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Isabelle Méjean

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Contents

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SUMMARY

According to Obstfeld & Rogoff (2000), the failure of the Purchasing Power Parity (PPP) relation is one of the main empirical "puzzles" in Open Macroeconomics: despite strong integration of good markets at the international level, the connection between exchange rates and national price levels is still weak and real exchange rates regularly deviate from their PPP level. The most popular explanation of this puzzle is the well-known Balassa-Samuelson model that explain PPP deviations in the non-traded good sector by the existence of cross-country *and* cross-sector productivity gaps. This model is however unable to explain observed deviations from the Law of One Price (LOP) for traded goods. Such price discrepancies in traded good sectors have been recently studied in New Trade frameworks by Ghironi & Melitz (2004) and Corsetti, Martin & Pesenti (2005). These papers show that productivity gains can affect firms' location decisions, which ultimately impact relative price levels.

In this paper, I put together both arguments in a single framework and analyze how deviations from the LOP in traded *and* non-traded good sectors interact in general equilibrium to explain PPP deviations. To this aim, I use a New Trade framework, combining increasing returns to scale and costly trade in traded good markets, that I enrich with a non-traded good sector to generate a Balassa-Samuelson effect. International trade costs lead to deviations from the LOP in the traded good sector. Moreover, in this setup, wages do not fully adjust to productivity shocks in the traded good sector. Last, location decisions also have an impact on the relative price index: *ceteris paribus*, the relative price of traded goods is lower, the higher the share of domestically produced goods, that do not incur any trade cost.

In this setup, the real exchange rate is altered by i) the cost-competitiveness of each location in the traded good sector, through the "Relative Cost of Producing" effect, ii) the double productivity ratio through the "Balassa-Samuelson" effect and iii) the location of firms through the "Variety Supply" effect. In general equilibrium, these determinants of real exchange rates are correlated, as productivity gains in the traded good sector lead firms to enter the traded good market, which itself affects the labor market equilibrium. Depending on several parameters, these "New Trade" effects can go either in the same or in the opposite direction as the Balassa-Samuelson effect. Last, the general equilibrium analysis highlights another structural determinant of the relative price level under endogenous location decisions. Indeed, changes in the relative size of countries, because they lead to a spatial re-allocation of the production of traded goods, have an effect on the relative price level.

ABSTRACT

This paper studies determinants of relative price levels in a New Trade framework. The model combines a Balassa-Samuelson mechanism, explaining Purchasing Power Parity (PPP) deviations in the non-traded good sector, and an endogenous location of firms leading to PPP deviations in the traded good sector. Calibrating the model with OECD data, I show that PPP deviations in the traded good sector can either lessen or strengthen the Balassa-Samuelson effect, depending on the share of traded goods in consumption. Moreover, in general equilibrium, the real exchange rate also depends on the relative size of countries, through the Home Market Effect.

JEL Classification: F1, F2, F4
Keywords: Long-Run Real Exchange Rate, PPP deviations, Balassa-Samuelson effect, Location decisions, New Trade Theory

LES CHOIX DE LOCALISATION DES FIRMES PEUVENT-ILS CONTREBALANCER L'EFFET BALASSA-SAMUELSON?

RÉSUMÉ

D'après Obstfeld & Rogoff (2000), les déviations à la Parité des Pouvoirs d'Achat (PPA) sont un des principaux "puzzles" caractérisant la Macroéconomie Ouverte moderne: malgré la forte intégration des marchés internationaux de biens et services, la corrélation des taux de change et des niveaux de prix reste faible et les taux de change réels s'écartent régulièrement de leur niveau de PPA. L'explication la plus classique de ce puzzle est décrite par le modèle Balassa-Samuelson qui explique les déviations à la PPA dans le secteur des biens non échangés par l'existence d'écarts de productivité entre pays et entre secteurs. Cependant, ce modèle ne permet pas d'expliquer les déviations observées à la Loi du Prix Unique (LPU) pour des biens échangés. Récemment, Ghironi & Melitz (2004) and Corsetti et al. (2005) ont expliqués de tels écarts de prix dans des secteurs exposés à la concurrence internationale dans des modèles inspirés des Nouvelles Théories du Commerce International. Ces articles montrent comment des gains de productivité peuvent affecter les décisions de localisation des firmes et, par là, les prix relatifs.

Cet article combine ces deux explications des déviations à la PPA dans un cadre unifié de façon à analyser comment, en équilibre général, ces déviations à la LPU dans les secteurs de biens exposés à la concurrence internationale et dans les secteurs de biens non échangés interagissent pour expliquer le puzzle de la PPA. Pour cela, on utilise un cadre d'analyse inspiré des Nouvelles Théories du Commerce, combinant des rendements croissants et un coût à l'échange international, et on l'enrichit d'un secteur de biens non échangés pour introduire un effet Balassa-Samuelson. Dans ce cadre, les coûts à l'échange international créent des déviations à la LPU pour des biens échangés. De plus, les salaires ne s'ajustent pas intégralement aux chocs de productivité affectant le secteur des biens échangés. Enfin, les choix de localisation des firmes affectent le niveau des prix relatifs puisque, toutes choses égales par ailleurs, le prix relatif dans le secteur des biens échangés augmente si la part des biens importés, qui supportent un coût de transport, augmente.

Dans ce cadre, le taux de change réel dépend i) de la compétitivité-coût relative des secteurs nationaux de biens échangés, ii) du double ratio des productivités à travers l'effet Balassa-Samuelson iii) et de la localisation des firmes. En équilibre général, ces déterminants sont corrélés puisque les gains de productivité dans le secteur des biens échangés conduisent un plus grand nombre de firmes à s'installer sur le marché bénéficiant du choc d'offre, et que la demande de travail de ces nouvelles firmes modifie l'équilibre du marché. En modifiant certains paramètres du modèle, on montre que ces effets de localisation peuvent soit renforcer, soit au contraire limiter l'effet Balassa-Samuelson. Enfin, l'analyse en équilibre général révèle un autre déterminant structurel du niveau des prix relatifs dans un cadre avec endogénéité des décisions de localisation des firmes. En effet, des changements de la taille relative des pays, en modifiant la répartition spatiale des firmes, affectent également le niveau des prix relatifs.

RÉSUMÉ COURT

Dans cet article, nous étudions les déterminants des prix relatifs dans un cadre d'analyse de la Nouvelle Théorie du Commerce. Le modèle mêle un effet Balassa-Samuelson, permettant d'expliquer les déviations à la Parité des Pouvoirs d'Achat (PPA) dans le secteur des biens non-échangés, et une répartition endogène des firmes dans l'espace conduisant à des déviations à la PPA dans le secteur exposé à la concurrence internationale. Lorsqu'on calibre ce modèle à partir de données de l'OCDE, on montre que les déviations à la PPA dans le secteur des biens échangeables peuvent soit renforcer, soit au contraire atténuer l'effet Balassa-Samuelson, la direction de cette interaction dépendant de la part des biens échangés dans la consommation. De plus, en équilibre général, on montre que le taux de change réel d'équilibre dépend de la productivité relative des pays mais aussi de leur taille relative, à travers un effet "Home Market".

Classification *JEL* : F1, F2, F4
Mots-clé : Taux de change réel d'équilibre, déviations à la PPA, effet Balassa-Samuelson, décisions de localisation, Nouvelle Théorie du Commerce

CAN FIRMS' LOCATION DECISIONS COUNTERACT THE BALASSA-SAMUELSON EFFECT ?[1]

Isabelle MEJEAN[2]

1 Introduction

According to Obstfeld & Rogoff (2000), the failure of the Purchasing Power Parity (PPP) relation is one of the main empirical "puzzles" in Open Macroeconomics: despite strong integration of good markets at the international level, the connection between exchange rates and national price levels is still weak and real exchange rates regularly deviate from their PPP level. Moreover, the persistence of PPP deviations is surprisingly high, thus suggesting that this phenomenon has a structural dimension.[3] Understanding the source of PPP deviations is a major source of concern for macro-economists, which has given rise to an abundant literature. Indeed, the way national price levels adjust to shocks has important implications for international spill-over effects of economic policy.

The most popular model of long-run deviations from PPP explains deviations from the Law of One Price (LOP) in the *non-traded good* sector by the so-called Balassa-Samuelson effect. But empirical evidence[4] also highlights PPP deviations in the *traded good* sector that the Balassa-Samuelson effect fails to explain. As a consequence, recent models have tried to rationalize the failure of the LOP for traded goods using models of trade under imperfect competition. In this paper, I put together both arguments and analyze how deviations from the LOP in traded *and* non-traded good sectors interact in general equilibrium. Indeed, as productivity shocks impact both the relative price of non-traded goods, through the Balassa-Samuelson effect, and the price of traded goods, through the endogenous distribution of firms across countries, it is of interest to study the interaction of these effects, that can either strengthen or mitigate each other.

The explanation of international price differentials popularized by Harrod (1933), Balassa (1964) and Samuelson (1964) lies in the existence of cross-country and cross-sector productivity differentials. In a perfectly competitive world where labor is immobile and some goods are not traded internationally, an increase in a country's relative productivity in the traded good sector leads to a wage adjustment that pushes the relative price of non-traded goods

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[3] Obstfeld & Rogoff (2000) refer to a "common consensus" for an half-life of real exchange rate innovations of three to four years. Such a persistence suggests that deviations from PPP must be accounted for by real factors.

