right) \right.$$
$$\left. + \left(\frac{(1+\tau_D) p_t(h)}{e_t P^*_{D,t}} \right)^{-\phi} (1+\tau_D) \left(C^*_{D,t} + G^*_t + ne^*_t (1-\theta_K) K^*_t + AC^*_{P,D,t} + AC^*_{B,D,t} \right) \right] \Big/ \mu_t \ .$$

which sums demands arising from consumption, use as intermediate inputs, sunk entry cost, price adjustment costs, and bond holding costs.

Under the assumption of producer currency pricing, this implies a foreign currency price

$$p^*_t(h) = (1+\tau_D) p_t(h) / e_t \,, \tag{28}$$

where the nominal exchange rate, *e*, measures home currency units per foreign currency unit.

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:

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

For purposes of reporting results, define overall home gross production of differentiated goods: $y_{D,t} = n_t y_t(h)$.

2.4. Home firm problem in the undifferentiated goods sector

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:

$$y_{H,t} = \alpha_{N,t} l_{H,t} \,, \tag{29}$$

where $\alpha_{N,t}$ is stochastic productivity specific to this country and sector. It follows that the price of the homogeneous goods in the home market is equal to marginal costs:

$$p_{H,t} = W_t / \alpha_{N,t} \,. \tag{30}$$

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

$$p^*_{H,t} = p_{H,t} (1+\tau_N) / e_t \,. \tag{31}$$

Analogous conditions apply to the foreign non-differentiated sector.

2.5. Monetary policy

Monetary authorities are assumed to pursue an independent monetary policy. As background, for purposes of comparison to data, the model approximates an historical policy rule with the following Taylor rule:

$$1+i_t=\left(1+i_{t-1}\right)^{\gamma_i}\left[\left(1+\bar{i}\right)\left(\frac{p_t\left(h\right)}{p_{t-1}\left(h\right)}\right)^{\gamma_p}\left(\frac{Y_t}{\bar{Y}}\right)^{\gamma_Y}\right]^{1-\gamma_i}, \tag{32}$$

where terms with overbars are steady state values. In this rule, inflation is defined in terms of differentiated goods producer prices, while Y_t is a measure of GDP defined net of intermediates as:[6]

$$Y_t=\left((1+n_t)^{(-1/(1-\sigma))}\int_0^{n_t}p_t\left(h\right)y_t\left(h\right)dh-P_{D,t}G_t+p_{H,t}y_{H,t}\right)/P_t.$$

We will study the implications of several types of polices. An inflation targeting rule fully stabilizes prices in the differentiated goods sector:

$$\frac{p_t\left(h\right)}{p_{t-1}\left(h\right)}=1. \tag{33}$$

As will be discussed below, targeting inflation specific to the differentiated goods sector is sufficient in the context of this model to replicate the flexible price equilibrium. We will also consider a monetary policy rule that pegs the nominal exchange rate,

$$\frac{e_t}{e_{t-1}}=1. \tag{34}$$

Enforcement of this peg may be assigned either to the home or foreign policy maker.

For purposes of comparison, we also will compute a Ramsey policy, in which the monetary authority maximizes aggregate welfare of both countries (with no weight on money balances, $\chi=0$):

$$\max E_0\sum_{t=0}^{\infty}\beta^t\left(\frac{1}{2}\left(\frac{1}{1-\sigma}C_t^{1-\sigma}-\frac{1}{1+\psi}l_t^{1+\psi}\right)+\frac{1}{2}\left(\frac{1}{1-\sigma}C_t^{*1-\sigma}-\frac{1}{1+\psi}l_t^{*1+\psi}\right)\right)$$

under the constraints of the economy defined above. As common in the literature, we write the Ramsey problem by introducing additional co-state variables, which track the value of the planner committing to a policy plan.

[6] For computational simplicity, the Taylor rule is specified in terms of deviations of GDP from its steady state value, which is distinct from the output gap.

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:

$$M_t - M_{t-1} + T_t = 0. \tag{35}$$

2.6. Market clearing

The market clearing condition for the manufacturing goods market is given in equation (22) above. Market clearing for the non-differentiated goods market requires:

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

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

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:

$$B_{Ht} + B^*_{Ht} = 0 \tag{39}$$

$$B_{Ft} + B^*_{Ft} = 0. \tag{40}$$

Balance of payments requires:

$$\begin{aligned}&\int_0^{n_t} p^*_t\left(h\right)\left(d^*_t\left(h\right)\right)dh - \int_0^{n^*_t} p_t\left(f\right)\left(d_t\left(f\right)\right)df + P^*_{Ht}\left(C^*_{H,t} + AC^*_{P,H,t} + AC^*_{B,H,t}\right)\\ &-P_{F,t}\left(C_{F,t} + AC_{P,F,t} + AC_{B,F,t}\right) - i_{t-1}B^*_{H,t-1} + e_t i^*_{t-1}B_{F,t-1} = \left(B^*_{H,t} - B^*_{H,t-1}\right) + e_t\left(B_{F,t} - B_{F,t-1}\right).\end{aligned} \tag{41}$$

2.7. Shocks process and equilibrium definition

We will consider a number of shocks studied in the literature, featuring shocks to productivity, but also including shocks to intertemporal consumption preferences, money demand, and fiscal policy. 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:

$$\begin{bmatrix} \log \alpha_{D,t} - \log \overline{\alpha_D} \\ \log \alpha_{N,t} - \log \overline{\alpha_N} \end{bmatrix} = \rho \begin{bmatrix} \log \alpha_{D,t-1} - \log \overline{\alpha_D} \\ \log \alpha_{N,t-1} - \log \overline{\alpha_N} \end{bmatrix} + \varepsilon_t$$

with autoregressive coefficient matrix ρ, and 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.

2.8. 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:

$$TOTS_t \equiv \frac{\omega_{Ht} p_t(h) + \left(1 - \omega_{Ht}\right) p_{H,t}}{\omega_{Ft} e_t p_t^*(f) + \left(1 - \omega_{Ft}\right) e_t p^*_{F,t}}, \tag{42}$$

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

$$\omega_{Ht} \equiv \frac{n_t\, p_t^*(h) d_t^*\left(h\right)}{n_t\, p_t^*(h) d_t^*\left(h\right) + P_{H,t}^*\left(C_{H,t}^* + AC_{P,H,t}^* + AC_{B,H,t}^*\right)}, \tag{43}$$

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

$$\omega_{Ft} \equiv \frac{n_t^*\, p_t(f) d_t\left(f\right)}{n_t^*\, p_t(f) d_t\left(f\right) + P_{Ft}\left(C_{F,t} + AC_{P,F,t} + AC_{B,F,t}\right)}. \tag{44}$$

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: $TOTM_t \equiv p_t(h)/\left(e_t p_t^*(f)\right)$.[7] The latter measure ignores the non-differentiated goods sector.

3. Analytical Insights from a Simple Version of the Model

In this section, we provide a detailed 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 the full-fledged version of the model.

We specialize our model as follows. First, we posit that production of differentiated goods involves only labor with no intermediates ($\zeta = 0$) and that entry costs are in labor units ($\theta_K = 1$). Second, we consider the case where these differentiated goods firms operate for one period only (implying $\delta = 1$ in the entry condition), and symmetrically preset prices over the same horizon. Third, 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.[8] Fourth, we restrict productivity shocks to be i.i.d., and only occur in the differentiated goods sector (we abstract from productivity shocks in the non-differentiated goods sector, and drop the sector subscript from the productivity term in the differentiated goods sector: $\alpha_t \equiv \alpha_{D,t}$). Fifth, utility is log in consumption and linear in leisure ($\psi = 0$). Next, we abstract from international asset trade ($B_H = B_F = 0$). This simplification has no effect on our results, as we show below that under trade in a single homogenous good whose production is not subject to shocks, production

[7] 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).
[8] 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.

risk is efficiently shared between countries, even in the absence of trade in financial assets, and independently of the way production and trade are specified in the other sector. 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 $\mu_t = P_t C_t$, 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_t (and μ_t^* for the foreign country).

Under these assumptions--in particular, using the fact that the discount rate for nominal quantities can be written as the (inverse of the) growth rate of $\mu_t = P_t C_t$--the firms' problem becomes

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

The optimal preset price in the domestic market is:

$$p_{t+1}(h) = \frac{\phi}{\phi - 1} \frac{E_t\left[\Omega_{t+1}\left(\frac{W_{t+1}}{\alpha_{t+1}}\right)\right]}{E_t\left[\Omega_{t+1}\right]}, \tag{45}$$

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:

$$\Omega_{t+1} = \left(c_{t+1}(h) + (1+\tau)c_{t+1}^*(h)\right) / \mu_{t+1}.^9$$

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

$$\frac{K_t}{\beta\theta} = E_t\left[\left(p_{t+1}(h) - \frac{\mu_{t+1}}{\alpha_{t+1}}\right) p_{t+1}(h)^{-\phi}\, \Omega_{t+1}\right]. \tag{46}$$

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

[9] Upon appropriate substitutions and cancellations, equation (45) may also be written with Ω_{t+1} defined as $\Omega_{t+1} = \left(n_{t+1} p_{t+1}(h)^{1-\phi} + n_{t+1}^* p^*{}_{t+1}(f)^{1-\phi} e_{t+1}{}^{1-\phi} (1+\tau)^{1-\phi}\right)^{-1} + \left(n_{t+1} p_{t+1}(h)^{1-\phi} + n_{t+1}^* p^*{}_{t+1}(f)^{1-\phi} e_{t+1}{}^{1-\phi} (1+\tau)^{\phi-1}\right)^{-1}$.

