VARIETIES, THE TRANSFER PROBLEM,

AND THE COSTS OF CURRENT ACCOUNT ADJUSTMENT*

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Abstract

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The macroeconomic costs of closing an external imbalance are revisited in the context of the classical controversy on the 'transfer problem,' accounting for net creation and destruction of product varieties. We set up a general-equilibrium model of current account rebalancing with firms' entry and exit in the tradables and nontradables sectors worldwide. We show that real exchange rate movements in equilibrium are considerably lower when trade adjustment at the extensive margin is accounted for, relative to traditional macro-models in which there is no free entry and debtor countries suffer a significant deterioration of their terms of trade. For reasonable parameterizations, movements in aggregate consumption and employment (hence changes in social welfare) are not sensitive to product differentiation, and change little regardless of whether adjustment occurs through movements in relative prices or quantities. This result warns against indexing macroeconomic distress from external rebalancing with large deteriorations of the terms of trade.

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1 Introduction

Between 1997 and 2006, the U.S. current account deficit rose from 140 billion dollars, or 1.7 percent of U.S. output, to over 800 billion dollars, or 1.7 percent of *world* output. Recent years have witnessed the onset of a process of global rebalancing associated with the sharp contraction in international trade volumes, and the U.S. deficit has somewhat declined. While there is considerable uncertainty about timing and drivers of current account movements going forward, the basic mechanism of adjustment requires a transfer of real resources from the United States to the rest of the world, and a decrease in domestic spending relative to production, accompanied by a simultaneous relative increase abroad.

Because of the sheer magnitude of the reallocation of resources on a global scale, the macroeconomic consequences of adjustment are bound to be pervasive in many dimensions. Yet the one aspect which appears to be singled out and scrutinized with most apprehension is the sharp change in international relative prices associated with global rebalancing, causing a vast redistribution of purchasing power across countries. According to influential contributions by Maurice Obstfeld and Kenneth Rogoff (2005, 2007), the unwinding of the U.S. current account deficit may indeed be related to "the potential collapse of the dollar."[1] However, recent events point to a much more nuanced story. In real effective terms the movements of the dollar between 2002 and 2007 have been quite significant, but their impact on global current account balances have been limited. Real dollar depreciation has been large relative to countries without a significant current account surplus vis-à-vis the United States (such as the European countries), but very contained relative to countries with large bilateral surpluses (such as China and the Gulf countries), that is, relative to the main counterparts of the large U.S. imbalance. Since late 2008 the contraction of world activity and the collapse of oil and commodity prices associated with the meltdown of global financial markets have partially contributed to closing the U.S. net saving gap, at the same time as the U.S. dollar has somewhat appreciated in effective terms, due to safe-haven considerations in international markets.

Economic analyses of the burden imposed by deteriorating international prices on debtor countries have a long intellectual history, going back at least to Keynes' (1919, 1929a,b,c) classic assessment of the macroeconomic effects of a transfer. Keynes' criticism of German international obligations after World War I stressed that the macroeconomic costs of any given amount of war reparations — the 'primary burden' of a transfer — were bound to be magnified by the adverse effects of deteriorating terms of trade and real exchange rates —

[1] See also Blanchard, Giavazzi and Sa (2005) and Edwards (2005).

the 'secondary burden' or 'double punishment'. Ohlin (1929a,b) criticized Keynes' emphasis on relative prices, arguing that the income effects from unilateral transfers could actually reduce terms of trade adjustment, or even make it redundant. In this case, there was no real reason to expect the overall macroeconomic burden to exceed the direct costs of the transfer itself (a point emphasized by Samuelson 1952).[2]

In this paper, we argue that the transfer-problem controversy is very much alive in the context of the current debate on global rebalancing, precisely for the same reasons emerged in its original incarnation. Macroeconomic adjustment occurs along a multiplicity of dimensions or margins, whose relative importance crucially affects how much real currency depreciation is eventually required in equilibrium to correct a given imbalance. Over the medium term (the time horizon of a current account adjustment) there is substantial firms' entry and exit across sectors and countries, and a large fraction of trade growth occurs at the *extensive margin* (exports of new varieties), as opposed to a rise in the volume of trade in existing goods and services (the intensive margin). We develop a model that accounts for different margins of current account rebalancing in the medium run, and calibrate the model to the U.S. case. Our simulations suggest that a correction of the large U.S. current account deficit may require only a moderate trend depreciation of the dollar (a result that does not preclude the possibility of high short-term volatility and overshooting). Our simulations also suggest that a moderate deterioration of the terms of trade is not necessarily good news for a debtor economy undergoing adjustment. As emphasized in the transfer-problem controversy, assessing the macroeconomic burden of rebalancing requires an evaluation of the welfare costs of real depreciation. In this respect, and departing from the conventional view, our model suggests that the aggregate welfare impact of trade adjustment is actually disconnected from the size of the real currency correction: a rebalancing scenario under stable real exchange rates need not be less socially costly than a rebalancing scenario with sharp price fluctuations.

Our result that rebalancing may lead to only moderate medium-term real depreciation is consistent with the stylized facts on recent episodes of trade and current account adjustment in industrialized countries. Freund and Warnock (2007) consider 26 episodes between 1980 and 2003 in which the current account deficit was at least 2 percent of GDP before going through a reversal. These countries on average experienced a real depreciation. But the resolution of large deficits did not require a more extensive depreciation, nor was more likely to be associated with an exchange rate crisis. If anything, large and persistent deficits involved less depreciation than average. Focusing on the U.S. case, Fratzscher, Juvenaly and

[2] See Brakman and Van Marrewijk (1998) for an overview of the Keynes-Ohlin debate.

Sarno (2007) show that shocks to the real exchange rate have been a relatively minor driver of past current account developments, accounting for only about 7 percent of the movements of the U.S. trade balance at a horizon of 20 quarters. These analyses suggest that, while a large real exchange depreciation could be a key element of the ongoing adjustment process, this need not be the case.

Moderate relative price adjustment also results from the simulations by Dekle, Eaton and Kortum (2007 and 2008). In their first contribution, these authors build a multilateral model calibrated to 40 countries using 2004 data on GDP and bilateral trade. In their exercise, closing the U.S. deficit completely requires a very limited adjustment of relative wages (labor costs). For instance, wages in the country with the largest deficit (U.S.) only fall by 10 percent relative to wages in the country with the largest surplus (Japan). Within each of these countries, real wages hardly change because of the large component of nontradables consumption.

In our model, however, domestic and international relative prices play only a contained role in the rebalancing process because a significant fraction of trade growth occurs at the extensive margin — an assumption that builds upon pervasive evidence. Over the past few decades, the strong expansion in the volume of international trade has been accompanied by a vast change in its composition, in favor of differentiated goods. Following the methodology by Rauch (1999), Tang (2006) reports that U.S. imports of differentiated products rose from 47.4 percent in 1975 to 75.5 percent in 2000 while the proportion of U.S. exports of differentiated goods increased from 61.3 to 78.6 percent between 1979 and 2000. Using highly disaggregated product-level data, Debaere and Mostashari (2005) report that, for around 80 percent of the countries, over 40 percent of all goods categories exported to the United States in 1998-2000 were in newly traded goods, that is, goods that were not exported in 1989-91. Hummels and Klenow (2005) show that the extensive margin can account for about two thirds of the difference in trade across countries of different size.[3]

Conventional analyses of the international transfer problem abstract from the possibility of trade in new varieties as a potential engine of international adjustment.[4] For this reason, they provide an incomplete framework for the assessment of global current account rebalancing. As emphasized by Broda and Weinstein (2004, 2006, 2007), welfare gains stemming from the increased number of imported varieties and enhanced consumer choice have been

[3] Yi (2003), Kehoe and Ruhl (2003), and Ruhl (2005) show that trade liberalization results in a significant increase of the extensive margin. The role of product varieties in international trade is also emphasized in Gagnon (2003) which — building on Krugman's (1989) notion that economic growth is channelled into product proliferation — provides evidence on the strong correlation between the growth of U.S. bilateral manufactured imports between 1972 and 2000 and the average growth rate of GDP of the exporting countries.