[4] See Engel (1999) and Obstfeld & Rogoff (2000).

upward and appreciates its real exchange rate.[5] This Balassa-Samuelson effect has been revisited recently by Bergin, Glick & Taylor (2004), trying to explain the reinforcement of the phenomenon observed in the data over the last fifty years. In their model, this feature is explained by the endogeneity of the tradability of goods to productivity shocks: a positive shock leads the most productive firms of the non-traded good sector to start exporting their production so that the Balassa-Samuelson effect is magnified, as long as the distribution of productivity shocks is not uniform across all sectors.[6]

Because it relies on the assumption of PPP in the traded good sector, the Balassa-Samuelson effect is not appropriate to explain cross-country price differentials in the traded good sector, which are a major source of PPP deviations, according to Engel (1999). Recently, two papers by Ghironi & Melitz (2004) and Corsetti et al. (2005) have studied PPP deviations in the traded good sector using tools of the New Trade Theory. In both models, productivity gains in a given country influence firms' entry decisions in each national market. This affects relative price levels through two channels. First, as traded goods are imperfectly substitutable, location decisions influence the relative cost of producing the traded good. Moreover, the endogeneous supply of differentiated goods determines the intensity of competitive pressures in each market, which is ultimately reflected in price levels.[7] As far as the impact of a productivity shock is concerned, both models show that, under some specific parameter sets, these endogenous changes lead to a real depreciation in the country where a positive supply shock happens. This means that taking into account the endogeneity of entry decisions in each market should allow researchers to rationalize PPP deviations in the traded good sector. Moreover, as long as wage adjustements do not cancel the productivity shock impact, this mechanism is likely to mitigate the Balassa-Samuelson effect.

The objective in this paper is to combine these mechanisms in a single framework to compare their potential power in explaining PPP deviations. To keep things as simple as possible, the Balassa-Samuelson effect is generated exogenously, rather than through a complex structure of heterogeneously productive firms as in Bergin et al. (2004) or Ghironi & Melitz (2004): there are two unequally productive sectors in the economy, a traded and a non-traded good sector, and we investigate the impact of an idiosyncratic productivity shock in the traded good sector of the domestic country. As in the New Trade Literature, the traded good sector is featured by imperfect competition and endogenous entry decisions. Under costly trade, there are deviations from the LOP in this sector also. In this setup, we show that, by contrast with the Balassa-Samuelson model, wages do not fully adjust to productivity shocks in the traded good sector. Moreover, location decisions also have an impact on the relative price level because, *ceteris paribus*, domestically produced goods are cheaper than imported ones

[5] Note that the same kind of effect can be obtained by assuming cross-country differences in capital-labor ratios rather than productivity gaps. See Kravis & Lipsey (1983).

[6] Note, however, that this effect is reversed when the productivity shock hides all sectors homogeneously because marginal costs decrease.

[7] More precisely, in Ghironi & Melitz (2004), a positive aggregate productivity shock in the domestic market forces the less productive foreign exporters to leave the domestic market, which tends to reduce the price of imported goods. In Corsetti et al. (2005), some firms enter the market to benefit from the positive productivity shock, which reduces the general price level when consumers value diversity.

in the presence of international trade costs.

This framework allows us to ask for the determinants of real exchange rates in a Balassa-Samuelson framework where the distribution of firms is endogenous. In partial equilibrium, it can be shown that the real exchange rate is altered by i) the cost-competitiveness of each location in the traded good sector, through the "Relative Cost of Producing" effect, ii) the double productivity ratio through the "Balassa-Samuelson" effect and iii) the location of firms through the "Variety Supply" effect. As expected, these determinants interact in a non-trivial way to determine the relative price level. Calibrating the model with OECD data for the 1988-2003 period, we verify that the combination of the Variety Supply and the Relative Cost of Producing effects can either mitigate or strengthen the Balassa-Samuelson effect.

Going further in the analysis by accounting the endogeneity of wages and location decisions allows us to explain this ambiguity. Indeed, these determinants of real exchange rates are then correlated, as productivity gains in the traded good sector lead firms to enter the traded good market, which itself affects the labor market equilibrium. Depending on several parameters, notably the share of traded goods in consumption, these "New Trade" effects can go either in the same or in the opposite direction as the Balassa-Samuelson effect. In particular, when the intensity of the Balassa-Samuelson effect is weak (because the country consumes a majority of traded goods), whereas the spatial distribution of firms is highly sensitive to productivity gaps, the Variety Supply effect can more than compensate the Balassa-Samuelson effect. In this case, an increase in the country's relative productivity in the traded good sector leads to a real depreciation. Last, the general equilibrium analysis highlights another structural determinant of the relative price level under endogenous location decisions. Indeed, changes in the relative size of countries, because they lead to a spatial re-allocation of the production of traded goods, have an effect on the relative price level, the direction of which is, however, ambiguous. If the share of traded goods in consumption is large (higher than one half), the entry of firms into the growing market leads to a real depreciation because local consumers benefit from trade costs savings when goods are domestically produced. However, this effect is reversed for a low share of traded goods in consumption due to a dominating, positive wage adjustment attributable to labor demand increase.[8]

The rest of the paper is organized as follows. Section 2 describes the theoretical framework used to compare the Balassa-Samuelson, the Relative Cost of Producing and the Variety Supply determinants of long-run real exchange rates. These determinants are then studied in Section 3, first in partial equilibrium, then in general equilibrium. Section 4 concludes.

2 Theoretical Framework

The general framework used in the following is largely based on Baldwin, Forslid, Martin, Ottaviano & Robert-Nicoud (2005)'s "Footloose Capital Model".[9] It is a static model with

[8] MacDonald & Ricci (n.d.) also note that the reaction of real exchange rates to shocks can be sensitive to the structure of preferences between traded and non-traded goods.

[9] This model has been chosen because of its analytical tractability in comparison with New Economic Geography models where endogenous demand externality leads to a circular causality between the

two countries (home H and foreign F), two productive factors (labor L and physical capital K) and two sectors, respectively producing a differentiated good T and a homogeneous good N.
As in the Footloose Capital model, an exogenous asymmetry in endowments is introduced, that leads to regional inequality in equilibrium as long as factor owners are not allowed to move across countries. Namely, world stocks of labor (L_W) and capital (K_W) are shared in proportions θ and $(1-\theta)$ between households from H and F. In the following, θ is supposed larger than one half so that the home country is larger than the foreign one. Despite this simplifying exogeneity assumption however, international capital flows are not ignored by the model. Indeed, whereas capital *owners* are not allowed to move across countries, these capital units can be *integrated in the production* of any country, which creates capital flows that remunerate domestic capital owners.
In each country, households offer these factorial endowments in a perfectly elastic way. Labor is immobile across countries but perfectly mobile across sectors. Domestic (foreign) firms of both sectors thus compete to share the domestic (foreign) labor stock. As a result, the labor market equilibrium determines a single nominal wage rate by country ($W_c,\ c = H, F$). Despite these uniform national wage rates, however, cross-sectoral and cross-country productivity differentials lead to labor cost differentials across sectors.
Contrasting with labor, capital is perfectly mobile across countries so that the (endogenous) share of capital employed in each country does not necessarily match the (exogenous) share of capital owners living there. Namely, capital owners from both countries sell their endowments on an integrated world market against the equilibrium unit price R. These endowments are then rented by firms located either in H or in F.

2.1 Preferences

Assume that, in each country, a representative consumer collects labor and capital incomes. With this income, the representative consumer buys goods according to the following consumption function:

$$C_c = T_c^{\mu} N_c^{1-\mu},\ c = H, F \tag{1}$$

μ is the share of differentiated goods in the total consumption expenditure,[10] N_c is the consumption of non-traded goods by the representative consumer in country c and T_c is her consumption basket of all existing varieties of the traded good. Assuming a constant elasticity of substitution between varieties ($\sigma > 1$), T_c can be written in a Dixit-Stiglitz form as:

$$T_c = \left(\int_0^{n_W} x_c(s)^{\frac{\sigma-1}{\sigma}} ds \right)^{\frac{\sigma}{\sigma-1}}$$

distribution of demand and the location of production. However, as nominal wages are not assumed to equalize across countries in equilibrium (contrasting with wages of the Footloose Capital model), the distribution of demand is endogenous to firms' location decisions in this model also.

[10] In the following, the share of traded goods in the consumption is assumed to be the same everywhere. However, when solving the model numerically, it will be interesting to allow for preferences to differ in H and F ($\mu_H \neq \mu_F$).

with $x_c(s)$ c's consumption of the variety s, and n_W the number of varieties produced at the world level.
In each country, labor and capital supplies (L_c^s and K_c^s) are exogenous. The consumer thus maximizes her consumption (1) under her budget constraint:

$$\int_0^{n_W} p_c(s)x_c(s)ds + P_c^N N_c \quad \leq \quad W_c L_c^s + R\ K_c^s + \Pi_c \equiv E_c$$

with :

- $p_c(s)$ the price of the variety s in country c,
- P_c^N the price of non-traded goods in country c,
- $W_c L_c^s$ and $R\ K_c^s$ the labor and capital incomes paid to factor owners in c,
- Π_c the residual profit, equal to zero in the free-entry equilibrium,
- E_c the consumer's total income, equal to her consumption expenditure in this static framework.

Solving this problem leads to the optimal demands for each type of goods, as a function of income and prices:

$$N_c = (1-\mu)\frac{E_c}{P_c^N} \quad (2)$$

$$T_c = \mu\frac{E_c}{P_c^T} \quad (3)$$

$$x_c(s) = \left(\frac{p_c(s)}{P_c^T}\right)^{-\sigma} T_c \quad (4)$$

$$c = H,\ F$$

where P_c^T is the consumption-maximizing price index for traded goods in country c :

$$P_c^T = \left[\int_0^{n_W} p_c(s)^{1-\sigma} ds\right]^{\frac{1}{1-\sigma}}$$

2.2 Technology

The sector N features constant returns to scale and perfect competition and produces a homogeneous good that is not traded in equilibrium (because of a prohibitive trade cost).[11] Labor

[11]Today, most of the goods which are not traded internationally are services. It could be argued that these goods are highly differentiated thus casting doubt on the assumptions of homogeneity and perfect competition. However, these assumptions make the analytical resolution easier. Moreover, as we are interested in the price impact of exporting firms' location decisions, assuming increasing returns in the

is the only input in the linear production function. The equilibrium price is then equal to the marginal cost of producing:

$$P_c^N = \frac{W_c}{A_c^N},\ c = H, F \tag{5}$$

with A_c^N the labor productivity in the sector N of country c.