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 that, by the equilibrium condition in the labor market with an infinite labor supply elasticity, the exchange rate is a function of the ratio of nominal consumption demands, hence of the monetary policy stances. To see this, 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 then can be expressed as:

$$e_t = \frac{P_{Dt}}{P^*_{Dt}} = \frac{W_t}{W^*_t} = \frac{P_t C_t}{P^*_t C^*_t} = \frac{\mu_t}{\mu^*_t}, \tag{47}$$

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.[10]

3.1. The equilibrium consequences of nominal rigidities

At the core of our results is a general property of sticky price models that is best exemplified in our simplified model. Rewrite (45) as follows:

$$p_{t+1}(h) = \frac{\phi}{\phi - 1}\left\{ E_t\left[\left(\frac{W_{t+1}}{\alpha_{t+1}}\right)\right] + \frac{Cov_t\left[\Omega_{t+1}\left(\frac{W_{t+1}}{\alpha_{t+1}}\right)\right]}{E_t\left[\Omega'_{t+1}\right]}\right\} \tag{48}$$

By the covariance term on the right-hand side of this expression, the optimal preset price is a function of the comovements of a firm's marginal costs ($W_{t+1}/\alpha_{t+1} = \mu_{t+1}/\alpha_{t+1}$), and overall (domestic and foreign) demand for the firm's good, Ω_{t+1}. To appreciate the relevance of this property for the monetary transmission mechanism, consider the extreme case of no

[10] 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 (47) 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.

monetary stabilization of business cycle fluctuation, i.e., posit that the monetary stance does not respond to any shock, but target a constant nominal demand in either country ($\mu_t = \mu_t^* = 1$). This implies a constant nominal exchange rate at $e_t = \mu_t / \mu_t^* = 1$ and, with i.i.d. shocks, no dynamics in predetermined variables such as prices and numbers of firms. Under these monetary rules, the optimal preset prices (48) 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 (46), so to obtain:

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

Intuitively, given constant 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 nor the real exchange rate, hence there will be no change in consumption demands and production for 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 sub-optimally 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 sub-optimally low markups. So, in a regime of no output gap 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 of 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, $E_t\left[\frac{1}{\alpha_{t+1}}\right] > \frac{1}{E_t\left[\alpha_{t+1}\right]} = 1$).[11]

Since both marginal costs and overall demand are functions of monetary stances, in the general case policy regimes can critically impinge on pricing (and thus on entry) via the covariance term in the equation. The implications for our argument are detailed next.

3.2. Prices and firm dynamics under efficient and inefficient stabilization

Suppose that the monetary stance in each country moves in proportion to productivity in the differentiated goods sector: $\mu_t = \alpha_t, \quad \mu_t^* = \alpha_t^*$. The exchange rate in this case is not constant, but contingent on productivity differentials, so that the home currency systematically depreciates in response to an asymmetric rise in home productivity:

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

It is easy to see that, by ensuring that the nominal marginal cost, μ_t / α_t, remains constant, the above policy zeroes the covariance term in (48), and thus insulates the ex-post markup charged by home manufacturing firms from uncertainty about productivity.[12] 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:

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

[11] 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.

[12] 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.

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 non-differentiated goods, redirecting demand across sectors. This rise in demand for differentiated goods supports the entry of additional manufacturing firms.

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 monetary policy rule that stabilizes markups in the differentiated sector. As shown in the appendix, under this rule the number of manufacturing firms is:[13]

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

the same as under flexible prices.[14]

Consider instead the case in which, while the home government keeps stabilizing its output gap, the foreign country switches monetary regime to a currency peg:

$$\mu_t = \alpha_t \text{ and } e_t = 1, \text{ so that } \mu_t^* = \mu_t = \alpha_t .$$ [15]

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

[13] 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.

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

[15] 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.

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

$$n_t > n_t^{stab} > n_t^* .$$

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 the foreign peg results in higher relative prices in the foreign manufacturing sector, inefficient stabilization redirects demand towards the (now relatively cheaper) non-differentiated goods sector. Most crucially, as the ratio of the country's differentiated goods prices to non-differentiated 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 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 goods 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. Despite the many differences between the simplified and the full versions of our model, we will show that the 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 and prices 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).

The model is solved as a second order approximation around a deterministic steady state. Nominal variables are scaled by the consumer price index, P_t, in the simulated model, to allow for the possibility of a steady state inflation rate that is not zero in the Ramsey policy solution.

4.1. Model Calibration

Where possible, parameter values are taken from standard values in the literature. Risk aversion is set at $\sigma = 2$; labor supply elasticity is set at $1/\psi = 1.9$ following Hall (2009). Parameter values are chosen to be consistent with an annual frequency---the frequency at which sectoral productivity data are available. Accordingly, time preference is set at $\beta = 0.96$.

To choose parameters for the differentiated and non-differentiated sectors we draw on Rauch (1999). We choose θ so that differentiated goods represent 55 percent of U.S. trade in value. We assume the two countries are of equal size with no exogenous home bias, $\nu = 0.5$, but allow trade costs to determine home bias ratios. To set the elasticities of substitution for the differentiated and non-differentiated goods we draw on the estimates by 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 non-differentiated commodities is η = 15.3.

The price stickiness parameter is set at $\psi_p = 8.7$, a 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.[16] The firm death rate is set at $\delta = 0.1$, which is four times the standard rate of 0.025 to reflect the annual frequency. The mean sunk cost of entry is normalized to the value $\overline{K}$ =1. The share of intermediates in differentiated goods production is set to a modest value of ζ =1/3, though higher values will be considered in robustness checks.[17]

To set trade costs, we calibrate τ_D so that exports represent 26% of GDP, as is the average in World Bank national accounts data for OECD countries from 2000-2017.[18] This

[16] 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 $\psi_P = 8.7$. 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.
[17] There is a wide range of opinion regarding the appropriate calibration for this parameter. Jones (2007) suggest a value of 0.43 for the share of intermediates, and it is common in the related literature to use a value at 1/2. We will consider a range of values for this parameter in sensitivity analysis, but we use a modest value of this parameter for our benchmark model, as it permits us to conduct sensitivity analysis for a wider range of alternative values for other parameters without violating dynamic stability of the model.
[18] See https://data.worldbank.org/indicator/NE.EXP.GNFS.ZS?locations=OE.

requires a value of τ_D =0.33[19]. This is similar to value of trade costs typically assumed by macro research, such as 0.25 in Obstfeld and Rogoff, 2001. But it is small compared to some trade estimates, such as 1.7 suggested by Anderson and van Wincoop 2004, and adopted by Epifani and Gancia (2017). We will conduct sensitivity analysis to a wide range of values for the trade cost and resulting trade share, and we will find that our results are robust to calibrations implying trade shares both much higher and much lower than our benchmark calibration. We begin with the standard assumption of trade models that the homogeneous good is traded frictionlessly (τ_N), but we will consider a range of value for this parameter also in sensitivity analysis.

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. Data for the U.S. on establishment entry are available from the Longitudinal Business Database. The standard deviation for this series, logged and HP-filtered, taken as a ratio to the standard deviation of GDP for 2004-2012, is 5.53. A value of λ = 0.10 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.)

Calibration of policy parameters for the historical monetary policy Taylor rule are taken from Coenen, et al. (2008): γ_i =0.7, γ_p =1.7, γ_Y =0.1.

To our knowledge, no one else has calibrated a DSGE model with sectoral shocks distinct to differentiated and non-differentiated goods. Annual time series of sectoral productivities are available from the Groningen Growth and Development Centre (GGDC), for the period 1980-2007. Given that we wish to isolate the asymmetries across countries attributable specifically to asymmetric monetary policies, we choose to parameterize the countries as symmetric in all respects other than for the policy rules. So we use data for the U.S. to parameterize shocks to both of the symmetric countries.[20] The benchmark case assumes no international correlation of shocks, but this will be introduced in our robustness

[19] To coincide with standard accounting definitions, differentiated goods used as intermediates are included in the measure of exports, and excluded in the measure of GDP, as is appropriate.
[20] We note that Backus et al., 1992 similarly used a “symmetricized” parameterization of the shock process as their benchmark case for quantitative experiments in their two-country model.

analysis. TFP is calculated on a value-added basis. 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 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 two de-trended series.

Table 2 compares the calibrated model to data in terms of some key second moments. Moments are generated by a stochastic simulation of a version of the model with the Taylor policy rule using historical policy parameters defined above. Following Ghironi and Melitz (2005), to facilitate comparison with data, Table 2 reports model simulations with units deflated using a data-consistent price index.[21] The parameterized model is broadly in line with the volatility of U.S. output, as well as the volatilities of key variables (in ratio to the volatility of output), such as consumption, employment and net business formation.[22] [23]

4.2. Impulse responses

Impulse responses provide intuition into the implications of alternative monetary policies in the context of this model. Figure 2 reports the dynamics of key variables in the benchmark model in response to a one standard deviation positive shock to productivity in the differentiated goods sector of the home country. The dashed line depicts the case where each country fully stabilizes prices of differentiated goods, using the inflation

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[21] For any variable X_t in consumption units, we report data-consistent units as $\tilde{X}_t = \left(P_t / \tilde{P}_t\right) X_t$, where $\tilde{P}_t$ is an overall price index that uses a price sub-index of differentiated goods redefined as

$\tilde{P}_{D,t} = \left(n_t + n_t^*\right)^{\frac{1}{1-\phi}} P_{D,t}$.

[22] The standard deviation of the home nominal interest rate under the historical policy rule is 0.0039 in units of percentage points (where the mean level of the interest rate is 0.0417 percentage points). Under the symmetric inflation targeting this standard deviation rises to 0.0106, under the foreign peg/home inflation targeting it is 0.0069, and Ramsey policy implies a value of 0.0151.

[23] Simulations are conducted for a first order approximation of the model, with output HP filtered with smoothing parameter 100 to reflect annual data.

targeting rule defined previously. The home policy responds to the shock with a monetary expansion that lowers the home interest rate. This boosts domestic demand and depreciates home currency, which shifts demand from foreign differentiated goods toward home counterparts. This policy reaction raises production in the differentiated sector, in line with its enhanced productivity. The number of home firms in the sector rises, and production shifts in favor of home differentiated goods, away from non-differentiated goods. Production in the foreign country is the converse, with a fall in foreign production of differentiated goods and a rise in non-differentiated production, along with a fall in the number of foreign differentiated goods firms.

Numerical experiments not shown confirm that this inflation targeting rule exactly replicates the dynamics of real variables in a flexible-price equilibrium of this model (where the price setting cost, ψ_P, is set to zero and money growth is held constant), and they imply a constant markup for all the productivity shocks. As a reflection of the flexible price equilibrium, the inflation targeting rule will be a useful benchmark for comparing other policies in the context of our model environment. This is not to say that the policy that replicates the flexible price allocation is fully optimal. There are a number of distortions present in our model, in addition to the sticky price distortion. These include incomplete asset markets leading to imperfect international risk sharing, and the monopolistic markups that distort the relative price between differentiated goods on one hand, and non-differentiated goods and leisure on the other. Further, a product creation distortion also exists, because markups are disconnected from the benefit of productivity to consumers.

To evaluate the optimal policy, we next consider the Ramsey solution as defined above. As depicted by the solid lines in Figure 2, the Ramsey solution is very similar to the inflation targeting rule in the context of our model. Ramsey implies an almost identical fall in home interest rate, and a slightly smaller home currency depreciation. As above, the policy implies a shift in home production toward differentiated goods and away from non-differentiated goods, facilitated by entry of more home firms into the differentiated goods sector. Again, the foreign country variables move in the opposite direction. Overall, the Ramsey policy implies nearly perfect stabilization of the differentiated goods inflation, with a standard deviation of just 0.2%, compared to a standard deviation of overall inflation of 1.7%. It also implies zero steady state inflation in differentiated goods prices.