[4] An exception worth emphasizing is Brakman and van Marrewijk (1995).

very large for the United States. Galstayn and Lane (2008) show that for several countries running large and persistent trade imbalances, the role of the extensive margin in trade dynamics has been substantial. In the specific case of the United States, over a relatively short period of time (2000-2004) around half of trade growth has occurred at the extensive margin. Also, the conventional view is likely to provide a biased framework for the quantitative evaluation of the real currency depreciation associated with rebalancing. The evidence discussed by IMF (2007) suggests that economies with lower costs of starting and closing a firm, and of hiring and firing labor, have experienced smaller movements in real effective exchange rates during current account adjustment episodes.[5]

Our model analyzes current account adjustment in an environment where new product varieties are created (at a cost) or destroyed as a consequence of a shift in aggregate demand from the home to the foreign country. Labor supply is elastic, and labor can be reallocated between sectors, so that the level and composition of traded and nontraded output are endogenous. The model encompasses a number of features usually associated with 'Keynesian' transfer effects on the terms of trade (home bias in spending due to trade costs, market segmentation and nontradables, imperfect substitutability between home and foreign goods). Given our emphasis on medium-term adjustment, and consistent with the original literature on the transfer problem as well as many recent analyses of global imbalances, we abstract from short-run costs due to frictions in the reallocation of resources across sectors or nominal rigidities.

In quantitative simulations, our model is calibrated to U.S. data and used to assess the effects of improving net exports from a deficit as high as 6.5 percent of GDP to a balanced position. Results from our 'endogenous-variety' model are then compared with those from a more conventional 'fixed-variety' model in which there is no entry and adjustment occurs exclusively at the intensive margin. We conduct several experiments checking robustness by varying the key parameters of the calibration.

According to the 'fixed-variety' model, closing the external imbalance requires a fall in long-run consumption by around 6 percent, and an increase in employment by 3 percent. The terms of trade and the real exchange rate deteriorate sharply, by 17 and 22 percent respectively. This scenario is well in line with related exercises in the recent literature on global rebalancing.[6] Conversely, in our 'endogenous-variety' model movements in the terms

[5] International Monetary Fund (2007), pp.103-104.

[6] For instance, these figures are comparable with experiments by Obstfeld and Rogoff (2007) in which output of tradables is increased parametrically by 20 percent. Model-based simulations of global rebalancing and real currency adjustment appear in IMF (2006), Box 1.3., Faruqee, Laxton, Muir and Pesenti (2007), and Ferrero, Gertler and Svensson (2009).

of trade and the real exchange rate are only 1.1 and 6.4 percent, respectively. Yet, the possibility of adjustment at the extensive margin does not significantly affect the impact of the transfer on employment and consumption. Employment falls precisely as in the 'fixed-variety' scenario, and home consumption declines reflecting changes in the basket of products available to domestic households. In utility terms, the welfare costs of adjustment is quite comparable in the two models. To the extent that the price indexes are appropriately adjusted to account for variety effects, the welfare-based real exchange rate may actually appreciate during the adjustment process — as a result of the net disappearance of consumption varieties available in the domestic market.

To emphasize the disconnect between real depreciation and the welfare costs of the transfer, we consider a parametric variant of the model in which all adjustment occurs at the extensive margin and a transfer has no impact at all on the terms of trade — an extreme version of the case Ohlin defended against Keynes. Next, we modify the calibration to reduce the relative importance of the extensive margin. We show that the equilibrium rate of real depreciation rises monotonically as adjustment at the extensive margin becomes less and less flexible, yet welfare costs first rise, then flatten and decline.

This paper is organized as follows. Section 2 introduces the model. Section 3 analyzes endogenous changes in consumption and output in response to a transfer, contrasting the 'endogenous-variety' case with the traditional 'fixed-variety' setup. Section 4 presents a quantitative assessment. Section 5 concludes.

2 A model of transfer with product varieties

We model a world economy consisting of two countries, Home and Foreign — Foreign variables are denoted with a star. In presenting the model below, we focus on the Home country with the understanding that the expressions characterizing the Foreign country can be readily derived from the ones shown in the text.

In each country households consume all varieties of goods available in their domestic market, both domestically produced and imported, and supply labor in a competitive market to domestic firms only. There are L households in the Home country and L^* households in the Foreign country.

In each country, firms operate either in the nontradables or in the tradables sector. Tradable goods are sold in the domestic markets — they are therefore import-competing goods — or exported. Markets are not perfectly integrated: we allow for trade frictions that cause market segmentation. Regardless of the sector in which it operates, a firm is assumed to manufacture a single product variety under conditions of monopolistic competition.

To start operating, firms face entry costs. With costly entry, the number of varieties supplied in the market is then endogenously determined in equilibrium. In the Home country, varieties in the nontradables sector N are defined over a continuum of mass n_N and indexed by $h_N \in [0,\, n_N]$. Home tradables (import-competing) varieties produced for the domestic market D are indexed by $h_D \in [0,\, n_D]$. Similarly, Home varieties produced for the export market X are indexed by $h_X \in [0,\, n_X]$. By the same token, in the Foreign country nontradables varieties are defined over the continuum $f_N \in [0,\, n_N^*]$, import-competing varieties are indexed by $f_D \in [0,\, n_D^*]$ and export varieties are indexed by $f_X \in [0,\, n_X^*]$.

Without loss of generality, we assume that in each country domestic labor units are the domestic numeraire in terms of which all prices are measured. This amounts to assuming that unit wages in both countries are $w = w^* = 1$. Under this assumption, the exchange rate ε is expressed in units of Home labor per unit of Foreign labor.

2.1 Firms

Firms have access to a linear technology in labor, which is the only input in production. The production function of the representative Home firm producing a specific variety is:

$$Y(h_i) = \ell(h_i) \qquad i = N, D, X \tag{1}$$

where $Y(h_i)$ is the output of variety h_i, $\ell(h_i)$ is labor used in its production, and N, D, and X denote the sector in which the firm operate. Observe that, for analytical convenience, we treat export and import-competing goods as different varieties.

To start production, a firm needs to employ labor in order to setup the manufacturing line of a particular product variety. These entry costs can be asymmetric across countries and sectors. Namely, for the Home country, we posit:

$$q(h_i) \equiv w c_i n_i^{\gamma} = c_i n_i^{\gamma} \qquad i = N, D, X \tag{2}$$

where the wage rate w is equal to one by the choice of the numeraire, and $c_i n_i^{\gamma}$ are units of labor used in the activities required to introduce a variety h in the i sector.[7] For $\gamma > 0$, the cost function is convex: the cost of creating an additional variety is an increasing function of the number of existing varieties in the sector. The idea underlying this specification is that a higher number of existing varieties on the market makes it more difficult for firms to differentiate their products relative to the competition, raising the costs of marketing and advertising associated with the introduction of a new variety or brand. The parameter γ measures the sensitivity of these costs to the number of sectoral varieties. While in principle

[7] Corsetti, Martin and Pesenti (2007) discuss the case in which entry costs are subject to shocks.

we could make the above function richer (e.g. making it dependent on domestic and foreign varieties in each market), what is essential for our results is the degree of asymmetry in the cost function across type of goods. The above formulation is a parsimonious and analytically efficient way to capture asymmetries.