As in the Footloose Capital model, the technology in the traded good sector exhibits increasing returns to scale. The total cost of producing the variety s is separated into a fixed cost of f capital units and a linear cost in labor.[12] Finally, international trade of differentiated goods involves a "iceberg" cost $\tau(>1)$: to sell one unit abroad, the individual firm has to produce τ units because of a real loss occurring during transportation.
In such a framework, a firm located in c that produces a variety s generates the following profit:

$$\Pi_c(s) = p_{cc}(s)x_c(s) + p_{cc'}(s)x_{c'}(s) - \frac{W_c}{A_c^T}\left[x_c(s) + \tau x_{c'}(s)\right] - R\, f, \quad c \neq c'$$

where A_c^T is the labor productivity in the sector T of country c, $p_{cc}(s)$ and $p_{cc'}(s)$ are the chosen prices, for respective sales in the domestic and foreign markets.
Maximizing profit with the demand functions (4) leads to the optimal prices set by an individual firm from c:

$$p_{cc}(s) = \frac{\sigma}{\sigma-1}\frac{W_c}{A_c^T} \tag{6}$$

$$p_{cc'}(s) = \frac{\sigma}{\sigma-1}\frac{W_c}{A_c^T}\,\tau \tag{7}$$

$$c = H,\ F \quad c \neq c'$$

Thus, firms optimally discriminate their domestic and foreign markets by passing the transport cost on to the foreign consumer. This price gap is at the root of the "Home Market Effect"(HME hereafter), that pushes firms under increasing returns to locate in the largest market to benefit from maximum scale economies where they are more competitive.

non-traded good sector would not add anything to this analysis. It could be argued, also, that some non-traded goods, like professional services, are embodied in traded goods. Taking it into account would be of great interest because the existence of non-trade inputs modifies the intensity of the Balassa-Samuelson effect, as well as the price impact of location decisions. This is however left for future research.

[12]The fixed cost is supposed to be large enough to ensure that, in equilibrium, each firm produces its own variety in a given location. This implies that the number of existing firms in equilibrium is equal to the number of produced varieties (n_W). Indeed, with CES preferences, the market share when producing a new variety is always higher than the market share that would be obtained by duplicating an existing one. See Dixit & Stiglitz (1977).

As firms in a given location are homogeneous[13], the index s can be dropped in the following. Denoting λ the (endogenous) share of firms located in H and $\phi = \tau^{1-\sigma}$ the "freeness" of trade[14], price indices in the traded good sector can be rewritten as:

$$P_H^T = \frac{\sigma}{\sigma-1}\left[\lambda n_W \left(\frac{W_H}{A_H^T}\right)^{1-\sigma} + (1-\lambda) n_W \phi \left(\frac{W_F}{A_F^T}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \tag{8}$$

$$P_F^T = \frac{\sigma}{\sigma-1}\left[\lambda n_W \phi \left(\frac{W_H}{A_H^T}\right)^{1-\sigma} + (1-\lambda) n_W \left(\frac{W_F}{A_F^T}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \tag{9}$$

These price indices are not symmetric because of the presence of trade costs (ϕ) which increase the price of imported goods: the higher the trade barriers (i.e. the lower the parameter ϕ), the higher the price index for traded goods, especially if the share of imports in consumption is large. Thus, in this model as in Ghironi & Melitz (2004) or Corsetti et al. (2005), there is no purchasing power parity in the traded good sector and the relative price of traded goods is influenced by two endogenous variables :

- the spatial distribution of firms (λ) that determines the share of imported goods in each country (i.e. the share of traded goods incurring a trade cost),
- the relative cost of producing the differentiated good ($\rho = \frac{W_H/A_H^T}{W_F/A_F^T}$) which determines the relative competitiveness of domestically produced and foreign traded goods.

2.3 Free Entry and Firms' Location

In the long run, firms are free to enter a national market. This drives profits towards zero in equilibrium. For an individual firm, which sells its products at the optimal prices (6) and (7), the zero profit condition implies (respectively for firms located in H and in F):

$$Rf = \frac{1}{\sigma-1}\frac{W_H}{A_H^T} y_H \tag{10}$$

$$Rf = \frac{1}{\sigma-1}\frac{W_F}{A_F^T} y_F \tag{11}$$

with y_c the equilibrium production of an individual firm located in c, including trade costs:

$$y_c = x_c + \tau x_{c'}, \quad c = H, F, \quad c \neq c'$$

[13]Indeed, productivity gaps are supposed here to be country- rather than firm-specific, as in Ghironi & Melitz (2004).

[14]This term has been taken from Baldwin et al. (2005). The "freeness" of trade is inversely related to the magnitude of trade barriers that trade costs create. Of course, it depends on the size of trade costs, as higher trade costs make international trade more difficult. But the freeness of trade also depends on the substitutability among traded goods. Indeed, when goods become more substitutable (when σ increases), trade costs are a stronger barrier to trade as consumers can substitute domestically produced to imported varieties.

At this point, three situations must be distinguished with regard to the spatial distribution of firms in equilibrium:

- two corner equilibria with a total concentration of the production of traded goods, either in H ($\lambda = 1$ and (10) applies), or in F ($\lambda = 0$ and (11) applies),
- an interior equilibrium where some traded goods are produced in each country ($\lambda \in]0, 1[$). In that case, λ is jointly determined by (10) and (11), with y_H and y_F determined by the demand functions (4).

In the interior equilibrium, long-run operational profits are equalized across countries, at a level that just covers the fixed cost Rf. Using the expressions for profits (10) and (11) and demands (4), one obtains the distribution of firms:

$$\lambda = \frac{s_E}{1 - \phi\rho^{1-\sigma}} - \frac{1 - s_E}{\phi^{-1}\rho^{1-\sigma} - 1} \tag{12}$$

where:

- ρ is the relative cost of producing the traded good: $\rho = \frac{W_H/A_H^T}{W_F/A_F^T}$
- and s_E is H's share in world expenditures: $s_E = \frac{E_H}{E_H + E_F}$

From this, it can be shown that, in an interior equilibrium, the higher H's relative demand and the lower its relative cost of producing, the higher the concentration of firms in the country H. In this model, then, two types of comparative advantage emerge:

- an advantage in terms of demand, linked to the Home Market Effect, which makes the "large" country specialize in the production of differentiated goods,
- a ricardian comparative advantage, that pushes the country with a high unit labor cost to specialize in capital exports and import the differentiated good.

The spatial equilibrium, thus the relative price of traded goods, is determined by the interaction between these comparative advantages.

The location condition (12) is only valid in the interior equilibrium, i.e. when $\lambda \in]0; 1[$. As shown in the Appendix, this implies the following restriction:

$$\frac{1}{\phi s_E + \phi^{-1}(1 - s_E)} < \rho^{\sigma-1} < \phi^{-1}s_E + \phi(1 - s_E)$$

The interior equilibrium is thus only sustainable for a small enough wage gap. Outside this interval, firms are all located in the low-cost country, production in the other one being unprofitable. In this case, one country is entirely specialized in capital exports and produces solely non-traded goods, whereas the other one produces its consumption of non-traded goods and the world demand of traded goods but pays net capital income to the high wage country. In such a corner equilibrium, the relative price of traded goods only depends on trade costs.[15]

[15] If the traded good is entirely produced in country H ($\lambda = 1$), the relative price of traded goods is: $P_H^T/P_F^T = 1/\tau$

Having characterized production patterns, the next step consists in endogenizing the relative cost of producing (ρ) and H's relative demand (s_E), which both depend on the spatial distribution of firms (λ).

2.4 Market equilibrium, national incomes and the relative wage

In equilibrium, all markets clear. Moreover, in the long-run, firms can move across countries and both λ and n_W are endogenous. The total number of firms (and produced varieties) in the traded good sector is obtained from the world capital market equilibrium:

$$n_W = \frac{K_W}{f}$$

Moreover, under the zero-profit conditions (10) and (11), the equilibrium price of capital is:

$$R = \frac{\mu}{\sigma}\frac{E_H + E_F}{K_W}$$

In each country, the labor market equilibrium implies:

$$W_H \theta L_W = \lambda n_W(\sigma - 1)Rf + (1-\mu)E_H \tag{13}$$

$$W_F(1-\theta)L_W = (1-\lambda)n_W(\sigma - 1)Rf + (1-\mu)E_F \tag{14}$$

These equilibrium conditions yield the distribution of world expenditure, which only depends on the location of firms:

$$s_E \equiv \frac{E_H}{E_H + E_F} = \frac{\lambda(\sigma-1)+\theta}{\sigma} \tag{15}$$

The more firms are concentrated in H, the more local workers benefit from the monopolistic rent of the traded good sector and the higher is H's share in the world demand.[16]

Last, using (13) and (14) as well as the equilibrium price of capital, one obtains the equilibrium relative labor cost in the traded good sector:

$$\rho \equiv \frac{W_H}{W_F}\frac{A_F^T}{A_H^T} = \frac{1-\theta}{\theta}\frac{A_F^T}{A_H^T}\frac{\lambda(\sigma-1)+\theta(1-\mu)}{(1-\lambda)(\sigma-1)+(1-\theta)(1-\mu)} \tag{16}$$

This relation defines ρ as an increasing function of λ. Indeed, the concentration of firms in H exerts pressures on its relative wage. In comparison with the Footloose Capital Model, this wage adjustment plays as a centripetal force that counterbalances the Home Market Effect, thus explaining why, for reasonable parameter values, the final outcome is always an interior equilibrium.[17]

Together (12), (15) and (16) form a system of 3 equations in 3 unknowns $\{\lambda,\ \rho,\ s_E\}$, that characterizes the long-run interior equilibrium. Because of the non-linearity of these equations, one has to rely on numerical simulations to solve this system and infer the determinants of real exchange rates.