Consider finally a policy where the home country commits to an exchange rate peg. In this instance we specify the peg is maintained by the home country, so that we can continue to focus on a home country shock, and thereby facilitate comparisons to the two policies already presented in Figure 2 for the case of a home shock. The foreign country continues the inflation targeting rule. Impulse responses, plotted in Figure 2 as dotted lines, are very different from the preceding two cases, especially in the initial periods after the shock when prices remain sticky. The home interest rate barely changes, so there is minimal effort to stimulate domestic demand. As a result, the rise in home differentiated goods production on impact is a third the size as under inflation targeting. The impact on the number of firms, as well as production in the non-differentiated sector are also much smaller. Clearly the home commitment to a peg, in the context of this model and this shock, severely limits its ability to replicate the flexible price allocation.

4.3. Unconditional means

Table 3 reports the unconditional means of key variables obtained from a second order approximation of the benchmark model.[24] The first column reports levels of variables under Ramsey optimal policy, while the other four columns report the percentage difference in means implied by alternative monetary policies relative to the Ramsey solution. The main contribution is in column (5) which reports the implications of the foreign country adopting an exchange rate peg while the home country targets inflation.

Numerical results from the full model confirm the main insights from the simplified model in the preceding section. When the foreign country pegs while the home country fully stabilizes inflation (column 5), the mean level of production of the differentiated good shifts away from the foreign country and toward the home country; the foreign country instead has a higher mean level production of the non-differentiated good. The share of differentiated goods in foreign exports (ω_F) is 4.6 percentage points lower and the home share (ω_H) 3.9 percentage points higher, relative to the Ramsey case. This production

[24] Unconditional means are analytical, with no HP filtering applied.

relocation is facilitated by a 6.8 percent lower number of foreign differentiated goods firms and an 8.3 percent higher number at home.

Also consistent with insights from the analytical model, the mechanism initiating the production relocation is a shift in comparative advantage in terms of relative prices across sectors and countries. On one hand, it is true that the adoption of a foreign peg drives up the relative price of a home differentiated good compared to foreign, even after accounting for home currency depreciation ($TOTM_t \equiv p_t(h)/\left(e_t p_t^*(f)\right)$ rises slightly in Table 3). This reflects the rise in home wages compared to foreign, which affects the prices in both home sectors; what matters for comparative advantage is the relative price of differentiated goods to non-differentiated goods. The table shows the relative price across sectors indeed falls for home (0.28 percent) and rises for foreign (0.72 percent), indicating a shift in comparative advantage in differentiated goods toward the home country. As in the analytical model, the higher foreign relative price comes in part from a higher markup (by 0.10 percent), reflecting the risk premium in the price-setting equation of sticky price firms. But in the full simulation model this effect is augmented by the higher cost of intermediate inputs, given the trade cost paid on imported intermediates (the differentiated goods composite price index rises 0.73 percent abroad and only 0.07 at home). Together the rise in foreign marginal costs of producing differentiated goods and the rise in foreign markup on these goods tilt the comparative advantage for producing and exporting these goods toward the home country.

Our result illustrates the point that an improvement in a country's terms of trade need not be a contradiction to the aim of greater price competitiveness, when defined in terms of comparative advantage. Observe in Table 3 that the home country has dramatically improved terms of trade defined over the full range of goods including both differentiated and non-differentiated (*TOTS*), despite the fact it has a lower markup on differentiated goods than the foreign country. Part of this terms-of-trade improvement comes from the rise in wages noted above. This highlights a difference between the full version of the model and the simplified version solved analytically – when the labor supply is not assumed to be infinitely elastic, a high level of entry tends to raise demand for labor and hence wages and production costs. Depending on the labor supply elasticity, this effect may become strong enough to prevent the international price of domestic manufacturing from falling in tandem with average markup in the sector. This effect drives the small rise in the manufacturing terms of trade, *TOTM*, observed in Table 3. However, the improvement in the overall terms of trade, *TOTS*, is much larger, pointing to a second effect at work deriving from changes in the composition of exports. 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. We posit that this coincidence of competitiveness specific to the manufacturing sector and terms of trade improvement points toward one way of reconciling a concern with terms of trade characteristic of the recent academic literature, with a concern for competitiveness that tends to dominate policy debates.

Columns 2-4 present material for context and robustness. The second column shows the means implied by the historical Taylor rule (used previously to generate standard deviations in Table 1), and the third column reports the symmetric policy of full stabilization of differentiated goods producer price inflation. Both sets of policies imply a small drop in production of differentiated goods relative to the Ramsey solution. The fourth column shows the result if a foreign peg is paired with the historical Taylor rule at home. The production relocation observed in the benchmark case (column 5) still occurs, with a rise in home entry and production in the differentiated goods sector and fall in foreign. But magnitudes are smaller, with the number of home firms rising 1.2% rather than the 8.3% observed under home inflation targeting.[25]

4.4. Welfare analysis

Welfare implications of the various monetary policies are reported in the last three rows of Table 3. We report the welfare effect of changing from the Ramsey solution to an alternative policy, compared to a case where the Ramsey policy is continued. We compute the change in welfare in consumption units household would be willing to forgo, by solving for Δ in:

[25] We also experimented with a strict inflation targeting rule where the measure of inflation is the full consumer price index rather than the differentiated goods price index. We find that when home applies this policy while foreign pegs, it does not effectively stabilize home marginal costs, and leads to a small loss in home comparative advantage in the differentiated goods sector. Under a foreign peg, the Home differentiated share falls 1.4% and home welfare falls 0.53% relative to the Ramsey policy.

$$\sum_{t=0}^{\infty} \beta^t \left(u\left(C_t^{alt.policy}, l_t^{alt.policy} \right) \right) = \frac{u\left[\left(1 + \frac{\Delta}{100} \right) \left(C_t^{Ramsey}, l_t^{Ramsey} \right) \right]}{1-\beta}$$

We assume identical initial conditions for state variables across different monetary policy regimes using the Ramsey case as the initial condition, and we include transition dynamics in the computation to avoid spurious welfare reversals.[26]

The table shows that there are substantial welfare implications of the foreign peg, arising from the reorientation of comparative advantage between the countries. For comparison, when both countries follow a symmetric inflation targeting rule, the loss of welfare relative to the Ramsey rule is a very modest 0.04%. This reinforces the observation from impulse responses that in our two-traded goods model, the simple policy rule targeting differentiated goods inflation is close to the Ramsey policy. In contrast, when the foreign country pegs while the home country targets inflation, the foreign welfare falls a much larger 1.8%. This is a large welfare loss compared to the inflation targeting rule or even the loss from the suboptimal historical policy rule, of 0.25%. Even more striking, the welfare change of the home country arising from the foreign peg goes in the other direction -- the home country improves relative to the Ramsey case by 1.4%. We observe that the asymmetric welfare effects of the peg policy are more than a full order of magnitude larger than when comparing a symmetric suboptimal policy, either inflation targeting or historical policies.

Note that this improvement in home welfare relative to the Ramsey solution does not violate the principle of Ramsey optimality, as the overall world welfare under this asymmetric policy is still worse than Ramsey, by 0.20%. But the shift in comparative advantage of differentiated goods toward the home country leads to a transfer of welfare from foreign to home, further worsening foreign welfare and improving home welfare above the Ramsey symmetric case.

This finding indicates that taking comparative advantage into consideration in a two country model can significantly amplify the welfare consequences of alternative monetary policy rules. It also indicates that when we consider the case of policies that are asymmetric

[26] We adopt the methodology created by Giovanni Lombardo and used in Coenen et al. (2008), available from https://www.dropbox.com/s/q0e9i0fw6uziz8b/OPDSGE.zip?dl=0.

by country, welfare impacts can be much greater than under the assumption of symmetric policies across countries, as the welfare loss of one county can translate into the welfare gain of another.

Table 3 also reports results when home strict inflation targeting is replaced by the historical policy rule, while foreign still pegs. Home welfare again is higher than foreign, but given the weaker production relocation effects observed for this policy above, the welfare levels of both countries are lower under a foreign peg than under the Ramsey policy.

4.5. Sensitivity analysis

This section describes sensitivity analysis for alternative model specifications and parameterizations. The purpose is to two-fold. We of course wish to characterize how general our result is to a range of economic environments. But more importantly, we wish to explore the mechanism at work, and isolate which elements in our model are central to the production relocation effect.

4.5.1. Isolating the mechanism

We begin by shutting down various elements in our model to demonstrate that the endogenous comparative advantage between two tradable sectors is the source of the substantial welfare implications of policy found above. Table 4 reports the effect of a foreign peg on welfare and on the differentiated shares of exports in each country, as percentage changes from the Ramsey case, under various alternative model specifications. First, suppose the number of firms is not allowed to respond endogenously to policy. This is accomplished by suspending the home and foreign firm free entry condition (equation 25), and replacing it with the equations $n = n^* = 0.41$. This specification shuts down the production relocation externality in response to differing monetary policies. The second column of the table shows that the substantial asymmetric welfare effects arising from the foreign peg policy now virtually are eliminated. Both home and foreign countries have lower welfare compared to the Ramsey case, by similar amounts. This result makes clear that the endogenous comparative advantage introduced in our benchmark model is an essential part of the mechanism generating the substantial asymmetric welfare found above.

A similar result obtains in a one sector model, where non-differentiated goods are eliminated from the model, implement by setting θ to a value close to 1. The model then resembles a standard sticky price model with firm entry (as in Bergin and Corsetti, 2008). The third column of Table 4 shows that while the home country has higher welfare than under the Ramsey case, the difference in welfare is an order of magnitude smaller than in the benchmark model with non-differentiated goods. Clearly the presence of two distinct tradable sectors is a necessary condition for comparative advantage to be an issue, let alone for it to be influenced by monetary policy.

The fourth column shows that these conclusions also apply when non-differentiated goods are present, but are not traded internationally ($\nu = 1$). Clearly the production relocation driving our result depends upon shifts in comparative advantage between the two traded sectors.

The fifth column shows that when entry costs are in units of labor rather than goods ($\theta_K = 1$), the home welfare continues to benefit from the foreign peg, but the magnitude of the home welfare gain is smaller. When entry costs are in units of differentiated goods, there is a virtuous circle at work to amplify the production relocation mechanism. As home specializes in differentiated goods and this lowers the price index of differentiated goods, this also reduces the entry cost for home firms, encouraging yet more home entry into the differentiated goods sector, and yet greater specialization in this sector.

One thing the welfare result is not sensitive to, however, is the asset market specification, inasmuch as an assumption of financial autarky (hence balanced trade) delivers similar results in column 6 as to the benchmark case. This case is generated by calibrating the international bond holding cost to be prohibitively high. In fact, the magnitude of the welfare effect is even somewhat greater in this case.

Column 7 shows results that are also very similar to the benchmark specification when prices are assumed sticky in the local currency of the buyer rather than the seller. To save space, the equations for this model specification are presented in the appendix.