An additional friction — causing market segmentation — consists of transportation costs. They are modelled as 'iceberg' costs, denoted by τ and expressed in units of the export good. The resource constraints for each variety of Home goods are therefore:

$$Y(h_N) \geq LC(h_N), \qquad Y(h_D) \geq LC(h_D), \qquad Y(h_X) \geq (1+\tau) L^* C^*(h_X) \quad (3)$$

where $C(h_N)$ is per-capita consumption of good h_N in the Home country, $C(h_D)$ is per-capita consumption of good h_D by the representative Home resident, and $C^*(h_X)$ is consumption of good h_X by the representative Foreign resident. As domestic households provide labor both for firms' start-up and production activities, the resource constraint in the Home labor market is:

$$L\ell \geq \sum_i \left(\int_0^{n_i} Y(h_i)\, dh_i + c_i n_i^{1+\gamma} \right) \quad (4)$$

Let $p(h_N)$, $p(h_D)$ and $p(f_X)$ denote the Home prices of, respectively, Home nontradables, Home import-competing varieties and Home imports. Using the above notation and assumptions, the operating profits Π of Home firms h_i are, respectively:

$$\begin{aligned}
\Pi(h_N) &\equiv p(h_N) LC(h_N) - \ell(h_N) \leq (p(h_N) - 1) Y(h_N), \quad (5)\\
\Pi(h_D) &\equiv p(h_D) LC(h_D) - \ell(h_D) \leq (p(h_D) - 1) Y(h_D), \\
\Pi(h_X) &\equiv \varepsilon p^*(h_X) L^* C^*(h_X) - \ell(h_X) \leq \left(\frac{\varepsilon p^*(h_X)}{1+\tau} - 1 \right) Y(h_X)
\end{aligned}$$

2.2 Households

In the Home country the utility of the representative household is a positive function of consumption C and a negative function of labor effort ℓ:

$$U = \log C - \frac{1}{1+\xi} \ell^{1+\xi} \quad (6)$$

where ξ is the inverse of the Frisch elasticity. C is a Cobb-Douglas index of tradables and nontradables varieties sold in the country:

$$C = \frac{C_T^{\delta} C_N^{1-\delta}}{\delta^{\delta} (1-\delta)^{1-\delta}} \quad (7)$$

where $1-\delta$ is the share of nontradables in consumption, and the baskets C_T and C_N are defined as:

$$C_T = \left[\int_0^{n_D} C(h_D)^{1-\frac{1}{\sigma}} dh_D + \int_0^{n_X^*} C(f_X)^{1-\frac{1}{\sigma}} df_X\right]^{\frac{\sigma}{\sigma-1}}, \tag{8}$$
$$C_N = \left[\int_0^{n_N} C(h_N)^{1-\frac{1}{\sigma}} dh_N\right]^{\frac{\sigma}{\sigma-1}}$$

In the expressions above σ denotes the elasticity of substitution across varieties, as well as the elasticity of substitution between import-competing goods h_D and imports f_X. We assume that this elasticity is higher than the elasticity of substitution between the tradables and nontradables baskets, that is $\sigma > 1$.

The budget constraint of the representative Home household is:

$$\int_0^{n_N} p(h_N) C(h_N) dh_N + \int_0^{n_D} p(h_D) C(h_D) dh_D + \int_0^{n_X^*} p(f_X) C(f_X) df_X + I \leq \ell + \Pi - F/L \tag{9}$$

Home households earn labor incomes ℓ (recall that wages are normalized to one) and spend on consumption goods. They finance the fixed costs of setting up firms and introducing goods varieties (I in our notation), receive dividends revenue from the firms they own (Π) and pay F/L to Foreign households, where F is the aggregate resource transfer to the rest of the world.

Without loss of generality, we posit that households are endowed with a well-diversified international portfolio of claims on firms' profits, so that they finance the same fraction of the cost of creating new varieties in each country.[8] Formally, Home households invest in a portfolio of firms worldwide:

$$I \equiv \frac{1}{L+L^*}\left(\sum_i \int_0^{n_i} q(h_i) dh_i + \varepsilon \sum_i \int_0^{n_i^*} q^*(f_i) df_i\right) \tag{10}$$

and in return receive an equal share of profits:

$$\Pi \equiv \frac{1}{L+L^*}\left(\sum_i \int_0^{n_i} \Pi(h_i) dh_i + \varepsilon \sum_i \int_0^{n_i^*} \Pi^*(f_i) df_i\right) \tag{11}$$

Optimal consumption demand satisfies:

$$C(h_N) = \left(\frac{p(h_N)}{P_N}\right)^{-\sigma} C_N, \quad C(h_D) = \left(\frac{p(h_D)}{P_T}\right)^{-\sigma} C_T, \quad C(f_X) = \left(\frac{p(f_X)}{P_T}\right)^{-\sigma} C_T, \tag{12}$$

$$PC = \frac{P_T C_T}{\delta} = \frac{P_N C_N}{1-\delta}$$

[8] Under the assumption of free entry, profits are identically equal to entry costs. Hence positing complete home bias in equity portfolio would not alter our results. This is in contrast with the standard assumption that households only own and finance domestic firms. In other words, in our analysis we abstract from a specific financial channel through which a transfer could potentially affect the world economy — via differences in net profit rates across countries.

where P, P_T and P_N are the utility-based consumer price indexes, defined as the minimum expenditures required to purchase one unit of the respective baskets:

$$\begin{aligned} P &= P_T^{\delta} P_N^{1-\delta}, \\ P_N &= \left[\int_0^{n_N} p\left(h_N\right)^{1-\sigma} dh_N \right]^{\frac{1}{1-\sigma}}, \\ P_T &= \left[\int_0^{n_D} p\left(h_D\right)^{1-\sigma} dh_D + \int_0^{n_X^*} p\left(f_X\right)^{1-\sigma} df_X \right]^{\frac{1}{1-\sigma}} \end{aligned} \tag{13}$$

With competitive labor market and free labor mobility across sectors (but not across borders) optimal labor supply implies:

$$w = 1 = \ell^{\xi} PC \tag{14}$$

Note that, as a result of our choice of numeraire, P is the price of consumption in terms of labor. In equilibrium, consumption increases when its price P falls (with unit elasticity) and when labor ℓ decreases (with elasticity ξ).

2.3 Prices

The prices charged by Home firms take the standard form of markups over marginal costs, equal in our setup to labor costs per unit of product:

$$\begin{aligned} p\left(h_N\right) &= p\left(h_D\right) = \frac{\sigma}{\sigma - 1} \equiv p, \\ \varepsilon p^*\left(h_X\right) &= \frac{\sigma}{\sigma - 1}\left(1 + \tau\right) = p(1 + \tau) \end{aligned} \tag{15}$$

Given that the two countries have identical labor productivities and demand elasticities, it must be the case that $p = p^*$. It follows that the terms of trade — conventionally defined as the price of imports in terms of the price of exports — is simply equal to ε.