[16] This effect only plays through workers' income. Indeed, as the capital market is perfectly integrated, the monopolistic rent paid to capital owners from each country is strictly proportional to relative endowments.

[17] This is in sharp contrast with the Footloose Capital model in which the interior equilibrium only

3 Determinants of the Real Exchange Rate

3.1 Partial Equilibrium Analysis

In this framework, the long-run real exchange rate, defined as the relative price of home consumption goods, can be written as:[18]

$$RER \equiv \frac{P_H}{P_F} = \left(\frac{P_H^T}{P_F^T}\right)^{\mu} \left(\frac{P_H^N}{P_F^N}\right)^{1-\mu}$$

Denoting $BS = \frac{A_H^T/A_H^N}{A_F^T/A_F^N}$ the double productivity ratio, and using the optimal prices (5), (6) and (7), we find, in partial equilibrium:

$$RER = \left(\frac{\lambda\rho^{1-\sigma} + (1-\lambda)\phi}{\lambda\phi\rho^{1-\sigma} + (1-\lambda)}\right)^{\frac{\mu}{1-\sigma}} (\rho\ BS)^{1-\mu} \tag{17}$$

This relation highlights the real exchange rate determinants discussed in the introduction. First, because of the Balassa-Samuelson effect, the higher H's relative productivity in the traded good sector, the higher the real exchange rate ($\partial RER/\partial BS > 0$). Secondly, a higher concentration of firms in H ($d\lambda > 0$) implies a purchasing power gain for the local representative household ($\partial RER/\partial\lambda < 0$). Indeed, the entry of firms allows her to consume a higher share of domestically produced goods and she saves on trade costs. Finally, RER is also increasing in the relative cost of producing the traded good ($\partial RER/\partial\rho > 0$), through the relative price of both traded and non-traded goods.[19]

In general equilibrium, these determinants of real exchange rates are likely to interact as both λ and ρ are affected by sectoral productivity shocks (see equations (12) and (16)). Before tackling general equilibrium results, however, a first insight about the likely direction of this interaction can be obtained by simulating the partial equilibrium relation (17) using real data on BS, λ and ρ. From this, the theoretical response of long-run real exchange rates to changes in each of these parameters can be computed. This allows us to infer on the total reaction of real exchange rates to country-specific simultaneous changes in BS, λ and ρ. To this end, the country-specific path of relative productivity gains (g_{BS} in the following), relative producing costs in the traded good sector (g_ρ and changes in the spatial distribution of produced traded

exists for similar enough countries (in terms of their size). Indeed, in the Footloose Capital model, the concentration of differentiated firms in a given country does not push up the national wage since their production substitutes itself to the production of homogeneous goods to keep the current account balanced. In our model, on the contrary, the centrifugal impact created by a high national demand is counteracted by a wage adjustment, which limits the Home Market Effect.

[18]Note that, with this definition of the real exchange rate, an increase in RER corresponds to a real appreciation in H.

[19]The influence of the relative cost of producing (i.e. of the relative wage and the relative productivity) on the relative price of traded goods is consistent with Zachariadis (2005) who uses a micro-level dataset of absolute prices and finds evidence that productivity affects deviations from the Law of One Price in traded good markets.

goods (g_λ) are calibrated using OECD data for the 1988-2002 period, then applied to (17) to conclude on the theoretical path of the country's real exchange rate (g_{RER}).[20]
All details concerning data sources, the construction of variables and the method used are provided in the Appendix. Each OECD country is considered successively as country H against the others and the theoretical response of its effective real exchange rate to the following factors is calculated:

- the observed mean annual growth of its relative productivity in the traded versus non-traded good sector ($\bar{g}^{BS}$)
- average annual changes in the share of traded goods produced domestically ($\bar{g}^{\lambda}$)
- the observed mean annual growth of the relative cost of producing the traded good ($\bar{g}^{\rho}$)

This simulation exercise uses a growth equivalent of (17) where μ is country-specific.[21] Moreover, each country is compared to the rest of the sample so that results obtained in our 2-country framework can be used. To this aim, the "rest of the world" is obtained by aggregating data relative to the considered country's partners, using trade-weighted averages.[22] This relation makes it possible to evaluate the expected response of the real exchange rate when BS, λ and ρ vary at the observed rate of growth. This analysis is done *ceteris paribus*, i.e. all other real exchange rate determinants being fixed at their beginning-of-period value, and for arbitrarily chosen parameters.[23]
The simulation results are summarized in Table 1. For each country of the sample, the column named "BS effect" reports the predicted annual growth rate of the real effective exchange rate attributed to the observed evolution of its relative productivity in the traded versus non-traded good sector ($\bar{g}^{BS}$).[24] Similarly, the "VS effect" column gives the theoretical annual growth

[20]Note that I do not try here to conduct an empirical analysis but content myself with a simulation exercise. Indeed, several difficulties make the conduct of an empirical test of my model tricky: its non-linearity, which makes a separate identification of each effect difficult; its long-run nature, which calls for a cointegration analysis based on a richer model; and measurement problems for real exchange-rate series that take into account the entry of new firms in the market during the estimation period (see Ghironi & Melitz (2004) and Corsetti et al., 2005).

[21]In this simulation exercise, a growth relation is used because labor productivity series provided by the OECD are indices. Moreover, the assumption of identical preferences across countries is unrealistic, as shown in Figure 5 which gives measures of μ for each of the considered countries. The final calibrated equations are given in Appendix A.2.5.

[22]As shown by Behrens, Lamorgese, Ottaviano & Tabuchi (2004), in a multi-country world, the Home Market Effect is complicated by the presence of "third-country" effects affecting the location of firms. However, it can be argued that trade patterns ultimately reflect the spatial distribution of firms. As a consequence, using a weighting scheme based on trade relations allows to account for the multiplicity of bilateral relations in a multi-country world.

[23]Namely, the elasticity of substitution (σ) is supposed to be equal to five and the iceberg cost is set at 1.25, these values being taken from Venables (1996). The results are somewhat sensitive to this choice, as shown in paragraph 3.2.

[24]Recall that, with our definition of real exchange rates, a positive value means that, on average, the country's real exchange rate is appreciating.

rate of real exchange rates attributable to observed changes in the distribution of the production of traded goods ($\bar{g}^{\lambda}$). Last, the "RCP effect" column is the predicted annual growth rate of real exchange rates due to labor cost differentials in the traded good sector. The fourth column, which sums up the previous three, thus corresponds to the theoretical real exchange rate appreciation (or depreciation if negative) attributed by the model to the combination of the Balassa-Samuelson, the Variety Supply and the Relative Cost of Producing effects.[25]

As expected, the model reproduces a strong positive Balassa-Samuelson effect in emerging countries like Poland, Korea or Hungary, attributable to strong productivity gains in their traded good sector. The BS effect is also strongly positive in the United States but this is because of the high share of non-traded goods in this country's consumption that magnifies moderate productivity gains. The strongest effect is obtained for Poland and implies a real exchange rate appreciation of more than 4% per year. As for the Variety Supply effect, its simulated magnitude is on average lower than that of the BS effect. The strongest effect is obtained for Hungary, whose productive expansion in the traded good sector allows us to explain an annual depreciation of its long-run real exchange rate of around 0.6% per year. Finally, the Relative Cost of Producing effect is large in countries where wage adjustments exceed productivity gains in the traded good sector (as in Spain, Hungary, Poland and, above all, Mexico), leading to a real appreciation, or, in the opposite situation where wages rise more slowly than productivity (as in Austria, Denmark, Finland and the United States), thus pushing relative prices downward.

In eight countries[26], both the Variety Supply and the Relative Cost of Producing effects play in the opposite direction to the Balassa-Samuelson effect: either the country's relative productivity in the traded good sector vanishes whereas wages only partially adjust, in which case traded good producers have an incentive to leave the domestic market (as in Australia), or on the contrary, the country's relative productivity increases whereas its cost competitiveness improves, explaining the growth of its production of traded goods (as in Austria). Under this configuration, neglecting PPP deviations in the traded good sector would lead to an underestimation of the Balassa-Samuelson effect, if these effects are correlated, as suggested by the model. For three countries, the model suggests that the Balassa-Samuelson, the Variety Supply and the Relative Cost of Producing effects reinforce each other: in Germany, the three effects tend to appreciate the real exchange rate whereas the opposite is true in New Zealand and Norway. In these countries, productivity gains are more than compensated for by wage adjustments, thus deterring firms from entering the "productive" countries. As a consequence, neglecting PPP deviations in the traded good sector would lead to overestimate the

[25]Of course, this theoretical effect does not exactly match the true movements in real exchange rates provided in the second column of Table 4. Indeed, this model solely focuses on the effect of trade on long-run real exchange rates, thus neglecting numerous other medium-run determinants, working through monetary or financial markets. For instance, the model underestimates the true real appreciation in East and Central European countries (Czech Republic, Hungary and Poland), as this appreciation is partly due to capital inflows, motivated by reasons that the model ignores: investors' optimism with regards to these countries' integration to the world economy, financing of privatization by foreign funds, undervaluation of their money at the beginning of the period, etc.

[26]Australia, Austria, Belgium, Canada, Denmark, Finland, Korea and New Zealand.

true Balassa-Samuelson effect. In the remaining countries, the direction of the omission bias when testing the textbook version of the Balassa-Samuelson effect is difficult to anticipate because the Variety Supply effect and the Relative Cost of Producing effect play in opposite directions.[27] However, one can still suspect the presence of an omission bias in standard estimations of the Balassa-Samuelson effect.