4.5.2. Alternative parameterizations

Next, we conduct sensitivity analysis to a range of alternative calibrations for key parameters. Figure 3a shows the trade cost of differentiated goods, τ_D , has a nonmonotonic relationship to the home welfare gain from a foreign peg: welfare gains are low both for trade costs near zero and near unity, but rise for intermediate values, reaching a peak at around trade costs of 0.3. Figure 3b shows that a nearly identical hump-shaped relationship exists between trade costs and the degree of home specialization in differentiated goods, represented as the ratio of home to foreign number of differentiated goods firms. The figure also plots the number of firms in each country separately, showing that higher trade costs on differentiated goods reduces the total number of firms active in this sector. It also shows that a foreign peg induces more firm entry at home than foreign at all levels of trade cost. But the difference between countries is small at both extremes of trade costs, and there is a pronounced peak around the same level of intermediate trade cost as seen in the plot of home welfare.

This graph offers two lessons. First, it suggests that the substantial home welfare gains are driven by the production relocation mechanism that we have been emphasizing. Ultimately, higher home welfare comes from the fact that home consumers pay trade costs on a smaller share of differentiated goods, leading to a lower price index and higher consumption. But this result depends upon the home country endogenously specializing in the production of differentiated goods.

Second, Figure 3b offers clues for explaining the nonmonotonicity in the relationship between trade cost and welfare, as it appears to be linked to the magnitude of the relocation effect. For example, relocation is small when trade costs are high, since it restricts the scope for international trade in differentiated goods, and hence restricts the scope of production relocation. Simply, if high trade costs mean not many differentiated goods are being traded, the home country cannot export as many. As trade costs become smaller and trade in differentiated goods rises, the fact that home firms have a somewhat lower price than foreign due to the better monetary policy induces a virtuous cycle. The fact that home firms pay trade costs on a smaller share of the differentiated goods means they have a lower price index when they use differentiated goods as intermediate inputs and as entry cost. This cheaper entry cost leads to even greater entry of home firms, which then reinforces the cheaper price index. Why does this virtuous cycle weaken for very low trade costs? In the limit when trade costs are zero, it does not matter whether one buys differentiated goods domestically or from abroad; home and foreign firms have access to the same set of differentiated goods at the same price, to use as intermediates and for paying entry costs. So it is only for an intermediate range of trade costs where the virtuous cycle -- the interaction of trade cost with intermediates prices and entry cost -- can become large.

Recall that the benchmark calibration of the trade cost, τ_D = 0.33, was chosen to imply an export-GDP share of 26%, which is the average value for OECD countries 2000-2017 in World Bank data. The range of τ_D on the horizontal axis of the Figures 3a,b maps directly into alternative trade shares. The export share implied by τ_D = 0.3, where the relocation effect reaches its maximum, is 27%, which is not so different from the benchmark calibration target. However, for the case of no trade cost, τ_D = 0, the export share in GDP rises to 55%. For a trade cost τ_D = 1, the export share falls to 13%, which is the value specific to the case of U.S. data in recent years. This level of trade cost implies a substantially smaller, but still noticeable production relocation effect and welfare gain.

While our benchmark model maintains the assumption of the trade literature on firm relocation that the homogeneous good is frictionlessly traded, Figure 4 studies the effects of supposing non-zero trade costs on the non-differentiated good (τ_N). The figure shows that the home welfare gain from a foreign peg becomes smaller and approaches zero as the trade cost for the non-differentiated sector grows relative to that of the differentiated sector. As in the trade literature on production relocation, the home welfare gain arises from the ability to avoid importing goods requiring payment of high trade costs. So if trade costs are similar across sectors, the welfare gain of specializing in a particular sector disappears.

The roundabout production structure, in which differentiated goods require intermediates in the form of other differentiated goods, plays a role in amplifying our welfare result. Figure 5 shows that the home welfare gain from the foreign peg consistently rises with a higher intermediates share. In fact, for an intermediate share of 0.35, just a bit higher than our benchmark calibration, the effect on welfare rises to 2%, measured in consumption units. This effect is similar to the role that differentiated inputs serve in Epifani and Gancia (2017) to amplify the welfare implications of the production relocation effect. We are not able to study welfare under still higher values of the intermediate share in the benchmark model, as there is no numerical solution for equilibrium under the Ramsey policy in that case. However, if the trade cost is lowered (τ_D = 0.1) implying a lower home welfare gain, a wider range of intermediate shares can be studied. Figure 5 shows that it remains true that the home welfare gain rises with yet higher intermediate shares.

The appendix explores a number of additional alternative model specifications, some of which require significant modifications in the structure of the model. These include a nontraded goods sector, an endogenously determined margin between traded and nontraded goods, as well as investment in real capital in place of a sunk entry cost. These results serve to underscore the main conclusion above, that our results arise from production relocation and shifts in comparative advantage in trade; models that narrow the scope for this channel dampen the asymmetric welfare effects of policy.

4.5.3. Alternative shocks

To gain further insight into the monetary transmission mechanism that is relevant for our results, we now consider the model including alternative sources of uncertainty. First we consider the robustness of our results when productivity shocks are allowed to be correlated across countries, which was ruled out in the benchmark calibration. Simulations indicate that if home and foreign shocks are assumed to be perfectly correlated across countries, then the foreign peg does not result in any production relocation effect. That is, the unconditional means of all variables remain symmetric across countries when the foreign pegs its exchange rate and home fully stabilizes differentiated goods inflation. The simple reason is that if the foreign country always experiences the same shock as home, then a peg will require foreign money supply and interest rates to exactly track home monetary policy. So both countries will experience the same degree of inflation and output gap stabilization, hence no asymmetries.

To see how much production relocation occurs under a reasonable, intermediate degree of international correlation, we gather data on an aggregate of European Union countries as a counterpart to those used to estimate the U.S. shock processes previously. We collect residuals from a first order vector autoregresion on the four series, and compute the international correlations across residuals. The correlation between home and foreign differentiated goods shocks is 0.321, between non-differentiated goods shocks is 0.0793, and between differentiated goods in one country and non-differentiated goods in the other county is 0.0528. Results reported in Table 5, column 6 show that the production relocation effect is somewhat diminished but remains substantial, with the home welfare rising 1.2% rather than 1.4% relative to the Ramsey solution.

Next we consider a range of additional shocks. Drawing on the literature we include a shock to money demand, consumption demand, and tax shocks affecting the markup. We augment the utility function with time-varying terms to shift the marginal utility of money balances (χ_t) and consumption (ϑ_t):

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

A tax shock specification used in Corsetti et al. (2010) is adapted to consider exogenous variations in firm markups. Let T_{Dt} represent the fraction of differentiated goods production that is surrendered to the government, so that the differentiated goods market clearing condition becomes $(1-T_{Dt})y(h) = d_t(h) + (1+\tau_D)d_t^*(h)$. Similarly for a tax on non-differentiated goods production, T_{Nt}, market clearing becomes $(1-T_{Nt})y_{H,t} = C_{H,t} + D_{AC,H,t} + (1+\tau_N)\left(C_{H,t}^* + D_{AC,H,t}^*\right)$. 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:

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

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

Note from these equations that the tax shocks act like a shock to firm markups.

All shocks are assumed to follow autoregressive processes in log deviations from steady state, orthogonal to other shocks, and orthogonal across countries. The parameterization of the tax shock is taken from the estimations of Leeper et al. (2010).[27] Parameterization of the consumption taste shock is taken from Stockman and Tesar (1995), and that of the money demand shock is taken from Bergin et al. (2007). [28]

Results are reported in Table 5. We first show that shocks to money demand are not relevant: under the monetary regimes considered in either of our experiments, any rise in money demand is automatically matched by a rise in money supply -- this is true under both inflation stabilization and under a peg, as well as under the Ramsey solution. Simulations confirm that the mean number of firms and differentiated export share are unaffected, and so are the other variables in the model. (See column 2.) This type of shock could be potentially consequential for firms' entry only under monetary regimes, such as a constant money growth rule, that would fall short of insulating aggregate demand from destabilizing liquidity shocks, inducing a positive covariance between demand and marginal costs.

Shocks to consumption tastes (column 3) are found to have effects that are of the same sign as those for productivity shocks, but are one to two orders of magnitude smaller. A foreign peg in the presence of taste shocks discourages foreign entry in the differentiated goods sector and thereby encourages entry in the home country that stabilizes inflation, but the magnitudes are very small.

Results for the tax shock indicate that firm entry and welfare decline in both countries, and both decline more so at home than foreign. This reflects the findings in other studies such as Corsetti et al. (2010) that cost push shocks introduce a significant trade-off between inflation stabilization and output gap stabilization. This underscores that our main point is not that inflation targeting, per se, induces production relocation, but that one country pursuing a stabilization policy more friendly to investment in new firm entry will

[27] 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).

[28] We follow the first experiment of Stockman and Tesar (1995), in parameterizing a shock to overall consumption with standard deviation 2.5 times that of productivity, and with the same autoregressive parameter as productivity. We follow Bergin et al (2007) in setting the standard deviation of the money demand shock at 0.030, with a serial correlation of 0.99.

benefit from production relocation. The exact specification of this better stabilization policy will depend on the mix of shocks.

We conclude with an experiment combining all four shocks, shown in column (5). The overall effects of stabilization policy on export shares and welfare are similar to a summing of the effects under productivity and tax shocks treated separately earlier in the table. The home country still has higher welfare than the Ramsey case, and the foreign lower welfare, but the home welfare gain is smaller than under the benchmark model with just productivity shocks.

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 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. Our results however suggest that monetary stabilization may affect the long-run comparative advantage of a country in a way that is separate from the prescription of pro-competitive devaluations familiar from traditional policy models. By the same token, our analysis provides a novel and important insight on the conclusions 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 goods 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 improves the country's overall terms of trade, even if the international price of domestic manufacturing falls. Overall, the theory developed in this paper points to new promising directions for integrating trade and macro models and brings the literature closer to addressing core concerns in the policy debate.