Using the above expressions, then, the equilibrium price indexes are:

$$\begin{aligned} P_N &= p n_N^{\frac{1}{1-\sigma}}, \qquad & P_T = p\left[n_D + n_X^* \phi \varepsilon^{1-\sigma}\right]^{\frac{1}{1-\sigma}}, \\ P_N^* &= p^* n_N^{*\frac{1}{1-\sigma}}, \qquad & P_T^* = p^*\left[n_D^* + n_X \phi \varepsilon^{\sigma-1}\right]^{\frac{1}{1-\sigma}} \end{aligned} \tag{16}$$

where:

$$\phi \equiv \left(1 + \tau\right)^{1-\sigma} \tag{17}$$

Borrowing a notation convention commonly adopted by the trade literature, the index of trade costs ϕ is positive and less than one; the case $\phi = 0$ corresponds to infinite trade costs, the case $\phi = 1$ to zero trade costs.

2.4 Free entry, balance of payments and equilibrium

To characterize the equilibrium in our model, we first rewrite the operating profits earned by Home firms (gross of entry costs) as follows:

$$\begin{aligned}
\Pi(h_N) &= p\frac{L}{\sigma}C(h_N) = \frac{1-\delta}{\sigma}\frac{L\ell^{-\xi}}{n_N}, \\
\Pi(h_D) &= p\frac{L}{\sigma}C(h_D) = \frac{\delta}{\sigma}\frac{L\ell^{-\xi}}{n_D + n_X^*\phi\varepsilon^{1-\sigma}}, \\
\Pi(h_X) &= p(1+\tau)\frac{L^*}{\sigma}C^*(h_X) = \frac{\delta}{\sigma}\frac{\phi L^*\ell^{*-\xi}\varepsilon^{\sigma}}{n_D^* + n_X\phi\varepsilon^{\sigma-1}}
\end{aligned} \tag{18}$$

Other things being equal, a higher number of firms (and varieties) in a sector reduces the profits of each firm operating in that sector. Observe that in the tradables sector, transportation costs partially shield local firms' profits from foreign competition: if ϕ is close to zero both $\Pi(h_D)$ and $\Pi(h_X)$ depend only on the number of import-competing firms, n_D and n_D^* respectively. When $\phi > 0$, the exchange rate affects relative profits: a Home depreciation raises $\Pi(h_D)$ over $\Pi(h_N)$, and $\Pi(h_X)$ over $\Pi(h_D)$.

With free entry, however, the value of operating profits is pinned down by the cost of creating a specific variety:

$$\Pi(h_i) = c_i n_i^{\gamma} \qquad i = N, D, X \tag{19}$$

expressions that define the *free entry conditions.* With no asymmetry in the entry costs across sectors, there can be no difference in operating profits. Note that, from (18) and (15) it follows immediately that operating profits for all firms are proportional to sales. Thus, using (19) the level of entry costs also pins down firms' size:

$$Y(h_i) = (\sigma - 1)\, c_i n_i^{\gamma} \qquad i = N, D, X \tag{20}$$

Combining these expressions with (4),[9] (9) and (19), the aggregate budget constraint can be written as:

$$PC = \ell - F/L \tag{21}$$

Together with the equilibrium wage rate (14), the previous expression implies that Home labor effort is univocally determined as a function of the transfer:

$$\ell^{-\xi} = \ell - F/L \tag{22}$$

The aggregate budget constraint (21) corresponds to the Home aggregate balance of payments:

$$\phi\delta\left[\frac{n_X L^*\ell^{*-\xi}\varepsilon^{\sigma}}{n_D^* + n_X\phi\varepsilon^{\sigma-1}} - \frac{n_X^* L\ell^{-\xi}\varepsilon^{1-\sigma}}{n_D + n_X^*\phi\varepsilon^{1-\sigma}}\right] - F = 0 \tag{23}$$

[9] Note that Home per-capita employment is $\ell = \sigma\left(c_N n_N^{\gamma+1} + c_D n_D^{\gamma+1} + c_X n_X^{\gamma+1}\right)/L$.

The first two terms are Home exports less Home imports measured in Home labor units, both inclusive of trade costs.

The expressions for labor (22), profits (18), the free entry conditions (19), and their Foreign analogs, together with the balance of payments (23) identity jointly determine the exchange rate ε, the number of varieties n_N, n_D, n_X, and their Foreign analogs (n_N^*, n_D^*, n_X^*,), as functions of exogenous variables (L, c_N, c_D, c_X and their Foreign analogs, as well as F). The price indexes are then determined according to (13) and Foreign analogs, and the consumption levels is determined according to (22) and its Foreign analog.

In a symmetric equilibrium with $L = L^*$ and $F = 0$, our model is solved by $\ell = \ell^* = 1$ and $\varepsilon = 1$. Aggregate GDP is therefore equal to $L = L^*$. It is convenient to define a measure of trade openness θ such as:

$$\theta \equiv \left(\frac{c_D}{c_X}\right)^{\frac{1}{\gamma}} \phi^{\frac{1+\gamma}{\gamma}}. \tag{24}$$

Observe that θ depends on both transport costs and the relative fixed cost of entry in the export market. It is straightforward to show that in a symmetric equilibrium with balanced trade, the ratio of exports (or imports) to GDP is equal to $\delta\theta/(1+\theta)$, and the ratio of exportable varieties to import-competing varieties in the tradables sector is $n_X/n_D = \theta/\phi$.[10]

3 Domestic and international implications of current account adjustments

In this and the next sections we use our model to analyze the macroeconomic impact of a current-account adjustment experiment, whereby the Home country engineers a permanent transfer ΔF to the Foreign country. Our analysis abstracts from the specific reasons why the country has external obligations to start with,[11] and focuses on the macroeconomic equilibrium response after all short-run and business cycle dynamics are exhausted. The approach is therefore along similar lines as Dekle et al. (2007) and Obstfeld and Rogoff

[10] Note that in the tradables sector, the ratio of export profits to domestic profits $\Pi(h_X)/\Pi(h_D)$ is equal to ϕ in the symmetric equilibrium. Similarly, $\Pi(h_N)/\Pi(h_D) = \frac{1-\delta}{\delta}\frac{1+\theta}{n_N/n_D}$, and the ratio n_N/n_D is equal to $\left[\frac{1-\delta}{\delta}\frac{c_D}{c_N}(1+\theta)\right]^{1/(1+\gamma)}$ in the symmetric equilibrium.

[11] By way of example, in the past the country's residents may have borrowed from abroad on expectations of growth differentials. Given the current stock of external debt, the country faces an adjustment problem to the extent that the expected differentials do not materialize ex post — disappearing productivity differentials in favor of the United States have indeed been the subject of vast debate since 2001. Also, liberalization of capital flows may have contributed to the emergence of U.S. deficits as a consequence of asymmetric developments of national financial markets (or differences in the level of risks and preferences), causing high precautionary savings in emerging market economies as in Caballero, Farhi and Gourinchas (2008) and Mendoza, Quadrini and Rios-Rull (2007).