This partial equilibrium analysis thus allows us to contrast the main determinants of real exchange rates introduced in this model. It shows that the interaction between these three effects is a complicated phenomenon that can have various implications for the real exchange rate. However, it is obviously insufficient, as location decisions, which determine λ and ρ, have not been taken into account. In the following, then, we use numerical simulations to study the structural determinants of the real exchange rate in general equilibrium, with a particular focus on the relative productivity in the traded vs. non-traded good sector (that generates the BS effect) and the relative size of countries (which influences the location of firms in our framework).

3.2 Structural determinants of the real exchange rate

To identify the role of the relative size of countries and the relative productivity in the traded good sector, the equilibrium real exchange rate is computed using the general equilibrium solution, obtained from (12), (15), (16) and (17), for different values of θ between 0.5 (symmetric countries) and 1 (strong size asymmetry) and when $RelA^T = A_H^T/A_F^T$ varies between 0.2 and 5.[28] Each of these computations is conducted for different values of i) the transport cost τ, set between 1.05 and 1.45 so as to cover estimates obtained by Hummels (2001), ii) the elasticity of substitution, fixed between 3 and 7 as in Venables (1996), iii) the share of traded goods in consumption.[29]

3.2.1 Productivity gap and the real exchange rate

The theoretical link between the equilibrium real exchange rate and H's relative productivity in the traded good sector is illustrated in Figure 1, for different parameters μ. Moreover, Table 2 gives the simulated magnitude of this effect, measured by the elasticity of the real exchange rate to a one percent change in H's relative productivity, for several parameter sets.[30]

[27] The direction of the bias could be inferred by comparing the relative magnitude of effects in columns 2 and 3 of Table 1. However, I consider these figures as purely indicative as they are sensitive to the chosen parameters and to my definition of productivity which is entirely based on labor productivity. As a consequence, I only trust the direction of the figures in Table 1.

[28] Here we focus on productivity gains in the traded good sector, because they are much higher than productivity gains in the non-traded good sector. See Figure 6.

[29] To replicate the multiplicity of situations among OECD countries illustrated in Figure 5, this parameter is allowed to vary between 0.1 and 0.9.

[30] When the relation is not linear, the table gives the interval in which the elasticity varies for $RelA^T$ between 0.2 and 5.

As already explained, the real exchange rate appreciates when H's relative productivity in the traded good sector increases because of a wage adjustment. As in a standard Balassa-Samuelson model, the strength of this effect is positively related to the share of non-traded goods in consumption (Figure 1). Moreover, as H's relative productivity in the traded good sector enters location decisions, the intensity of this effect slightly varies with location determinants, notably H's relative size θ and trade costs τ (see Table 2). For some specific parameter sets, the Variety Supply effect is even strong enough to entirely compensate the Balassa-Samuelson effect, in which case the real exchange rate decreases when H's relative productivity in the traded good sector increases. This situation occurs when the intensity of the Balassa-Samuelson effect is weak (because the share of traded goods in consumption is important) whereas the elasticity of λ to $RelA^T$ is high, either because the size asymmetry is moderate (small θ), or because trade costs are high.[31] and thus the intensity of the Balassa-Samuelson effect is weak, it this Figure 2 illustrates the reaction of λ, ρ and RER in such a configuration.

Though modelling such a strong variety supply effect requires a very specific calibration, this highlights the importance of taking into account the impact of firms' location decisions when testing the Balassa-Samuelson hypothesis. Indeed, the correlation between both effects is a potential source of omission bias. With the parameters chosen in Table 2, the location effects are, however, quantitatively small and the model globally reproduces the standard Balassa-Samuelson mechanism: a 1% improvement in H's relative productivity in the traded good sector leads to a real appreciation of around $(1-\mu)\%$.

3.2.2 Relative Size and the real exchange rate

We now turn to the influence of the relative size of countries on real exchange rates. To this aim, we make θ vary between 0.5 and 1, thus increasing the firms' incentive to enter H through the Home Market Effect. The results concerning the sensitivity of the real exchange rate to this parameter are summarized in Figures 3, 4 and Table 3.

As illustrated in Figure 3, the direction of the induced exchange-rate effect depends on the share of traded goods in price levels. When the share of traded goods is large enough ($\mu > 0.5$), the size effect is negative: the more firms are concentrated in H to benefit from a large local demand, the lower is H's relative price level. This is due to the fact that local consumers save on trade costs when substituting local products for imported ones. On the other hand, when the consumption of non-traded good is high, this trade cost saving is more than compensated for by the pressure that the strong labor demand exerts on H's relative wage. As a consequence, when $\mu < 0.5$, H's relative price level increases with H's share in world factor endowments.

Because the influence of θ on the real exchange rate comes from the endogenous distribution

[31] To illustrate this situation, one can think of the relative price level of Belgium and the Netherlands: both countries consume a relatively high share of traded goods (see Table 4) and give firms an access to the same market (the European Union). As a consequence, firms should be especially sensitive to the relative cost competitiveness of Belgian and Dutch locations and the Variety Supply effect should be strong.

of firms (λ), any factor affecting location decisions modifies the intensity of this link. Thus, the magnitude of this effect depends on the size of trade frictions because high trade costs make market access more crucial, from the firm's viewpoint. As a consequence, the size effect is reinforced by a rise in trade costs (see Figure **??**). In the same way, the intensity of this effect is affected by the substitutability between varieties: it is increasing with the elasticity of substitution between goods. Indeed, when the demand is little sensitive to price changes, the agglomeration effect that pushes firms to locate near the largest demand is strong, as shown by Baldwin et al. (2005).
The quantitative importance of the size effect is measured in Table 3 through the elasticity of RER to θ, for different sets of parameters. This sensitivity increases when countries become more asymmetric. Moreover, the real exchange rate is more sensitive to the relative size of countries as i) preferences between traded and non-traded goods are more biased towards one sector (very high or very low μ) , ii) trade costs are higher, iii) H's relative productivity in the traded good sector is lower, iv) the elasticity of substitution between varieties of the traded good is higher. Depending on the entire set of parameters, the simulated elasticity of the real exchange rate to the relative size of countries varies between -0.85 and 1.04. Compared with the elasticity of RER to the Balassa-Samuelson determinant, this implies that, at least in fast growing countries, the Home Market effect is likely to be an important determinant of real exchange rates.

Comparing the results of these two sets of simulations thus highlights a rich variety of situations. Changing a small number of parameters in a realistic scale, one is indeed able to contrast situations where i) the structural Balassa-Samuelson and Home Market effects reinforce each other or play in opposite directions, ii) the Balassa-Samuelson effect dominates or is dominated by the Home Market effect. In particular, when the share of traded goods in consumption is low ($\mu < 0.5$), one can expect the Balassa-Samuelson effect to be strong, and reinforced by a size effect if the country that gains productivity in the traded good sector also increases its size. A good illustration of this case could be observed in the United States where productivity gains in the traded good sector are relatively high whereas its size attract more and more firms willing to serve this large market. On the other hand, in countries consuming many imported goods, the Balassa-Samuelson effect should be somewhat compensated for by the Home Market Effect. This should be the case in the new members states of the European Union which market potential has strongly increased after joining the EU.

4 Conclusion

By combining traditional aspects of the real exchange rate modelization with assumptions of the New Trade Theory, this paper contrasts two determinants of PPP deviations working through the price of traded and non-traded goods. First, as in a standard Harrod-Balassa-Samuelson model, exogenous cross-sectoral productivity differentials generate price gaps in the non-traded good sector: the higher relative productivity gap between the traded and the non-traded good sector, the more appreciated is the real exchange rate. At the same time, New Trade assumptions lead to a relation between location decisions and relative price levels. Indeed, when trade costs are passed on to import prices, an entry of firms into the local market benefits the local consumer who buys a higher share of domestically produced goods and saves on trade costs. Last, this entry of firms leads to a wage adjustment that can exceed or less than compensate the productivity shock.

Calibrating the model with OECD data shows that standard tests of the Balassa-Samuelson hypothesis may be biased by the omission of a control for location decisions. The direction of the bias, however, depends on general equilibrium effects: if the productivity shock is more than compensated for by wage adjustments, firms have no incentive to enter the country, the real exchange rate of which appreciates. However, if wages adjust less than proportionally, firms find it profitable to enter the productive market, which tends to depreciate the real exchange rate. In this case, the entry of firms mitigates the Balassa-Samuelson effect.

Solving the model in general equilibrium highlights the structural determinants underlying these effects. As expected, a country's real exchange rate increases with its relative productivity in the traded good sector. This Balassa-Samuelson effect is, however, mitigated by the impact of productivity shocks on location decisions. However, relative price levels also depend on the relative size of countries, an important determinant of location decisions under the Home Market Effect. The direction of this effect is, however, ambiguous, as it depends on the structure of preferences. When the share of traded goods in consumption is large enough, a size increase leads to a real depreciation because firms enter the market and the consumer reduces her consumption of imported goods, which incur a trade cost. However, when a large share of consumption goods is not traded in equilibrium, the pressure that the entry of firms exerts on wages leads to a dominant cost effect, affecting both traded and non-traded goods. This effect more than compensates for the positive effect linked to the trade cost saving. In this case, the real exchange rate appreciates when a country becomes larger.

These results are interesting for several reasons. First, they show that using results of the New Trade Theory can be highly instructive for macroeconomists. Indeed, whereas the impact of location decisions on trade flows has been extensively analyzed, their influence on global variables, such as price levels, has not been much studied. Yet, this simple model emphasizes some structural determinants of long-run real exchange rates that are neglected in neo-classical frameworks. As the New Trade Theory has received strong empirical support, such an approach could be useful to understand some Open Macroeconomic empirical "puzzles" , such as the PPP puzzle. From an applied perspective, the results suggest that neglecting the impact of firms' location decisions when estimating long-run real exchange rates can lead to biased estimates of the Balassa-Samuelson effect. On this point, however, the empirical difficulty discussed by Ghironi & Melitz (2004) or Corsetti et al. (2005) persists. Indeed, measuring real exchange rates using consumer price indices leads to underestimate changes in the supply of differentiated goods available in each country. This introduces a measurement bias that could be embarrassing when trying to identify the impact of location decisions on relative price levels.