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Table 1. Benchmark Parameter Values

Preferences	
Risk aversion	$\sigma = 2$
Time preference	$\beta = 0.96$
Labor supply elasticity	$1/\psi = 1.9$
Money balances	$\chi = 1$
Differentiated goods share	$\theta = 0.61$
Non-differentiated goods home bias	$\nu = 0.5$
Differentiated goods elasticity	$\phi = 5.2$
Non-differentiated goods elasticity	$\eta = 15.3$
Technology	
Firm death rate	$\delta = 0.1$
Price stickiness	$\psi_P = 8.7$
Intermediate input share	$\varsigma = 0.33$
Differentiated goods trade cost	$\tau_D = 0.33$
Non-differentiated goods trade cost	$\tau_N = 0$
Mean sunk entry cost	$\overline{K} = 1$
Firm entry adjustment cost	$\lambda = 0.10$
Bond holding cost	$\psi_B = 0.001$
Monetary Policy (for the historical policy rule):	
Interest rate smoothing	$\gamma_i = 0.7$
Inflation response	$\gamma_p = 1.7$
GDP response	$\gamma_Y = 0.1$

Shocks:

$$\rho = \begin{bmatrix} 0.4132 & 0.1379 \\ 0.0057 & 0.2574 \end{bmatrix}$$

$$E\left[\varepsilon_t \varepsilon_t^{'}\right] = \begin{bmatrix} 5.23e-4 & 1.70e-4 \\ 1.70e-4 & 8.16e-4 \end{bmatrix}$$

Table 2 Standard deviations (percent)

	Data (U.S.)	Historical policy rule
GDP	2.07	2.49
As ratios to std. dev. of GDP:		
firm creation	5.53	4.06
Consumption	0.75	0.29
labor	0.87	0.88

Table 3: Means: comparison across policy regimes

	(1) Ramsey	(2) Symmetric historical	(3) Symmetric inflation targeting	(4) Foreign peg/ home historical	(5) Foreign peg/home inflation targeting
		Percentage deviation from Ramsey			
unconditional means of variables:					
ω_H	0.551	-0.320	-0.354	0.061	3.930
ω_F	0.551	-0.318	-0.354	-0.640	-4.580
n	0.409	0.832	2.045	1.193	8.299
$n*$	0.409	0.835	2.045	-0.292	-6.772
y_D	1.472	-0.091	-0.051	0.101	2.287
y_H	1.772	0.870	1.214	0.209	-4.771
y_D^*	1.472	-0.090	-0.051	-0.265	-2.338
y_F^*	1.772	0.868	1.215	1.152	6.416
C	0.583	-0.002	0.136	0.047	0.827
$C*$	0.583	-0.002	0.136	-0.103	-0.800
$p(h)$	1.546	0.151	0.307	0.157	0.771
$p*(f)$	1.546	0.152	0.307	0.031	-0.532
W	0.401	0.068	0.326	0.110	1.240
$W*$	0.401	0.068	0.326	-0.090	-1.101
markup	0.238	0.013	0.011	0.029	0.011
*markup**	0.238	0.013	0.011	-0.054	0.098
$p(h)/P_N$	3.866	0.230	0.250	0.161	-0.284
$p*(f)/P_N^*$	3.866	0.229	0.250	0.221	0.716
p_D	1.801	0.506	0.622	0.388	0.069
p_D*	1.801	0.506	0.622	0.436	0.725
RER	1.001	0.181	0.257	0.221	1.178
TOTM	1.000	-0.021	0.002	0.014	0.231
TOTS	1.061	12.014	17.154	10.090	18.653
Welfare relative to Ramsey policy, percent difference in consumption units, conditional on initial conditions					
total		-0.246	-0.041	-0.259	-0.202
home		-0.246	-0.041	-0.105	1.390
foreign		-0.246	-0.041	-0.412	-1.807

Results come from 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

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

; ω_F represents the counterpart for the foreign country. Since ω_H and ω_F are in percentage form already, the table reports differences from Ramsey policy for these two variables in units of percentage points. Home markup is calculated as markup = $(p(h)/mc-1)*100$; analogous for foreign.

Table 4. Alternative Model Specifications: percent difference of foreign peg from Ramsey

	(1) Benchmark	(2) Fixed num. firms (n=n*=0.41)	(3) No non-diff. goods ($\theta = 1$)	(4) No trade in non-diff. goods ($\nu = 1$):	(5) Entry cost in labor units ($\theta_K = 1$)	(6) Balanced trade (ψ_B =1000)	(7) Local currency pricing
Welfare:							
Home	1.390	-0.144	0.072	0.042	0.078	1.492	1.370
Foreign	-1.807	-0.190	-0.232	-0.247	-0.163	-1.957	-1.641
Total	-0.202	-0.167	-0.080	-0.103	-0.042	-0.226	-0.477
Diff. goods export share:							
Home	3.930	-0.134	0.000	0.000	0.728	8.212	6.126
Foreign	-4.580	-0.019	0.000	0.000	0.213	-8.358	-6.441

Welfare computed as percent difference from Ramsey case, in units of steady state consumption, conditional on Ramsey policy allocation as initial conditions. Differentiated goods share of exports (ω_H and ω_F) are in percentage form already, so the table reports differences from Ramsey policy in units of percentage points. Values based on unconditional means from simulation of second order approximation of the model.

Table 5. Alternative shocks

	(1) Productivity (benchmark)	(2) Money demand	(3) Tastes	(4) Tax	(5) All four shocks	(6) Correlated productivity shocks
Welfare:						
Home	1.390	0.000	0.012	-1.113	0.363	1.174
Foreign	-1.807	0.000	-0.055	-0.236	-2.113	-1.409
Total	-0.202	0.000	-0.022	-0.674	-0.871	-0.114
Diff. goods export share:						
Home	3.930	0.000	0.057	-6.318	4.494	3.260
Foreign	-4.580	0.000	-0.116	-0.065	-3.421	-3.761

Welfare computed as percent difference from Ramsey case, in units of steady state consumption, conditional on Ramsey policy allocation as initial conditions. Differentiated goods share of exports (ω_H and ω_F) are in percentage form already, so the table reports differences from Ramsey policy in units of percentage points. Values based on unconditional means from simulation of second order approximation of the model.

Figure 1. Aggregation for home consumption

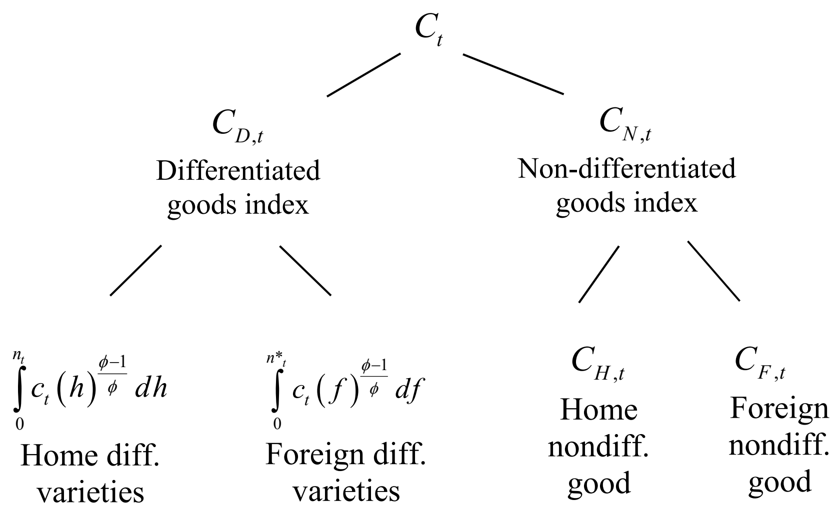
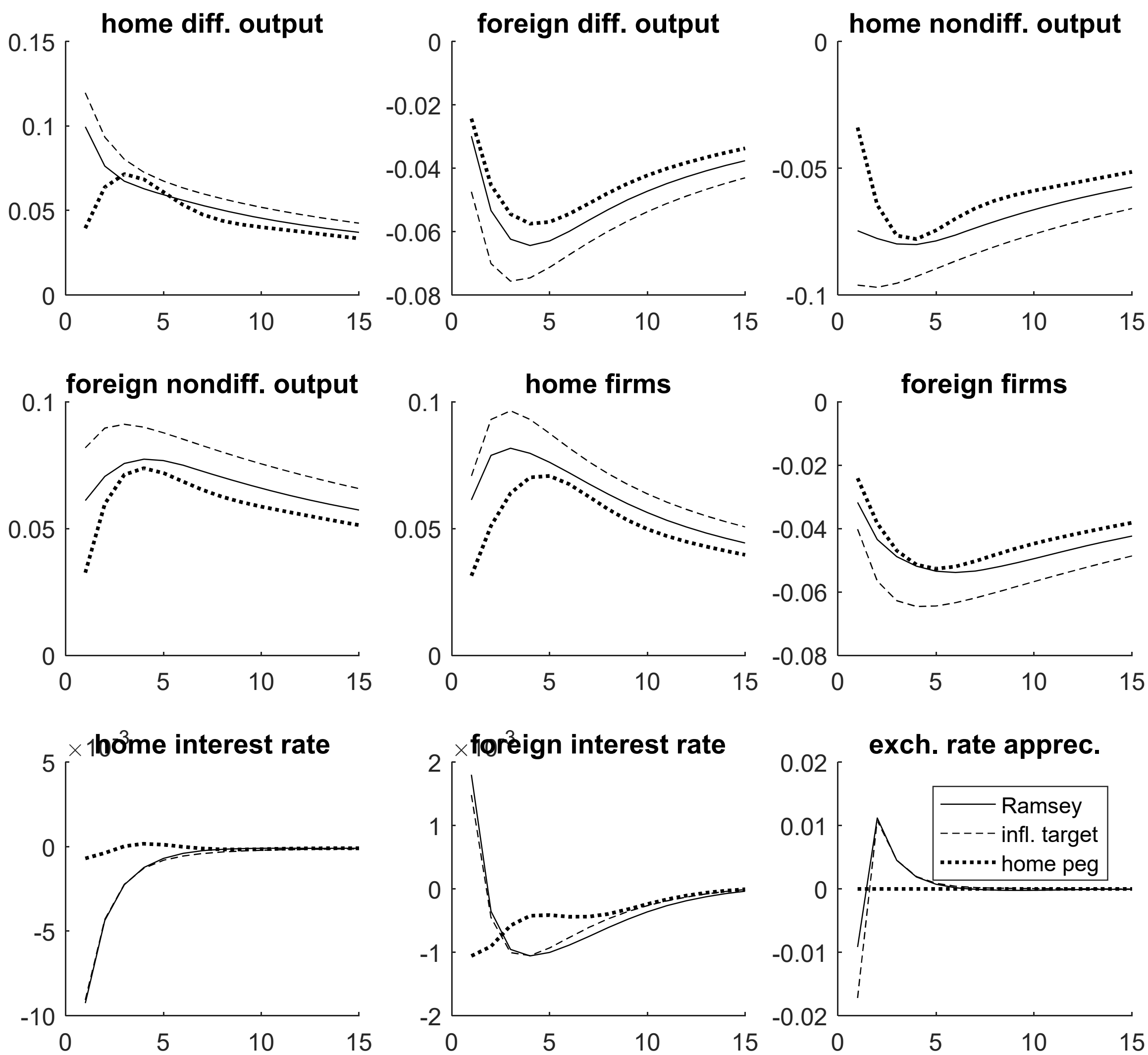