Table 1: Comparative statics

$$\widehat{C} = -\widehat{C^*} = -\delta\frac{\theta\widehat{\varepsilon}}{1+\theta} - \xi\widehat{\ell} + (1-\delta)\frac{\widehat{n_N}}{(\sigma-1)} + \delta\frac{\widehat{n_D}-\theta\widehat{n_X}}{(\sigma-1)(1+\theta)} < 0 \quad (26)$$

$$\widehat{\ell} = \widehat{GDP} = -\widehat{\ell^*} = \frac{1}{1+\xi}. \quad (27)$$

$$\widehat{n_N} = -\widehat{n_N^*} = -\frac{\xi}{(1+\xi)(1+\gamma)} < 0 \quad (28)$$

$$\widehat{n_X} = -\widehat{n_X^*} = \frac{(1+\theta)}{\Gamma(1+\gamma)\theta}\{[\sigma(1+\gamma)+\gamma\theta][1+\xi(1-\delta)] + \sigma\xi\delta(1+\gamma)\} \quad (29)$$

$$\widehat{n_D} = -\widehat{n_D^*} = \frac{(1+\theta)}{\Gamma(1+\gamma)}\{[\sigma+\gamma(\sigma-1)][1+\xi(1-\delta)] - \sigma\xi\delta(1+\gamma)\} \quad (30)$$

$$\widehat{n_D} + \widehat{n_X} = \frac{\sigma(1+\theta)}{\theta\Gamma}[(1+\theta)(1+\xi) - 2\delta\xi\theta] \quad (31)$$

$$\widehat{\varepsilon} = \frac{\gamma(1+\theta)}{\theta\Gamma}[(1+\theta)(1+\xi) - 2\delta\xi\theta] = \frac{\gamma}{\sigma}(\widehat{n_D} + \widehat{n_X}) \quad (32)$$

$$\Gamma \equiv \delta[2\sigma + \gamma(2\sigma - 1 + \theta)](1+\xi) > 0 \quad (33)$$

$$\widehat{RER} = \frac{1+\theta-2\delta\theta}{1+\theta}\widehat{\varepsilon} + \frac{2\delta}{\sigma-1}\frac{\widehat{n_D}-\theta\widehat{n_X}}{1+\theta} + \frac{2(1-\delta)}{\sigma-1}\widehat{n_N} \quad (34)$$

(2007).[12] As suggested by the simulations in Ferrero et al. (2009) and Faruqee et al. (2007), however, the core results of these exercises remain valid, both in qualitative and quantitative terms, in the context of full-fledged dynamic simulations.

The equilibrium implications of the adjustment are shown synthetically in Table 1. In this table, as well as in the text below, we make use of the fact that, for sufficiently small values of $\Delta F/L$, one can approximate the effects of the transfer with the equilibrium multipliers in the neighborhood of the symmetric equilibrium. For any generic variable x, we adopt the notation:

$$\widehat{x} = \frac{dx/x}{dF/L} \quad (25)$$

3.1 Decomposing the effects of a transfer

Table 1 show that current account adjustment requires some combination of falling Home consumption (26) and increasing home employment (27) — in our linearized model changes in these variables are perfectly mirrored, with a different sign, in the Foreign economy. Indexing the domestic macroeconomic cost of a transfer with the utility of the national

[12] As in the latter paper, we also assume that prices are flexible. However we do not assume a fixed output, allowing for an endogenous response of employment, both total and across sectors.

representative agent, it follows that a transfer unambiguously worsens domestic welfare:

$$\frac{dU}{dF/L} = \widehat{C} - \widehat{\ell} < 0 \tag{35}$$

raising Foreign welfare in the same proportion. Observe however that the extent of adjustment in employment (27) depends on the elasticity of labor supply: a very high elasticity ($\xi \to 0$) makes domestic employment move one-to-one with the transfer. Vice-versa, a highly inelastic labor supply ($\xi \to \infty$) implies that all the adjustment takes place via the fall in consumption.

The response of aggregate consumption demand (26) in turn depends not only on the adjustment in employment, but also on changes in the terms of trade *and* the number of product varieties in the different sectors of the economy. For illustration purposes, it is convenient to focus on the case in which labor supply is very inelastic, ($\xi \to \infty$), so that $\widehat{\ell} = 0$, and welfare changes are completely indexed by changes in domestic consumption. The response of consumption to a transfer can be then broken down into three different components — conveniently related to the points stressed in the controversy between Ohlin and Keynes, as well as to the main arguments in this paper:

$$\widehat{C}\mid_{\xi \to \infty} = \underbrace{-1}_{\text{Ohlin-Samuelson effect}} - \underbrace{\frac{\delta\theta\widehat{\varepsilon}}{1+\theta}}_{\text{Keynes' effect}} + \underbrace{(1-\delta)\frac{\widehat{n_N}}{(\sigma-1)} + \delta\frac{\widehat{n_D} - \theta\widehat{n_X}}{(\sigma-1)(1+\theta)}}_{\text{Extensive margin effect}} < 0 \tag{36}$$

With no change in the terms of trade and/or the extensive margin, consumption falls one to one with the size of the transfer (first term on the right-hand side) — a point stressed by Samuelson (1952) in reference to Ohlin's argument. One could observe that this is indeed the *only* effect if goods are homogeneous ($\sigma \to \infty$). When goods are imperfect substitutes, but the number of varieties is fixed, the Keynes' effect (second term on the right-hand side) lowers consumption further, as the Home terms of trade worsen — what Samuelson (1952) refers to as the secondary burden of adjustment. In equilibrium, the exchange rate movement is a function of all parameters in the model; yet observe that, for a given change in ε, consumption falls proportionally to openness, as captured jointly by the size of the tradable sector (δ) and home bias in consumption of tradables (a function of θ).

Behind the curtain of these two effects — Ohlin and Keynes — there is active sectoral adjustment, with reallocation of labor away from the nontradables sector and toward the production of tradables. Reallocation of resources across sectors is driven by differences in profitability: in this respect the real depreciation ε affects output valuation in the economy, boosting profitability in the production of exports and, to a lower extent, in the production of import-competing varieties according to (18). Conversely, the internal relative price of nontradables does not move in response to a transfer and plays no role in reallocating resources, as shown by (15). This is a feature of the model that stems directly from the simplifying assumptions of our framework, although it can be motivated on the basis of evidence of contained movements in relative prices unrelated to productivity developments.[13]

The main lesson from (36), however, is that the overall consumption — and welfare — impact of a transfer is a function of additional factors, essentially capturing adjustment at the *extensive* margin (third term on the right-hand side). Observe that in all the expressions for $\widehat{n_i}$ in Table 1, the magnitude of entry or exit crucially depends on γ, i.e. the convexity of the cost function, indexing the degree of flexibility at the extensive margin. Other things equal, the higher γ, the lower the response at the extensive margin.

3.2 Transfer and product varieties

Consider what happens to the supply of product varieties in each sector of the economy, N, X and D in turn. The transfer unambiguously causes Home nontraded varieties n_N to contract according to (28). According to the mechanism discussed at length in the classic transfer-problem controversy, resources are freed from the nontraded good sector in favor of the tradables sector. With adjustment at the extensive margin, however, a key dimension of reallocation consists in the contraction of the array of nontraded goods available to consumers. As preferences exhibit 'love for variety', this is clearly bad news for welfare.

Home exports varieties n_X invariably rise according to (29). It should be emphasized that the transfer of income abroad raises the relative size of the market for Home exports, and therefore the operating profits of domestic exporters. This in turn creates a clear incentive for firms to enter the export market with new goods. For essentially the same reason, the transfer reduces the Home market for imports n_X^*, once again translating into welfare losses for Home residents.