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A.1. Productive patterns in partial equilibrium

The geographical distribution of firms in the interior equilibrium is determined by equalizing operational profits, at the previously determined optimal prices and individual demands :

$$\begin{aligned}
\frac{1}{\sigma-1}\frac{W_H}{A_H^T}(x_H+\tau x_F) &= \frac{1}{\sigma-1}\frac{W_F}{A_F^T}(x_F+\tau x_H) \\
\Rightarrow \frac{s_E}{\Delta_H}(\rho^{1-\sigma}-\phi) &= \frac{1-s_E}{\Delta_F}(1-\phi\rho^{1-\sigma}) \\
\Leftrightarrow \lambda = \frac{s_E}{1-\phi\rho^{1-\sigma}} &- \frac{1-s_E}{\phi^{-1}\rho^{1-\sigma}-1}
\end{aligned}$$

with $\rho = \frac{W_H/A_H^T}{W_F/A_F^T}$ the relative cost of producing the traded good, $\Delta_H = \lambda\rho^{1-\sigma}+(1-\lambda)\phi$ and $\Delta_F = \lambda\phi\rho^{1-\sigma}+(1-\lambda)$.
The interior equilibrium is defined as a productive pattern where some traded goods are produced in each country: $\lambda \in]0;1[$. The interval on which this interior equilibrium is defined comes immediately :

$$0<\lambda<1 \;\Rightarrow\; \frac{1}{\phi s_E+\phi^{-1}(1-s_E)} < \rho^{\sigma-1} < \phi^{-1}s_E+\phi(1-s_E)$$

Outside this interval, the traded good is entirely produced in a single country ($\lambda = 0$ or $\lambda = 1$), the external equilibrium being achieved through the compensation of the trade imbalance by the opposite flow paid by firms from the producing country to the foreign capital owners. Which country concentrates the whole production depends on the relative profitability of producing the traded good. For $\lambda = 0$ to be a stable equilibrium, the production in H has to be unprofitable. The profit that an individual firm would obtain when entering H, starting from a situation where all firms are concentrated in F, is:[32]

$$\Pi_{H|\lambda=0} = \frac{\mu}{\sigma}\,\frac{f(E_H+E_F)}{K_W}\left[\frac{\phi^{-1}s_E+\phi(1-s_E)}{\rho^{\sigma-1}}-1\right]$$

which is negative (thus making this entry unprofitable) as long as $\rho^{\sigma-1} > \phi^{-1}s_E+\phi(1-s_E)$.
In the same way, it can be shown that $\lambda = 1$ is a stable equilibrium if

$$\begin{aligned}
\Pi_{F|\lambda=1} &= \frac{\mu}{\sigma}\,\frac{f(E_H+E_F)}{K_W}\left[\rho^{\sigma-1}(\phi^{-1}(1-s_E)+\phi s_E)-1\right]<0 \\
\Rightarrow \rho^{\sigma-1} &< \frac{1}{\phi^{-1}(1-s_E)+\phi s_E}
\end{aligned}$$

[32] Here, we use the standard result featuring the Dixit-Stiglitz model according to which, in equilibrium, the total amount paid to cover the fixed costs is proportional to the world expenditure with a factor μ/σ :

$$RK^W = \frac{\mu}{\sigma}(E_H+E_F)$$

The following table summarizes patterns of specialization in the traded good sector, as a function of the cost gap :

$\rho^{\sigma-1}$		$\rho_l^{\sigma-1\ (a)}$		$\rho_h^{\sigma-1\ (a)}$	
Productive structure	FS in H[b]		IE		FS in F

(a) $\rho_l^{\sigma-1} = (\phi s_E + \phi^{-1}(1 - s_E))^{-1}$, $\rho_h^{\sigma-1} = \phi^{-1} s_E + \phi(1 - s_E)$

(b) FS = "Full Specialization", IE = "Interior Equilibrium".

A.2. Calibration of RER with OECD data

A.2.1. Data sources

The data used to calibrate the parameters of the model have been obtained from various OECD databases : the STAN Bilateral Trade, the STAN sectorial labor productivity indicators and the Main Economic Indicators.
These databases are constructed on a uniform sectorial classification in 99 industries, that makes data merging easier. Data cover the OECD members over a maximum period from 1988 to 2003. In the paper, we only use data concerning 24 countries : Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, the United Kingdom and the United States.

A.2.2. Traded and non-traded goods

To determine which sectors are exposed to international competition and which can be considered as "non-traded good sectors", a criterion combining data on the import penetration of each sector (i.e. the share of imported goods in the national consumption) and the share of exports in the value added is used. With these indicators, an industry is identified as a non-traded good sector if both its import penetration and the share of value added exported abroad are less than 10%.[33] Sectorial value added series are drawn from the "STAN International Trade" database. As this database does not cover trade in services, the corresponding sectors are always considered as non-traded. The subsample of non-traded good sectors thus always includes the following activities : "Construction, Wholesale and Retail Trade", "Restaurants and Hotels", "Transport and Storage", "Communication", "Finance, Insurance, Real Estate and Business Services", "Community Social and Personal Services". In addition, the "Electricity, Gas and Water Supply" sector is often included in non-traded good sectors.

[33] Gregorio, Giovannini & Wolf (1994) use the same type of criteria to separate traded and non-traded goods. They however restrict this criterium to the share of value added that is exported, without taking into account the import penetration. In our model however, in the case of a corner equilibrium, the traded good may be entirely produced in a given country, in which case, in the partner country, the exported share of value added will be zero whereas its import penetration will be unitary. Alternatively, Crucini, Telmer & Zachariadis (2005) measure this by the ratio of exports and imports over output corrected by a measure of local input content.

A.2.3. Measure of variables

From this classification of sectors into traded and non-traded good industries, the share of traded goods in consumption can be calculated. This is done using data from the "STAN Bilateral Trade" database that gives details on each country's sectorial imports, from each of its partners.[34] Thus, the share of traded goods in country i's consumption at time t is computed as :

$$\mu_{it} = \frac{\sum_{s \in T} \sum_j IMP_{ijt}^s}{\sum_s \sum_j IMP_{ijt}^s}$$

with IMP_{ijt}^s the value of i's imports from j in the sector s at time t (in current international dollars) and T the (country-specific) set of traded good sectors. The time dimension is then dropped by computing the simple mean of $\{\mu_{it}\}$ at the country-level ($\bar{\mu}_i$).

As shown in Figure 5, the share of traded goods in consumption varies widely across countries, much more than the share of traded goods in the total value added : the richest countries (Japan and United States), or the more isolated ones (New Zealand or Australia) appear to consume a higher share of non-traded goods than developing or smaller countries. Note that the time-variance of this indicator is smaller than the cross-country heterogeneity, except in countries like Poland or Mexico, which consumed very few tradable goods at the beginning of the period but had reached similar shares of traded goods in their consumption as middle-income countries in 2003.

Statistics on the labor productivity by type of goods (A^T or A^N) are obtained using the STAN sectorial labor productivity indicators. In this database, the labor productivity is computed as the value added per worker in each industry. The aggregation in the "traded/non-traded" classification is done by averaging these industry-specific labor productivities, with a weighting scheme based on the share of each sector in the total value added in traded or non-traded sectors :

$$A_{it}^b = \sum_{s \in b} A_{it}^s \frac{VA_{it}^s}{VA_{it}^b}, \quad b = T, N$$

with A_{it}^s the labor productivity in the industry s of country i at time t and VA_{it}^s the value added (at current prices) in the sector s relative to the total value added for all industries. The ratio of A_{it}^T on A_{it}^N is then i's relative productivity in the traded good sector, with respect to the non-traded one. As labor productivity indicators provided by the OECD are indices[35], the level of this variable is not really interesting, unlike its evolution. As expected, the annual growth rate of labor productivity is on average higher in traded than in non-traded good sectors (see Figure 6). This justifies the focus on the relative productivity in the traded good sector in Section 3.1.

From these sectoral productivities, the Balassa-Samuelson term entering in (17) is obtained

[34] This database also includes "imports" from the country itself so that the global imports correspond to the country's total consumption.

[35] The reference year being 1995, as for all indices used in this paper.

as follows:

$$BS_{ijt} = \frac{A_{it}^T / A_{it}^N}{A_{jt}^T / A_{jt}^N}$$

Wages are measured by the unit labor cost in the whole economy, also provided in the STAN database.[36] Using these labor cost data and the labor productivity series, the relative cost of production in the traded good sector (ρ_{ijt}) can be calibrated as :

$$\rho_{ijt} = \frac{w_{it}/A_{it}^T}{w_{jt}/A_{jt}^T}$$

The spatial distribution of traded good producers (λ) is measured indirectly through the ratio of the nominal traded good productions in the countries considered:

$$\nu_{ijt} = \frac{n_{it} p_{it}^T y_{it}^T}{n_{jt} p_{jt}^T y_{jt}^T}, \quad \lambda_{ijt} = \frac{\nu_{ijt}}{1 + \nu_{ijt}}$$

To measure each country's nominal production of traded goods, the series of GDP at current prices provided by the OECD's "Main Economic Indicators"are used, as well as the share of value added in traded good sectors :

$$n_{it} p_{it}^T y_{it}^T = GDP_{it} * VA_{it}^T$$

Last, to have a rough idea of the relative size of countries, θ is approximated by the share of each country in the total GDP of the sample. Indeed, in the model, θ measures H's share in both the labor and capital world endowments. In reality however, countries can have very different endowments in labor and capital. For instance, Chinese share in the world stock of labor is much higher than its share in capital endowments. In Table 4, the GDP is thus chosen as a proxy for total factorial endowments and used to compute the size measure:[37]

$$\theta_{it} = \frac{GDP_{it}}{\sum_i GDP_{it}}$$

with GDP_{it} i's GDP at current prices and PPP, obtained from the OECD's "Main Economic Indicators".