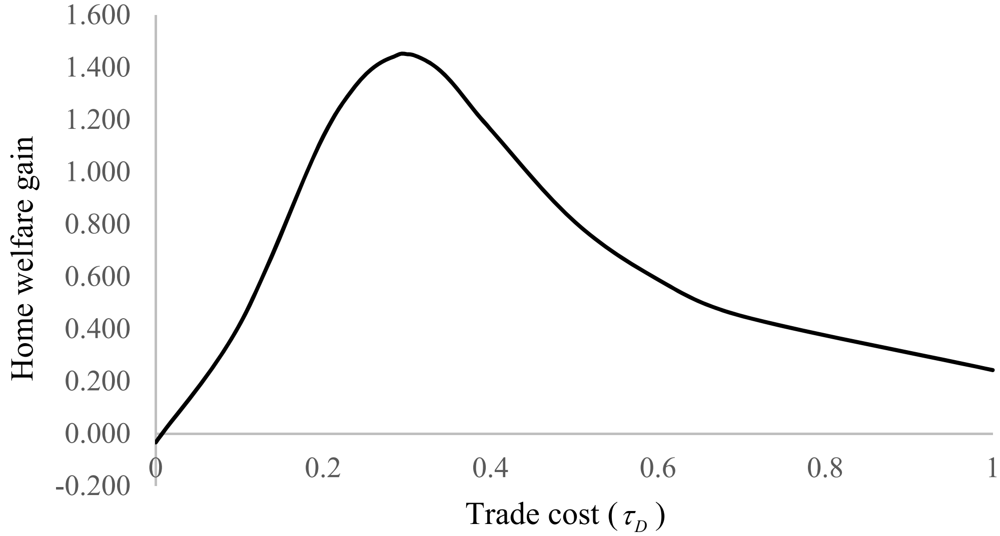
Figure 2.

Impulse responses to a 1 standard deviation rise in home manufacturing productivity, under various policies



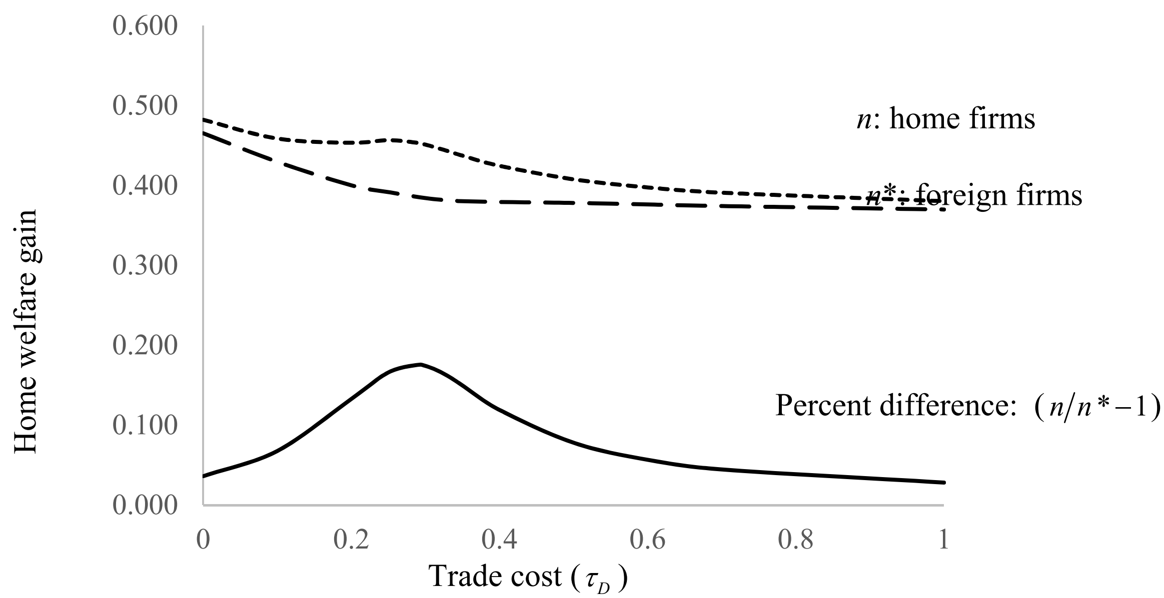
Vertical axis is percent deviation (0.01=1%) from steady state levels. Horizontal axis is time (in years).

Figure 2a. Effect of trade cost of differentiated goods on the home welfare gain from foreign peg



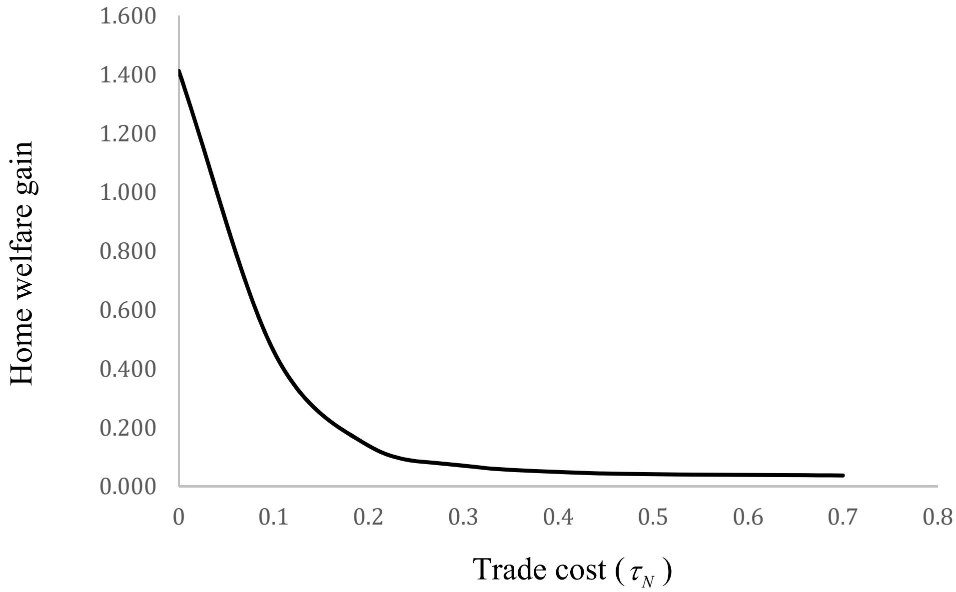
Home welfare gain is percentage difference from Ramsey policy welfare, in consumption units.

Figure 2b. Effect of trade cost of differentiated goods on numbers of firms



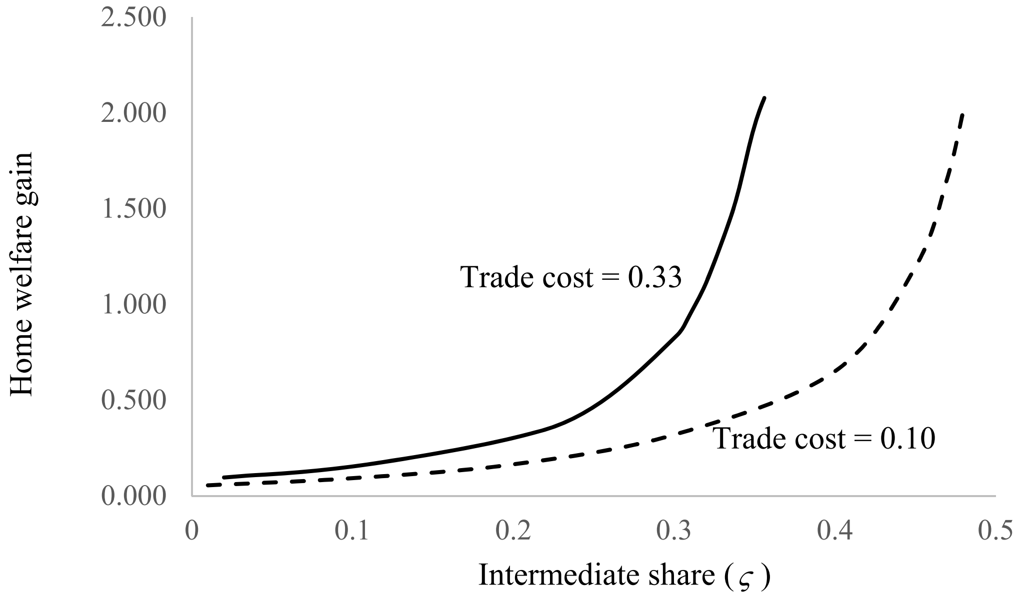
Home welfare gain is percentage difference from Ramsey policy welfare, in consumption units.

Figure 3. Effect of trade cost of non-differentiated goods
on the home welfare gain from foreign peg



Home welfare gain is percentage difference from Ramsey policy welfare, in consumption units.

Figure 4. Effect of intermediate input share
on the home welfare gain from foreign peg



Home welfare gain is percentage difference from Ramsey policy welfare, in consumption units.

Appendix:

1. Demand equations not listed in text

The composition of expenditure on adjustment costs, both for prices and bond holding, follow the same preferences as for consumption, and the associated demands mirror equations (4)-(9). Adjustment costs for bond holding are as follows:

$$AC_{B,D,t} = \theta P_t AC_{B,t} / P_{D,t} \qquad AC_{B,N,t} = (1-\theta) P_t AC_{B,t} / P_{N,t}$$

$$d_{AC,B,t}(h) = \left(p_t(h)/P_{D,t}\right)^{-\phi} AC_{B,D,t} \qquad d_{AC,B,t}(f) = \left(p_t(f)/P_{D,t}\right)^{-\phi} AC_{B,D,t}$$

$$AC_{B,H,t} = \nu\left(P_{H,t} / P_{N,t}\right)^{-\eta} AC_{B,N,t} \qquad AC_{B,F,t} = (1-\nu)\left(P_{F,t} / P_{N,t}\right)^{-\eta} AC_{B,N,t}$$

The economy-wide demand for goods arising from price adjustment costs sums across the demand arising among *n* home firms: $AC_{P,t} = n_t AC_{P,t}(h)$. This is allocated as follows:

$$AC_{P,D,t} = \theta P_t AC_{P,t} / P_{D,t} \qquad AC_{P,N,t} = (1-\theta) P_t AC_{P,t} / P_{N,t}$$

$$d_{AC,P,t}(h) = \left(p_t(h)/P_{D,t}\right)^{-\phi} AC_{P,D,t} \qquad d_{AC,P,t}(f) = \left(p_t(f)/P_{D,t}\right)^{-\phi} AC_{P,D,t}$$

$$AC_{P,H,t} = \nu\left(P_{H,t} / P_{N,t}\right)^{-\eta} AC_{P,N,t} \qquad AC_{P,F,t} = (1-\nu)\left(P_{F,t} / P_{N,t}\right)^{-\eta} AC_{P,N,t}$$

2. Entry condition

The single-period version of the entry condition (25) 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 (24), 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 $C_{M,t}$ and $c_t(h)$, as well as definition of $P_{M,t}$:

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

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

Under log utility, where $W_t=\mu_t$ and $P_tC_t=\mu_t$, this becomes equation (46).