The number of import-competing goods n_D may go either way. Specifically, n_D rises under either of the following conditions: (a) the size of the nontradables sector is large relative to the tradables sector (δ is close to zero), so that the amount of resources released by the nontradables sector is enough to produce additional varieties in the import-competing sector; (b) the labor supply is sufficiently elastic (ξ is close to zero), so that there is no shortage of labor. When these conditions fail, exit from the nontradables sector n_N and the

[13] Focusing on the latest episode of U.S. current account rebalancing at the end of the 1980s, Corsetti (2007) and EEAG (2008) show that the relative price of nontradables in the United States hardly moved away from its trend throughout the 1980s and beyond. This is in contrast with conventional models of the transfer problem, which stress the need for a decline not only in the relative price of Home tradable goods (to raise Foreign demand for Home exports, and discourage Home demand for imports), but also in the relative price of Home nontradables (to redirect Home demand away from tradables towards Home nontradables).

equilibrium contraction in leisure are not sufficient to compensate for the expansion of the tradables sectors: the number of import-competing varieties n_D has to shrink as well. These considerations make it clear that, even abstracting from the welfare implications of terms of trade movements, adjustment at the extensive margin brings new arguments in favor of the 'double punishment' view of transfers championed by Keynes. Essentially, in Keynes' view, the transfer rises the price of consumption in terms of labor because it increases the price of imported goods in terms of exports. In our framework, the price of consumption can rise independently of the terms of trade, because of the shrinking number of goods varieties in the Home markets.[14]

3.3 Varieties and international relative prices

The expression (31) in Table 1 sheds light on the equilibrium interaction between extensive margin and terms of trade adjustment. Namely, as long as $\gamma > 0$ (and goods are not perfect substitutes, or $\sigma < \infty$), the terms of trade depreciation is proportional to changes in the number of varieties overall produced in the Home tradables sector $(n_X + n_D)$.[15] As discussed above, exchange rate movements affect relative operating profits across sectors. In our specification with free entry and a common demand elasticity across sectors — arguably suitable in a world with a large volume of intra-industry trade — differences in operating profits must be matched by differences in the costs of entry. Since entry raises the cost of setting up new varieties to the extent that $\gamma > 0$, the latter parameter effectively indexes the extent to which operating profits can vary at different rates across types of goods.

When γ is close to zero (constant entry costs), free entry ensures that, in equilibrium, firms' operating profits do not change with the transfer.[16] In this case there is no need for terms of trade adjustment in order to switch demand in favor of Home exports, and only the extensive margin of trade is at work: due to 'love for variety', new product varieties can be sold and exported without a fall in relative prices.[17]

Conversely, when γ is strictly positive, adjustment at the extensive margin is relatively difficult and induces asymmetries in entry costs, thus in operating profits across sectors. The

[14] As we observe below, this effect would not be detected by statistical measures of the Consumer Price Index that do not account for changes in the basket of varieties available for consumption.

[15] A sufficient condition for the change in the number of tradables varieties to be positive is $\theta < 1$.

[16] It is worth mentioning that the case of a constant or even decreasing fixed cost is standard in endogenous growth models with expanding product variety, as analyzed for example in Grossman and Helpman (1991) and Barro and Sala-i-Martin (1995).

[17] The same is true if $\gamma > 0$ but the cost function in the tradables ector is assumed to be symmetric across goods types, say, it depends on $n_D + n_X^*$ and $n_D^* + n_X$. In this case, operating profits are constrained to move proportionally with the common cost, leaving no room for relative price adjustment.

terms of trade of the Home country necessarily worsen. Observe that the rate of depreciation tends to be large when trade costs are high (ϕ and therefore θ goes to zero), or the Frisch elasticity is low, making employment less responsive to the transfer.

The last line of Table 1 shows the response of the real exchange rate, denoted by RER, and defined as the ratio of the price of consumption in the two countries, i.e. $RER \equiv \varepsilon P^*/P$. This is the appropriate (i.e. welfare-based) measure of real exchange rate, encompassing the price indexes derived in Section 2. Under a current account adjustment the welfare-based real exchange rate may in principle move either way. As we show in Section 4 below, the parameter values of our benchmark simulations are such that RER depreciates following a transfer, i.e. expression (34) is positive. This is due to the fact that, in our benchmark, weaker terms of trade and net entry in the tradables sector more than compensate for the drop in the number of nontraded varieties available to consumers. However, an appreciation scenario is not implausible when terms of trade adjustment is small. In such a scenario, a strong fall in the number of varieties available to Home agents significantly raises the welfare-based price index of Home consumption in (16): Home consumption becomes more expensive relative to Foreign.

It is worth stressing that our definition of real exchange rate does not correspond to the definition underlying official statistics, as these typically do not account for changes in the number of varieties available to consumers (a point stressed by Broda and Weinstein 2007). To obtain a 'statistical' measure of the real exchange rate depreciation consistent with the analysis above, it is sufficient to make it conditional on a constant number of varieties, that is, to set the two last terms in the expression (34) equal to zero. For convenience, we reproduce the expression below:

$$\left.\widehat{RER}\right|_{\widehat{n_i}=0} = \frac{1+\theta-2\delta\theta}{1+\theta}\widehat{\varepsilon} \tag{37}$$

Ignoring the extensive margin, the statistical measure of the real exchange rate would unambiguously record a depreciation. The reason is apparent: the fall in the total number of varieties available to domestic consumers translates into an increase in the welfare-based Consumer Price Index P. For any given change in product prices, the variety-induced changes in the CPIs would tend to reduce the equilibrium depreciation rate according to (34) — effects which are ignored by the statistical counterpart of our RER. Abstracting from changes in the number of varieties, the real exchange rate instead moves proportionally to the terms of trade, depending on the degree of home bias. The rate of depreciation according to the statistical measure of the real exchange rate is therefore comprised between the rate of depreciation in the terms of trade ε, and the rate of change in the welfare-based real exchange rate RER.

3.4 Extensive margins and trade flows

To shed additional light on the interaction between adjustment at the extensive and the intensive margin, we rewrite Home exports X and imports M as follows:

$$X = n_X \cdot \left(\frac{\delta \phi L^* \ell^{*-\xi} \varepsilon^{\sigma}}{n_D^* + n_X \phi \varepsilon^{\sigma-1}} \right) \qquad M = n_X^* \cdot \left(\frac{\delta \phi L \ell^{-\xi} \varepsilon^{1-\sigma}}{n_D + n_X^* \phi \varepsilon^{1-\sigma}} \right) \tag{38}$$

Strictly speaking, the extensive margin of exports is given by the change in the number of exportable varieties n_X (the first term on the right hand side). However, changes in the volume of exports of a given variety (i.e. the intensive margin, corresponding to the terms in parenthesis on the right hand side) also depend on the number of Foreign import-competing varieties, and the number of Home exporters itself. These affect the size of the sales by each individual exporter, via their endogenous effect on total demand for Home products in the Foreign market.

The general-equilibrium interaction between extensive and intensive margins makes the distinction between the two — from an empirical point of view — quite a difficult task. To see why, write the response of Home exports and imports to a transfer distinguishing between the two margins, labelled 'extensive' and 'intensive' according to usual conventions:

$$\widehat{X} = \underbrace{\widehat{n_X}}_{extensive} + \underbrace{\frac{1}{1+\theta} \left[\widehat{n_D} - \theta \widehat{n_X} + (\sigma + \theta) \widehat{\varepsilon} + \xi (1+\theta) \widehat{\ell} \right]}_{intensive} \tag{39}$$

$$\widehat{M} = \underbrace{-\widehat{n_X}}_{extensive} - \underbrace{\frac{1}{1+\theta} \left[\widehat{n_D} - \theta \widehat{n_X} + (\sigma - 1) \widehat{\varepsilon} + \xi (1+\theta) \widehat{\ell} \right]}_{intensive} \tag{40}$$

As apparent from the expression above, the term in square brackets on the right hand side of (39) can be further decomposed into different multipliers. These consist of the change in the level of competition on the export market (captured by $\widehat{n_D} - \theta \widehat{n_X}$), the change in the terms of trade, and the wealth effect of the transfer on labor supply.