[36]The unit labor cost relative to the whole economy is preferred to the unit labor cost in the traded good sector in order to match our assumption of a perfect labor mobility between sectors driving wages to equality in each country.

[37]Note that this approximation is not crucial in the paper as θ is not used in the simulation.

A.2.4. Aggregation into "effective" statistics

When simulating (17) to evaluate the potential impact of the Balassa-Samuelson and the Variety Supply effects on real exchange rates (see Section 3.1), it is convenient to work in effective terms, i.e. to consider each country with respect to all its OECD partners. Thus, all variables concerning country F entering in (17) are a trade-weighted geometric average of the considered variable across H's partners. For instance, the measure of the relative productivity in the traded good sector relative to the non-traded sector of H's partners is computed as follows:

$$\frac{A^T_{-it}}{A^N_{-it}} = \prod_{j \in -i} \left(\frac{A^T_{jt}}{A^N_{jt}} \right)^{\omega_j}$$

with ω_j is the share of country j in i's total trade during the base year (1995).
The Balassa-Samuelson variable, in effective terms, is then :

$$BS_{i-it} = \frac{A^T_{it}/A^N_{it}}{A^T_{-it}/A^N_{-it}}$$

An equivalent weighting scheme is used in the simulations to average each country's relative cost of producing the traded good ($\rho_{it} = \frac{W_{it}/A^T_{it}}{W_{-it}/A^T_{-it}}$) as well as its relative share in the production of traded goods $\left(\lambda_{it} = \frac{\nu_{i-it}}{1+\nu_{i-it}} \text{ with } \nu_{i-it} = \frac{n_{it} p^T_{it} y^T_{it}}{n_{-it} p^T_{-it} y^T_{-it}} \right)$

A.2.5. Methodology

These series being constructed, the theoretical relation (17)can be simulated to infer each country's long-run effective real exchange rate (as predicted by the model). As some of the series are based on indices, it is, however, convenient to switch from the relation in levels to a growth equivalent of (17). Moreover, as shown by Figure 5, assuming μ to be the same in all countries is obviously unrealistic. As a consequence, the simulation is based on a growth relation where the coefficient μ is authorized to vary across countries ($\mu_H \neq \mu_F$). The exact relation used is :

$$g^{RER}_t = (\mu_F - \mu_H) g^{A^T_F/A^T_H}_t + \mathbf{A} g^\lambda_t + \mathbf{B} g^\rho_t + (1 - \mu_H) g^{BS}_t \tag{18}$$

where $g^i_t = di/i$ is the annual growth rate of variable i between $t-1$ and t and:

$$\begin{aligned} \mathbf{A} &= \frac{\lambda}{\sigma - 1} \left(\frac{\mu_F(\phi\rho^{1-\sigma} - 1)}{\lambda\phi\rho^{1-\sigma} + (1-\lambda)} - \frac{\mu_H(\rho^{1-\sigma} - \phi)}{\lambda\rho^{1-\sigma} + (1-\lambda)\phi} \right) \\ \mathbf{B} &= \frac{\mu_H \rho^{1-\sigma}\lambda}{\lambda\rho^{1-\sigma} + (1-\lambda)\phi} - \frac{\mu_F \lambda\phi\rho^{1-\sigma}}{\lambda\phi\rho^{1-\sigma} + (1-\lambda)} + (1 - \mu_H) \end{aligned}$$

More precisely, in section 3.1, we simulate, for each country, the predicted average growth of RER ($g^{RER} = T^{-1} \sum_t g^{RER}_t$) induced by :

i) the observed mean growth of the double productivity ratio ($g^{BS} = T^{-1} \sum_t g^{BS}_t$)

ii) the observed mean growth of the traded good production in the domestic market ($g^{\lambda} = T^{-1} \sum_t g_t^{\lambda}$),

iii) the observed mean growth of the relative cost of producing the traded good ($g^{\rho} = T^{-1} \sum_t g_t^{\rho}$).

This simulation exercise is a *ceteris paribus* analysis, i.e. all other variables entering in (18) are maintained constant at their initial value.

Figure 1: RER dependence on productivity gaps

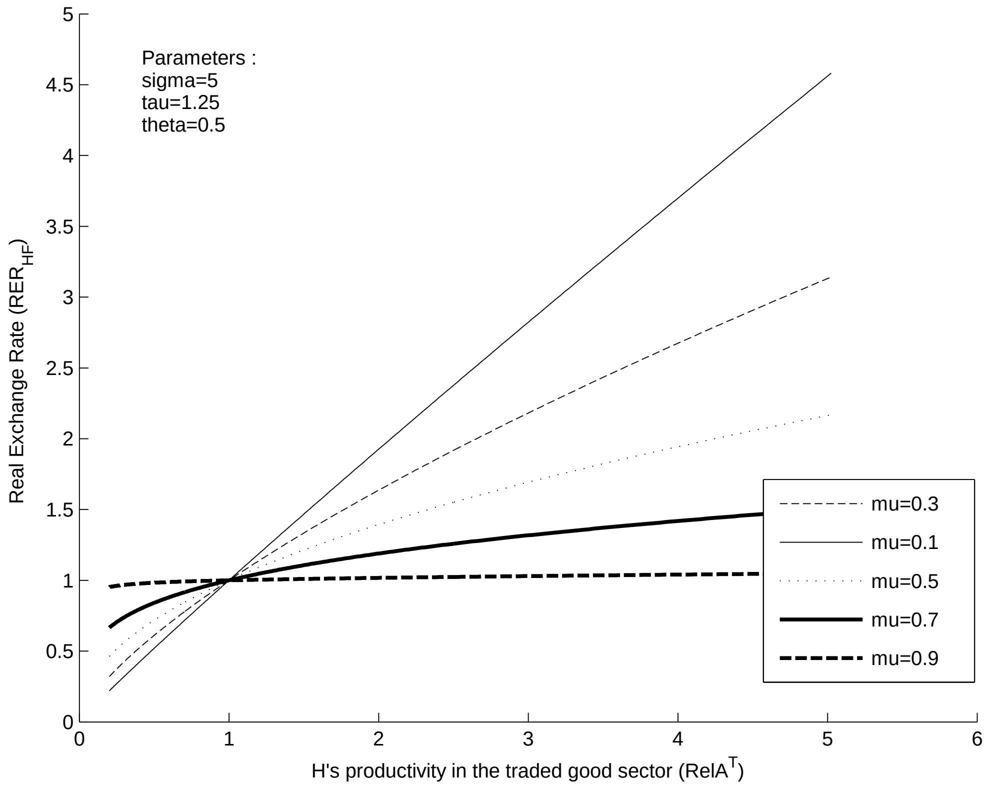

Figure 2: RER dependence on productivity gap under strong Variety Supply effect
(*Calibration:* $\tau = 1.55$, $\sigma = 1.5$, $\mu = 0.9$, $\theta = 0.55$)

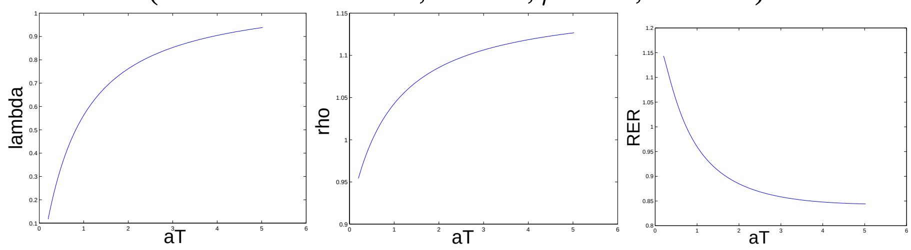

Figure 3: Home Market Effect and the share of traded goods

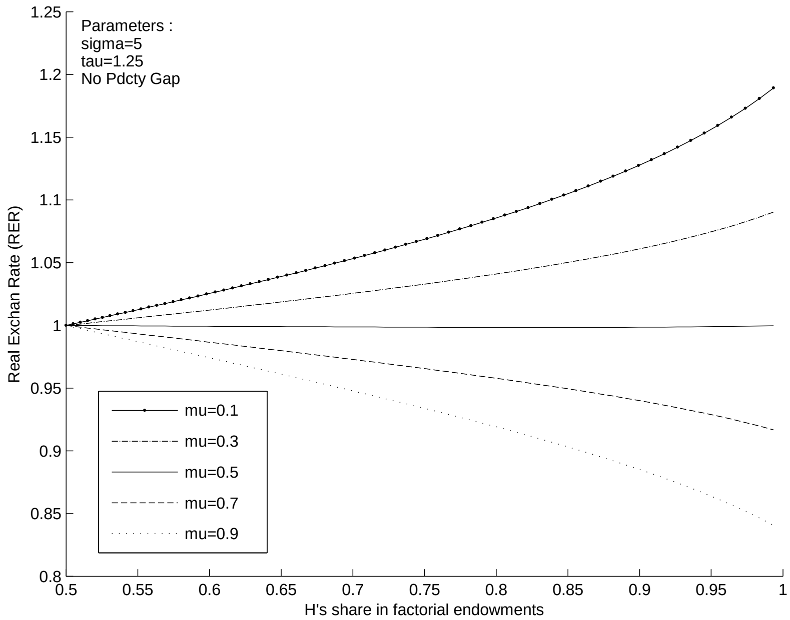

Figure 4: Home Market Effect and the size of trade costs

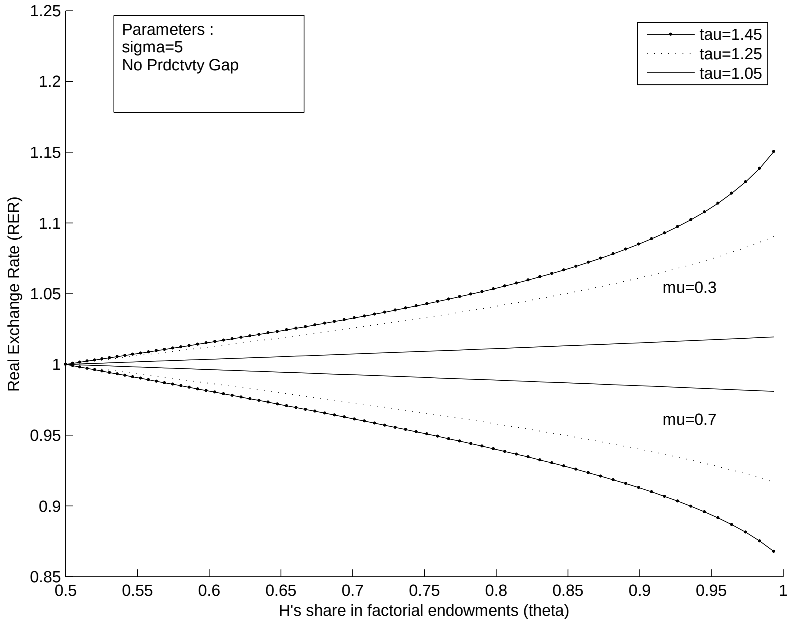

Figure 5: Share of traded goods in consumption and in value added
Sources : Author's calculations from OECD data (See details in Appendix A.2)