3. Entry under full stabilization

Substitute prices, $p_{t+1}(h)=p^*_{t+1}(f)\left(\phi/(\phi-1)\right)$, and policy rules ($\mu_t=\alpha_t$, $\mu_t^*=\alpha_t^*$) into (46) 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

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

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

Note that $n^{stab}_{t+1}>n^{no\,stab}_{t+1}$ 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.

4. Case of fixed exchange rate rule:

Substitute prices and policy rules ($\mu_t = \alpha_t^*$, $\mu_t = \alpha_t$, so $e_t = 1$) into (46):

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

Pass through expectations and simplify

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

Do the same for the foreign entry condition:

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

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:

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

Equating across countries:

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

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

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:

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

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

So $\frac{n_{t+1}}{n^*_{t+1}}>1$ 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 $n_t>n_t$*.

5. Local currency pricing (LCP) model specification

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 $\Omega_{H,s}=\left(\frac{p_s(h)}{P_{D,s}}\right)^{-\phi}\left(C_{D,s}+G_s+ne_s(1-\theta_K)K_s+AC_{P,D,s}+AC_{B,D,s}\right)\frac{1}{\mu_s}$, and

$$\Omega^*_{H,s}=\left(\frac{(1+\tau_D)p_s(h)}{e_s P^*_{D,s}}\right)^{-\phi}(1+\tau_D)\left(C^*_{D,s}+G^*_s+ne^*_s(1-\theta_K)K^*_s+AC^*_{P,D,s}+AC^*_{B,D,s}\right)\frac{1}{\mu_s}.$$

6 . Additional sensitivity analysis.

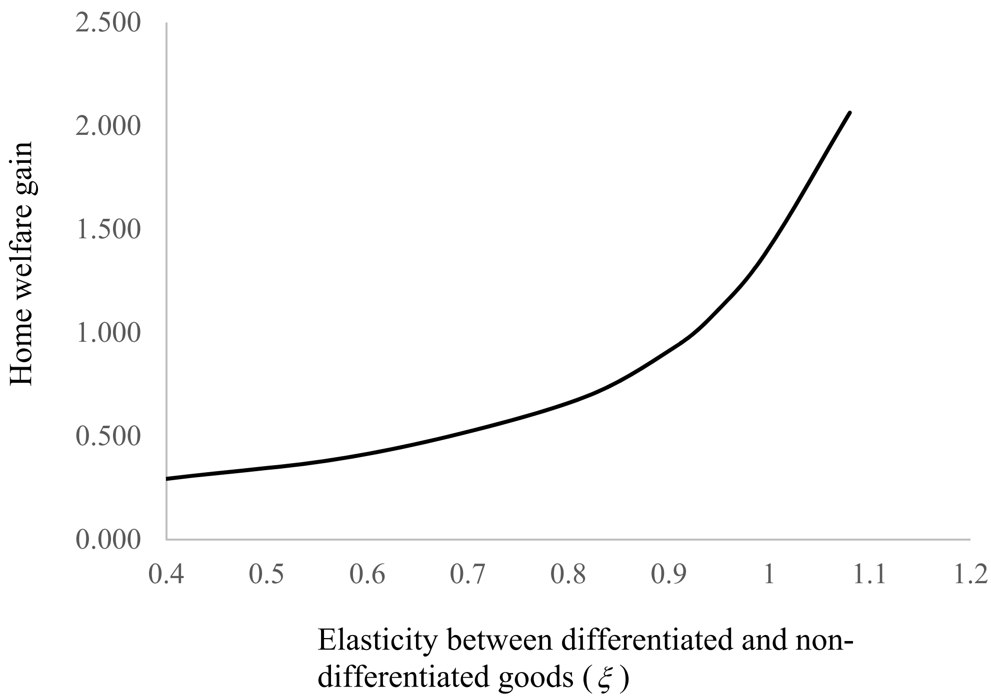
6.1: Elasticity between differentiated and non-differentiated goods

The benchmark model implies a unitary elasticity between differentiated and non-differentiated goods. We can generalize the aggregator to a CES specification, with elasticity ξ:

$$C_t \equiv \left(\theta^{\frac{1}{\xi}} C_{D,t}^{\frac{\xi-1}{\xi}} + (1-\theta)^{\frac{1}{\xi}} C_{N,t}^{\frac{\xi-1}{\xi}} \right)^{\frac{\xi}{\xi-1}}.$$

Figure A1 below shows the effect of alternative assumptions about the elasticity ξ on home welfare gain when the foreign country pegs and home targets inflation, relative to the Ramey solution. The home welfare gain is reduced as the two goods become more complementary, and it rises as they become more substitutable, although the range is limited where Ramsey can be solved numerically in the latter case.

Figure A1: Effect of elasticity of substitution between sectors on the home welfare from foreign peg



Home welfare gain is percentage difference from Ramsey policy welfare, in consumption units.

6.2. Endogenous tradedness of goods

The benchmark model makes the standard assumption in the trade literature on production relocation that all differentiated goods are traded, and the relevant entry decision is whether a potential entrant should pay the sunk cost of firm creation. We consider here an alternative model where the entry decision instead is whether to export, where those firms that do not export continue to produce for just the domestic market as nontraded varieties.

The new model assumes a fixed unit mass of differentiated goods producers in each country, and n_t becomes the fraction of domestic firms that choose to become exporters. For those firms that choose to be nonexporters, the sales abroad for their varieties are set to zero ($d_t^*(h)$, defined from the counterpart of equation (22) in the text). Firm profits and firm valuations are defined accordingly. For exporters, the specifications of demand for their exports, profits, and firm valuations are the same as in the benchmark model. Firms choose to be an exporter when the firm value of being an exporter minus that of being a nonexporter equals the sunk export entry cost. The sunk cost is calibrated to imply the same ratio of exports to GDP as in the benchmark model (implying $\bar{K} = 0.126$). This implies that 29% of domestic firms choose to become exporters, which is a standard value in the literature.

Simulations in Appendix Table A1 indicate that the production relocation effect is very small, and there is only a small welfare gain for the home country that stabilizes inflation when the foreign country pegs. The main effect of the foreign peg is that both countries lose firms and welfare compared to the Ramsey policy. The reason is that if tradability is endogenous but not the location of production, then the production relocation effect cannot have its full effect. The scope for comparative advantage to shape domestic production is very limited if domestic firms are not forced to leave the market. It is possible that the effects of production relocation might be restored if there were also a sunk cost of domestic entry as well as exporting. However, two simultaneous sunk costs would greatly multiply the complexity of solution, as firms might pay the sunk cost of domestic firm creation in order to secure the option of future export entry under particular realizations of shocks. This option value problem would require different solution methods.

Table A1. Models with nontraded goods

	(1) Endogenous traded margin	(2) Nontraded sector
Welfare:		
Home	-0.290	0.856
Foreign	-0.591	-1.179
Total	-0.440	-0.165
Diff. goods export share:		
Home	-7.678	4.478
Foreign	-7.822	-4.643

6.3. Exogenously nontraded goods

Even if tradedness is not endogenous, the presence of nontraded goods could limit the relocation mechanism driving our result by reducing the scope for comparative advantage. We propose another variant of the model where half of the differentiated goods varieties are defined as nontradable. In this model, the nontradable and tradable sectors both consist of differentiated goods producers, but each subsector is handled independently. There is a mass of n_x differentiated goods firms that both export and sell domestically, and there is mass n_d domestic firms that sell only to the domestic market. The tradable firms face a sunk cost entry decision identical that in the benchmark model. The nontraded firms are assumed to be of a constant mass and do not face an entry decision, but their number is calibrated as half of the number of firms in the benchmark model (n_d = 0.2).[29] We adopt

[29] The restriction was required by the fact that both sectors fact the same demands for their varieties in the home market, since they face the same marginal costs and price stickiness. If they face the same sunk entry cost, then there is no solution that supports both an endogenous number of domestic firms and export firms, where the firm value of the latter is necessarily greater than the former.

the local currency pricing specification of price stickiness discussed in the text, as this allows us to model a single set of prices for both sets of firms when selling domestically.

This model is calibrated with the same sunk entry cost as in the benchmark model. The steady state shows that approximately half the differentiated goods varieties are not traded, and half of domestic consumption of differentiated goods is of nontraded varieties. But the smaller number of differentiated goods varieties export a proportionately larger quantity of output, so that the share of exports in overall GDP is same as in the benchmark model.

Results in appendix Table A1 indicate that the magnitude of production relocation is reduced compared the benchmark model, but it still remains substantial. The foreign peg still shifts production of differentiated goods from foreign to home, raising home welfare and lowering foreign welfare relative to the symmetric Ramsey solution. The magnitude of these asymmetric effects on welfare are slightly more than half of the magnitudes under the benchmark model. This lower magnitude reflects the smaller share of tradable differentiated goods in the consumption bundle in the alternative version of the model.

6.3. Investment in physical capital

In this version of the model, we introduce investment in physical capital, to investigate whether standard capital accumulation can replace the sunk entry cost of firm entry in generating the production relocation effect. In this version of the model firm entry is suspended and the number of firms in each country is fixed.

Consumers invest in new capital subject to quadratic adjustment costs. They earn a competitive rate of return, r_t, while capital depreciates at rate δ. The household budget constraint becomes:

$$P_tC_t + (M_t - M_{t-1}) + (B_{H,t} - B_{H,t-1}) + e_t(B_{F,t} - B_{F,t-1}) =$$
$$W_tl_t + \Pi_t + i_{t-1}B_{H,t-1} + i^{\star}_{t-1}B_{F,t-1} - P_tAC_{B,t} - T_t + r_tK_{t-1} - I_t - AC_{K,t}.$$

Adjustment costs, $AC_{K,t}$, are quadratic while investment follows the standard definition:

$$AC_{K,t} = \frac{\psi_k}{2}\frac{(K_t - K_{t-1})^2}{K_{t-1}},$$

$$I_t = K_t - K_{t-1}(1-\delta).$$

The consumer's first order condition for capital is:

$$\beta E_t\left(\frac{\mu_t}{\mu_{t+1}}\left[r_{t+1} + 1 - \delta + \psi_k\left(\frac{(\Delta K_{t+1})^2}{2} + \Delta K_{t+1}\right)\right]\right) = 1 + \psi_k \Delta K_t,$$

where $\Delta K_t = (K_t - K_{t-1})/K_{t-1}$ and μ_t is the inverse of the nominal marginal utility.