In light of the above expression, the extensive margin of trade adjustment should actually be re-defined as to encompass all the effects (direct and indirect) from entry and exit of new varieties. As a result, the label 'extensive' should include the first two terms in square brackets on the right-hand side of (39) and the label 'intensive' should residually include only the last two terms.[18] This new classification would better capture the general-equilibrium implications of changes in the number of varieties as predicted by the theory, but its implementability in empirical studies is bound to be highly demanding.

[18] It is worth stressing that adjustment at the intensive margin also comes in two parts: exports of each variety increase because of the terms of trade depreciation, and expenditure in the Foreign country rises due to the effect of the transfer.

4 Quantitative simulations

In this section we calibrate our model and provide some basic quantitative elements for an assessment of the relative price and macroeconomic adjustment associated with a correction of the U.S. trade imbalance, complementing our comparative statics analysis in Section 3. In that section, to derive analytical results, we posited a symmetric balanced equilibrium and studied the effect of a transfer to Foreign creditors, requiring the current account to move to a surplus of the same size. In this section we account for asymmetries across countries. The initial conditions are such that the Home country runs a current account deficit, and we consider the effects of a transfer that restores the balanced equilibrium over a time horizon in which firms can enter and exit the product market. We analyze the response of the economy at different degrees of economic 'flexibility' in creating new product varieties, and discontinuing existing ones.[19]

4.1 Calibration

The size of the world economy is normalized to 200 and we choose $L = 54$ and $L^* = 146$ to roughly approximate the weight of the U.S. economy in world GDP, about 27 percent in 2006. Consistently, we set $F = -3.5$ in the initial equilibrium, which yields a Home country deficit of roughly 6.5 of U.S. GDP (corresponding to the U.S. deficit in 2006), and consider the effects of a transfer $\Delta F = 3.5$.

In the baseline calibration the elasticity of substitution between product varieties σ is set equal to 2, a value consistent with macro studies of current account adjustment. We also experiment with $\sigma = 5$ and $\sigma = 10$, values suggested by trade studies. Trade costs τ are set at 20 percent following Anderson and van Wincoop (2004) estimate of transport costs. Following Obstfeld and Rogoff (2007) we take the share of tradables to be 25 percent of consumption (e.g. $\delta = 0.25$), although in sensitivity analysis we consider the implications of values as high as $\delta = 2/3$.

We normalize c_N and $c_N^* = 1$, and set c_X such that the ratio of Home exports to Home GDP is 11 percent (corresponding to U.S. values in 2006). Similarly, in the rest of the world c_X^* is such that Foreign exports as a ratio of Foreign GDP are equal to 6.6 percent.[20] The specific values of c_D and c_D^* are irrelevant for the purpose of our analysis, in the sense that changes in these parameters only affect the ratios n_X/n_D and n_X^*/n_D^* without modifying

[19] In this respect, we should make it clear from the start that our simulations are not meant to provide a framework for critical 'sudden stop' scenarios — which are arguably more plausible for small emerging markets than for a large advanced economy.

[20] The latter value is equal to U.S. imports from the rest of the world in 2006 (about \$2280 billion) divided by world GDP excluding the U.S. in 2006 (\$47800 billion minus \$13000 billion).

relative profits across sectors, thus leaving unchanged the equilibrium allocation of resources and agents' response to macroeconomic shocks.

The parameter γ, measuring the convexity in the cost function for the creation of new varieties, is directly related to the relative importance of extensive margin adjustment. Hummels and Klenow (2005) show that the extensive margin accounts for two-thirds of the greater exports of larger economies. In our model, the latter effect is equal to $\partial \ln X / \partial \ln L = 1/(1+\gamma) = 2/3$, suggesting $\gamma = 0.5$ in the long run. Galstayn and Lane (2008) show that in the case of the United States, over a relatively short period of time (2000-2004), around half of the trade growth has been on the extensive margin. This suggests a higher γ, around unity (i.e. a quadratic cost function). In light of these considerations we choose $\gamma = 1$ as our benchmark case (corresponding to an estimated extensive margin of U.S. exports of 47.2 percent). In sensitivity analysis we experiment with the calibration suggested by Hummels and Klenow ($\gamma = 0.5$) as well as a more conservative parameter value ($\gamma = 2$). We also report the results for $\gamma = 12$ (corresponding to the case in which adjustment at the extensive margin accounts for a negligible fraction of exports). In addition, we also consider a calibration with γ very close to zero, to emphasize the differences between a model in which all adjustment occurs at the extensive margin, and the conventional 'fixed-variety' models in which all adjustment occurs at the intensive margin.

Finally, most micro studies using microdata on wages, hours worked and various household characteristics, suggest a low estimate of the Frisch elasticity ($1/\xi$). For men, most estimates are in the range 0 to 0.5 (see for example Heckman and MaCurdy 1980, MaCurdy 1981, Altonji 1986, Blundell and MaCurdy 1999). Browning, Hansen and Heckman (1999) note however that these microeconomic estimates are incompatible with real business cycle models that use values in the range of 3 or higher. In our benchmark parameterization we choose $\xi = 1$, following Gali, Gertler and López-Salido (2007). In sensitivity analysis we consider the cases $\xi = 0$ (infinite elasticity, corresponding to the Hansen (1985) and Rogerson (1988) model of indivisible labor) and $\xi = 5$.

4.2 Numerical results

Table 2 reports our numerical results. The table compares our 'endogenous-variety' model with entry (columns 1 through 8), with a specification in which product varieties do not endogenously change per effect of the transfer and the current account adjustment only occurs at the intensive margin (columns 9 through 12). For each variable in the Table 2, we report the percentage change resulting from current account adjustment.

Our baseline parameterization is displayed in the first row of the table (*Benchmark*). A

Table 2: Numerical simulations

	Endogenous-Variety Model								Fixed-Variety Model			
	n_N	n_D	n_X	n_X^*	ε	RER	ℓ	C	ε	RER	ℓ	C
Benchmark	−1.6	7.6	18.4	−11.0	9.9	4.4	3.3	−6.9	21.9	17.0	3.3	−6.2
$\sigma = 5$	−1.6	9.2	17.2	−9.3	3.8	2.3	3.3	−4.2	7.8	6.2	3.3	−4.3
$\sigma = 10$	−1.6	9.7	16.9	−8.7	1.9	1.2	3.3	−3.7	3.8	3.0	3.3	−3.8
$\xi = 0$	0.0	10.8	20.3	−10.7	11.4	7.7	6.9	−2.5	25.2	19.5	6.9	−3.6
$\xi = 5$	−2.6	5.7	17.2	−11.1	9.0	2.3	1.1	−9.5	19.8	15.4	1.1	−7.8
$\xi = 5, \delta = 2/3$	−2.6	−0.4	14.2	−12.5	6.7	0.8	1.1	−9.0	15.7	12.4	1.1	−7.3
$\gamma = 0$	−3.2	22.3	35.0	−16.1	0.0	−4.4	3.3	−6.3	21.9	17.0	3.3	−6.2
$\gamma = .5$	−2.1	11.5	24.4	−13.1	6.4	1.1	3.3	−6.8	21.9	17.0	3.3	−6.2
$\gamma = 2$	−1.1	4.4	12.3	−8.1	13.7	8.1	3.3	−6.8	21.9	17.0	3.3	−6.2
$\gamma = 12$	−0.2	0.8	2.9	−2.2	19.9	14.8	3.3	−6.4	21.9	17.0	3.3	−6.2

transfer from the Home country to the rest of the world is associated with a 1.6 percent contraction in the nontradables sector n_N, a 7.6 percent increase in the (varieties produced by the) import-competing sector n_D,[21] and a 18.4 percent expansion in the export sector n_X (abroad, the export sector n_X^* contracts by 11 percent). The terms of trade (and the relative price of labor ε) depreciate by 9.9 percent, while the CPI-based real exchange rate RER depreciates by only 4.4 percent, reflecting the interaction between intensive and extensive margins. In the absence of firms' entry (see the last four columns of the table) the adjustment relies exclusively on movements of relative prices: in the fixed-variety model the terms of trade depreciate by more than twice the endogenous-variety model (21.9 versus 9.9 percent), and the extent of RER depreciation is four times larger.

The transfer is associated with an expansion of employment and GDP in the Home country (labor effort ℓ increases by 3.3 percent), but external demand crowds out internal

[21] It is possible to consider scenarios in which n_D actually *falls* due to the effect of the transfer. For instance, in our case this happens when the Frisch elasticity is sufficiently low *and* the share of tradables is particularly (and implausibly) high: see the results reported in row $\xi = 5, \delta = 2/3$.

demand and Home consumption C falls by 6.9 percent. As a result, welfare unambiguously falls in the Home country. Welfare also falls in the fixed-variety model, as consumption falls and labor effort rises. It is straightforward to compare welfare losses across models, since labor movements are identical whether or not the extensive margin is operational. Thus, what matters is the fall in consumption, which is larger in the endogenous-variety model (6.9 percent) than in the fixed-variety model (6.2 percent).[22]

This point is subject to a number of caveats, stressed by our sensitivity analysis. When varieties are relatively more substitutable in global consumption ($\sigma = 5$ or $\sigma = 10$), the welfare loss is stronger in the fixed-variety model than in the endogenous-variety setup. The parameterization of σ does not influence the response of the labor effort, but affects the change in consumption: namely, the higher is σ, the smaller is the loss of consumption. When we increase σ from 2 to 5, the fall in consumption shrinks from 6.9 to 4.2 percent in the endogenous-variety model, mostly because consumers get less utility from varieties when goods become more homogeneous. The same variable declines from 6.2 to 4.3 percent in the fixed-variety model: the terms of trade depreciate less if goods are more substitutable. Obviously, with a high degree of elasticity of substitution σ, both our argument stressing loss of utility from product varieties and the Keynesian argument stressing adverse movements in the terms of trade become less consequential — the welfare losses converge across different versions of the model. Yet, with a large σ, small equilibrium movements in relative prices can have a large impact on trade values[23].

Observe that, for a given σ, adjustment at the extensive margin effectively raises the trade elasticity over the medium run, dampening the price movements required to redirect world demand away from domestic importables, in favor of domestic exportables. In this respect, both our endogenous-variety model with a relatively low elasticity of substitution (say $\sigma = 2$) and a fixed-variety model with a high elasticity of substitution (say $\sigma = 10$) similarly predict a small change in relative prices. However, the overall macroeconomic response to a transfer across these two specifications is vastly different: the fall in consumption in the endogenous-variety model is much larger, -6.9 percent versus -3.8 percent. Again, these results suggest that relative price changes following the transfer need not be a reliable measure of the welfare loss.

An economy in which welfare worsens more in the fixed-variety model than in the

[22] These welfare considerations are particularly relevant when ξ is high: see for instance the consumption losses associated with $\xi = 5$ in Table 2.

[23] Pappada (2008) analyzes the impact of the elasticity of substitution on the terms of trade adjustment required by a transfer in a model with heterogenous firms. He finds that when firms are heterogenous a higher elasticity of substitution increases the role played by the extensive margin and reduces the extent of the required depreciation.

endogenous-variety model is one in which the Frisch elasticity is high (that is, ξ is low). Consider the row corresponding to $\xi = 0$ in Table 2. As labor supply is infinitely elastic, the transfer does not require any contraction in the nontradables sector ($\widehat{n_N} = 0$). Exchange rates adjust more than in the *Benchmark* cases across models. In both models, labor effort increases more than twice relative to *Benchmark*. Consumption falls 3.6 percent in the fixed-variety model, but only 2.5 percent in the endogenous-variety model. With a Frisch elasticity lower than in the *Benchmark* case ($\xi = 5$), more of the adjustment falls on consumption, and less on employment. Interestingly, the size of the nontradables sector contracts sharply across specifications, and the exchange rates moves less than in the case of an infinite elasticity. This simulation also sheds light on the role of intersectoral adjustment in driving our results: if the extensive margin is eliminated from the model (last four columns of the table), the terms of trade still deteriorates sizably (19.8 percent), suggesting that mobility across sectors does not play a key role in muting relative price adjustment.

The parameter γ is key to our numerical simulations and welfare comparisons. Consider the last four rows of Table 2. When $\gamma = 0$ the exchange rate does not move at all in the extensive margin model ($\widehat{\varepsilon} = 0$) and all adjustment occurs through the reallocation of product varieties, in strong contrast with the traditional view captured by the fixed-variety model. If we set the parameter γ equal to .5 — consistent with the estimate of the extensive margin by Hummels and Klenow (2005) — the relative price changes are smaller than in the *Benchmark* case. On the contrary, raising the value of γ brings our model progressively closer to the fixed-variety model. Interestingly, in terms of welfare analysis the polar cases $\gamma = 0$ and $\gamma \to \infty$ yield virtually similar outcomes (compare the consumption losses under the two parameterizations, recalling that changes in labor effort are unaffected by γ). Interestingly, however, the welfare difference across the two models is non-monotonic in γ: when $\gamma = 0$ the fall of Home consumption and the loss of welfare in the endogenous-variety model is comparable to the fixed-variety model. When γ approaches 1, the loss of welfare in the endogenous-variety model gets larger than in the alternative model. When γ increases above one, the gap between the two welfare losses shrinks, and eventually disappears when γ is sufficiently high.

5 Conclusion

In this paper we have revisited the classical model of international transfer to gain insights on the ongoing debate on global current account rebalancing. A transfer-problem approach to the analysis of the adjustment of the current account deficits run by the United States since the mid 1990s is deeply insightful, as it sheds light on the equilibrium reallocation of employment and resources across sectors, and the corresponding movements in international relative prices. Such reallocation process in turn depends on the relative importance of different adjustment margins. The main emphasis in our paper is on the role of product differentiation: in contrast with the conventional view that predicts large currency declines as a key dimension of the rebalancing process, our model suggests that real exchange rate movements can be quite contained in the long run once net creation and destruction of product varieties are appropriately accounted for.

While our simulations elucidate the trend fundamentals of real exchange rate movements allowing for product differentiation, it is well understood that exchange rates have vastly erred on either side of purchasing power parity across the main currency areas of the world, and large and persistent swings have systematically eluded theoretical explanations. By focusing on the medium and long term, and abstracting from dynamic considerations related to financial de-leveraging and current account funding, our contribution singles out the basic components of the transmission mechanism that are bound to shape the macroeconomics of transfers and rebalancing even in full-fledged adjustment scenarios.

Our model also emphasizes that a small real depreciation driven by extensive margin adjustment would not necessarily be good news from a welfare perspective. The 'secondary burden' of the transfer would shift from adverse movements in the terms of trade onto adverse movements in welfare-based price indexes, reflecting the utility losses from a reduced number of product varieties available to domestic consumers. These findings suggest that fluctuations in currency values, much emphasized in the traditional literature on current account reversals, are important but only imperfect gauges of the social costs associated with the adjustment process. It is certainly possible to envision scenarios of global rebalancing involving limited movements in international relative prices, and nevertheless associated with larger welfare losses than alternative scenarios in which exchange rate depreciations play a much more conspicuous role.

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