The firm problem is different in two ways. First, the firm minimizes cost with capital as a new input. Second, we drop the entry condition when the firm chooses prices. Output becomes a function of capital, and marginal costs are similar to before but now incorporate payments to capital:

$$y_t(h) = \alpha_{D,t}\left[(G_t(h))^{1-\zeta}(l_t(h))^{\zeta}\right]^{1-\gamma}[K_t(h)]^{\gamma},$$

$$mc_t = \frac{(r_t)^{\gamma}(W_t)^{(1-\gamma)(\zeta)}(P_{d,t})^{(1-\gamma)(1-\zeta)}}{\alpha_{D,t}(\gamma)^{\gamma}((1-\gamma)(\zeta))^{(1-\gamma)(\zeta)}((1-\gamma)(1-\zeta))^{(1-\gamma)(1-\zeta)}},$$

$$r_t K_{t-1}(h) = W_t l_t(h)\frac{\gamma}{(1-\zeta)(1-\gamma)},$$

where the last equation comes from cost minimization. Investment is funded from differentiated goods so that the new market clearing condition in the home country for the individual firm is:

$$d_t(h) = c_t(h) + d_{G,t}(h) + d_{AC,P,t}(h) + d_{AC,B,t}(h) + d_{K,t}(h) + d_{AC,K,t}(h).$$

The difference here are the last two terms, $d_{K,t}(h)$ and $d_{AC,K,t}(h)$, which are demand for new investment goods and demand for the differentiated goods to cover adjustment costs. These are respectively:

$$d_{K,t}(h) = \left(\frac{p_t(h)}{P_{D,t}}\right)^{-\phi} I_t,$$

$$d_{AC,K,t}(h) = \left(\frac{p_t(h)}{P_{D,t}}\right)^{-\phi} AC_{K,t}.$$

From the firm's optimization problem, we can now update the expression for Ω_t from the text so that the stochastic discount factor for the firm becomes

$$\Omega_t = \left[\left(\frac{p_t(h)}{P_{D,t}}\right)^{-\phi} \left(C_{D,t} + G_t + ne_t(1-\theta_k)K_t + AC_{P,D,t} + AC_{B,D,t} + AC_{K,t} + I_t\right)\right]/\mu_t$$

$$+\left[\left(\frac{p_t(h)(1+\tau_D)}{e_t P^{\star}_{D,t}}\right)^{-\phi} \left(C^{\star}_{D,t} + G^{\star}_t + ne^{\star}_t(1-\theta_k)K^{\star}_t + AC^{\star}_{P,D,t} + AC^{\star}_{B,D,t} + AC^{\star}_{K,t} + I^{\star}_t\right)\right]/\mu_t.$$

The number of firms, n_t, is now fixed so that $n_t = n^{\star}_t = 0.4$. We then set new entry to zero. Simulations use standard values for the new parameters: $\psi_k = 0.05$, $\delta = 0.06$, $\gamma = 0.3$.

Simulation results indicate that this model does not generate a large production relocation effect. Assuming policies where the foreign country pegs the exchange rate while the home country fully stabilizes differentiated goods producer price inflation, the home share of differentiated goods in exports rises only 0.039 percentage points, and the foreign share falls just 0.005 percentage points, relative to a case where both countries fully target differentiated goods inflation. These values work in the same direction as the results from the benchmark model simulation, but they are two orders of magnitude smaller. This result serves simply to reiterate the claim in the main text that the large production reallocation effect in the benchmark model depends crucially upon endogenous firm entry in the differentiated goods sector, in order to facilitate a large production reallocation of sectors between countries.

6.4. Calvo price stickiness

Under Calvo pricing, demand for the differentiated goods, $d_t(h)$, must satisfy:

$$d_t(h) = c_t(h) + d_{G,t}(h) + d_{AC,B,t}(h) + d_{K,t}(h).$$

Using the definitions for each of the components, we arrive at

$$d_t(h) = \left(\frac{p_t(h)}{P_{D,t}}\right)^{-\phi} \Delta_t,$$

where $\Delta_t = C_{D,t} + G_t + AC_{B,D,t} + AC_{K,t} + ne_t(1-\theta_k)K_t$. The foreign country has $\Delta^{\star}_t = C^{\star}_{D,t} + G^{\star}_t + AC^{\star}_{B,D,t} + AC^{\star}_{K,t} + ne^{\star}_t(1-\theta_k)K^{\star}_t$. Total output of variety h is then $y_t(h) = d_h + d^{\star}_t(h)(1+\tau_D)$ so that we can write this as:

$$y_t(h) = \left(\frac{p_t(h)}{P_{D,t}}\right)^{-\phi} \left(\Delta_t + \Delta_t^{\star}(1+\tau_D)^{1-\psi}\left(\frac{P_{D,t}}{e_t P_{D,t}^{\star}}\right)^{-\phi}\right).$$

From here onward, we let $\overline{\Delta}_t$ be the second term on the right in parenthesis, so that

$$\overline{\Delta}_t = \left(\Delta_t + \Delta_t^{\star}(1+\tau_D)^{1-\phi}\left(\frac{P_{D,t}}{e_t P_{D,t}^{\star}}\right)^{-\phi}\right).$$

Using this demand function in the optimization problem for the firm, allowing share $1-\rho$ of firms to adjust price each period, we arrive at the price chosen by any firm in time t:

$$p_t^{\#} = \frac{\phi}{\phi-1}\frac{E_t\left\{\sum_{s=0}^{\infty}(\rho\beta)^s mc_{t+s}\widetilde{\Omega}_{t+s}P_{D,t+s}^{\phi}\right\}}{E_t\left\{\sum_{s=0}^{\infty}(\rho\beta)^s\widetilde{\Omega}_{t+s}P_{D,t+s}^{\phi}\right\}},$$

and the term $\widetilde{\Omega}_{t+1}$ is defined as

$$\widetilde{\Omega}_{t+s} = \frac{\mu_t}{\mu_{t+s}}\overline{\Delta}_{t+1}.$$

Because share ρ of firms are locked into the price they set today, and share $1-\rho$ is able to readjust and set prices at $p_t^{\#}$, aggregating across all firms we arrive at the average price for domestically sold differentiated goods, $\tilde{p}_t^h$:

$$\left(\tilde{p}_t^h\right)^{1-\phi} = (1-\rho)(p_t^{\#})^{1-\phi} + \rho\left(\tilde{p}_{t-1}^h\right)^{1-\phi}.$$

Abroad, the foreign country has a similar condition:

$$\left(\tilde{p}_t^{f,\star}\right)^{1-\phi} = (1-\rho)\left(p_t^{\#,\star}\right)^{1-\phi} + \rho\left(\tilde{p}_{t-1}^{f,\star}\right)^{1-\phi}.$$

Using the definition for the domestic price of the foreign differentiated good,

$$\tilde{p}_t^f = e_t(1+\tau_D)\tilde{p}_t^{f,\star}.$$

Using the price together with the domestic price, we arrive at the price index for domestic and foreign differentiated goods:

$$P_{D,t} = \left(n_t\left(\tilde{p}_t^h\right)^{1-\phi} + n_t^{\star}\left(\tilde{p}_t^f\right)^{1-\phi}\right)^{\frac{1}{1-\phi}}.$$

To compute the price dispersion, v_p, we set demand equal to supply and integrate across all varieties:

$$\alpha_{D,t}\int_0^{n_t}(G_t(h))^{1-\zeta}(l_t(h))^{\zeta}dh = \overline{\Delta}_t\int_0^{n_t}\left(\frac{p_t(h)}{P_{D,t}}\right)^{-\phi}dh.$$

Since technology is identical across firms and returns to scale are constant, this yields:

$$\alpha_{D,t}(G_t^{\zeta})(l_{D,t}^{1-\zeta}) = n_{t-1} v_{p,t} \overline{\Delta}_t,$$

where $v_{p,t}$ is the degree of price dispersion and is equal to: $v_{p,t} = \int_0^1 \left(\frac{p_t(h)}{P_{D,t}}\right)^{-\phi} dh$.

Integrating, we can write this in terms of $\pi_{D,t}$ and $\pi_{D,t}^{\#}$, which are defined respectively as $\pi_{D,t} = P_{D,t}/P_{D,t-1}$ and $\pi_{D,t}^{\#} = p_t^{\#}/P_{D,t-1}$. The price dispersion is

$$v_{p,t} = (1-\rho)\left(\frac{\pi_{D,t}}{\pi_{D,t}^{\#}}\right)^{\phi} + \rho \pi_{D,t}^{\phi} v_{p,t-1}.$$

Using this expression, we now replace the variety-specific demands (differentiated by h) with average demands across varieties. To arrive at the average demand across varieties for the various uses of the differentiated good, we simply integrate with respect to h and divide by the number of firms. For example, defining the average consumption of differentiated goods as $\tilde{c}_t$,

$$\tilde{c}_t = \frac{1}{n_t}\int_0^{n_t} c_t(h)dh = \frac{1}{n_t}\int_0^{n_t}\left(\frac{p_t(h)}{P_{D,t}}\right)^{-\phi} C_{D,t} dh = v_{p,t} C_{D,t}.$$

Doing the same to demand across all uses for differentiated goods, i.e. $d_{G,t}(h)$, $d_{AC,B,t}(h)$, and $d_{K,t}(h)$, the average demands are,

$$\tilde{d}_{G,t} = v_{p,t} G_{K,t}$$

$$\tilde{d}_{AC,B,t} = v_{p,t} AC_{B,t}$$

$$\tilde{d}_{K,t} = v_{p,t} ne_t (1-\theta_k) K_t.$$

We use these expressions to replace demand for variety h with average demand across all varieties. This change has no material impact on the steady state or even the entry condition for firms into the differentiated goods sector, as we assume that firms choose to enter or not before they learn if they are able to set prices for that period. In experiments we set parameter $\rho = 0.5$.

Simulation results indicate that this model produces results very similar to the benchmark model with Rotemberg pricing, if we retain the feature of free entry of firms into the differentiated goods sector. Assuming policies where the foreign country pegs the exchange rate while the home country fully stabilizes differentiated goods producer price inflation, the home share of differentiated goods in exports rises by 3.33 percentage points, and the foreign share falls a similar 3.41 percentage points, relative to a case where both countries fully target differentiated goods inflation. This production relocation is facilitated by a shift in the location of firms, with a rise in the number of home firms by 6.26 percent, and fall in the number of foreign firms by 5.12 percent.

When firm entry is eliminated from the model and the number of firms is exogenously fixed, the production relocation effects becomes very small. A foreign peg raising the home share of differentiated goods by just 0.018 percentage points and lowering foreign share by 0.038 percentage points. These values have the same sign as the benchmark model, but the values are two orders of magnitude smaller. Again, this reiterates the point that the production relocation effect depends crucially upon endogenous firm entry.