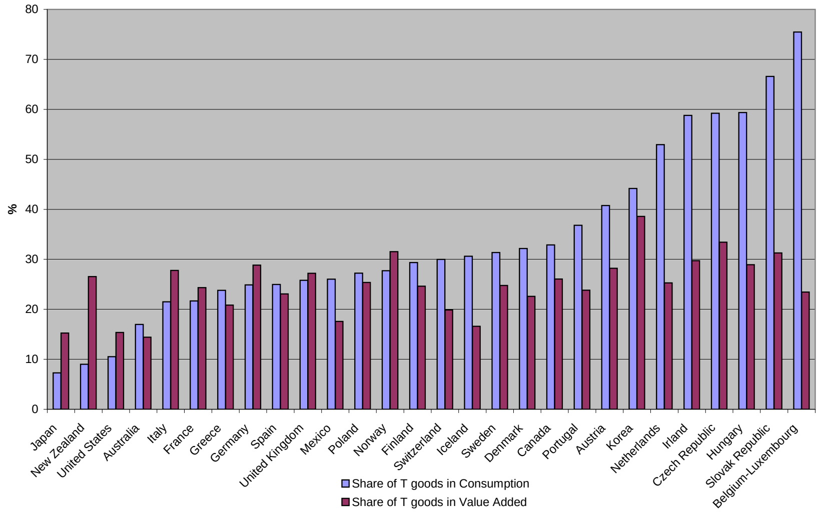

Figure 6: Mean annual labor productivity growth in T vs NT sectors
Sources : Author's calculations from OECD data (See details in Appendix A.2)

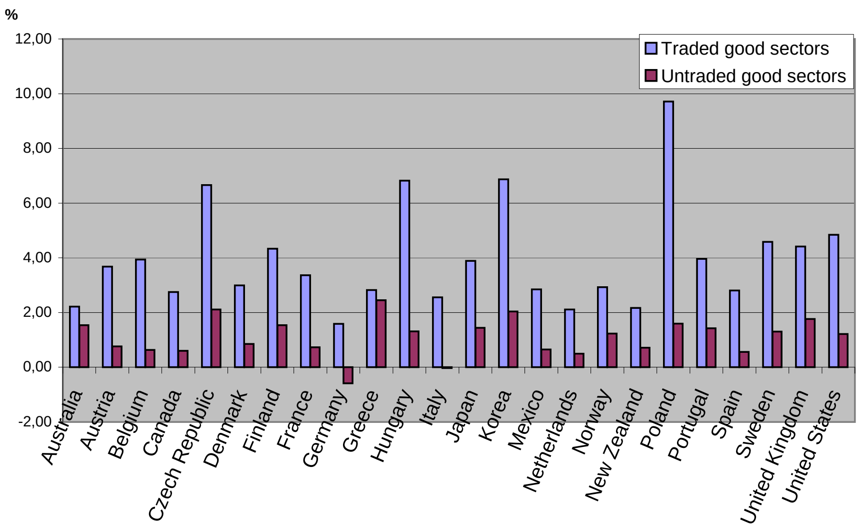

Table 1: Predicted annual growth rate (in %) of the effective RER, attributable to each effect

	Period	BS effect	VS effect	RCP effect	Total effect	Observed
Australia	88-01	-1.92	0.02	1.32	-0.58	0.68
Austria	88-02	0.23	-0.16	-2.65	-2.58	-0.87
Belgium	88-02	0.04	-0.28	-0.58	-0.82	-0.54
Canada	88-00	-0.96	0.00	0.75	-0.21	-0.80
Czech Rep.	95-00	0.81	-0.06	0.64	1.39	4.37
Denmark	88-02	0.51	-0.31	-2.03	-1.83	-4.00
Finland	88-02	0.02	-0.12	-2.05	-2.15	-0.47
France	88-01	0.62	0.01	-1.64	-1.01	-1.24
Germany	88-01	0.35	0.02	1.61	1.98	-0.83
Greece	95-02	-0.75	-0.10	1.39	0.54	2.30
Hungary	92-02	1.11	-0.58	3.12	3.65	12.98
Italy	88-02	-0.66	-0.20	0.68	-0.18	0.95
Japan	88-01	-0.83	0.02	-1.55	-2.36	-2.28
Korea	89-99	1.69	-0.09	-0.26	1.34	2.97
Mexico	88-01	-0.86	-0.27	14.53	13.40	14.94
Netherlands	88-02	-0.13	-0.20	-0.35	-0.68	-0.30
New Zealand	89-98	-0.65	0.00	0.24	-0.41	-0.52
Norway	88-02	-1.30	-0.11	-0.33	-1.74	-0.35
Poland	92-01	4.01	-0.13	6.95	10.83	15.58
Portugal	88-99	0.04	-0.10	1.87	1.81	3.20
Spain	88-01	-0.61	-0.02	2.76	2.13	1.07
Sweden	88-01	0.81	0.01	-1.28	-0.46	0.56
UK	88-02	-0.70	-0.31	0.27	-0.74	0.83
USA	88-01	1.22	0.02	-3.09	-1.85	-1.04

Sources : Simulation of a growth equivalent of (17) using OECD data to calibrate the growth of ρ*,* λ *and* BS*.*

Table 2: Elasticity of RER with respect to H's relative productivity in the traded good sector

Parameters		$\xi_{RER}^{RelA^T (a)}$
$\sigma = 5$, $\tau = 1.25$, $\theta = 0.5$	$\mu = 0.1$	0.94
	$\mu = 0.3$	0.71
	$\mu = 0.5$	0.48
	$\mu = 0.7$	0.25
	$\mu = 0.9$	0.03
$\sigma = 5$, $\tau = 1.25$, $\mu = 0.7$	$\theta = 0.5$	0.25
	$\theta = 0.7$	$[\,0.25\,;\quad 0.28]^{(b)}$
	$\theta = 0.9$	$[\,0.25\,;\quad 0.30]$
$\sigma = 5$, $\mu = 0.5$, $\theta = 0.6$	$\tau = 1.05$	0.50
	$\tau = 1.15$	0.49
	$\tau = 1.25$	0.48
	$\tau = 1.35$	0.47
	$\tau = 1.45$	0.45

(a) $\xi_{RER}^{RelA^T} = \frac{\partial RER}{\partial RelA^T} \frac{RelA^T}{RER}$ with $RelA^T = A_H^T / A_F^T$. $\xi_{RER}^{RelA^T}$ measures the sensitivity of the real exchange rate to a one percent change of H's relative productivity in the traded good sector.

(b) Interval in which $\xi_{RER}^{RelA^T}$ varies when $RelA^T = A_H^T / A_F^T$ increases from 0.2 to 5.

Table 3: Elasticity of RER with respect to H's relative size

Parameters		$\xi_{RER}^{\theta}\ ^{(a)}$
$\sigma = 5$, $\tau = 1.25$,	$\mu = 0.1$	$[\,0.12\,;\ \ 0.72]$
No Productivity Gap	$\mu = 0.3$	$[\,0.06\,;\ \ 0.37]$
	$\mu = 0.5$	$\simeq 0$
	$\mu = 0.7$	$[-0.07\,;-0.33]$
	$\mu = 0.9$	$[-0.13\,;-0.64]$
$\sigma = 5$, $\mu = 0.3$,	$\tau = 1.05$	$[\,0.02\,;\ \ 0.04]$
No Productivity Gap	$\tau = 1.25$	$[\,0.06\,;\ \ 0.37]$
	$\tau = 1.45$	$[\,0.08\,;\ \ 1.04]$
$\sigma = 5$, $\mu = 0.7$,	$\tau = 1.05$	$[-0.02\,;-0.04]$
No Productivity Gap	$\tau = 1.25$	$[-0.07\,;-0.33]$
	$\tau = 1.45$	$[-0.09\,;-0.85]$
$\tau = 1.25$, $\mu = 0.3$,	$RelA^T = 0.5^{(b)}$	$[\,0.06\,;\ \ 0.57]$
$\sigma = 5$	$RelA^T = 1$	$[\,0.06\,;\ \ 0.37]$
	$RelA^T = 2$	$[\,0.06\,;\ \ 0.25]$
$\tau = 1.25$, $\mu = 0.7$,	$RelA^T = 0.5$	$[-0.06\,;-0.70]$
$\sigma = 5$	$RelA^T = 1$	$[-0.07\,;-0.33]$
	$RelA^T = 2$	$[-0.06\,;-0.12]$
	$RelA^T = 5$	$[-0.04\,;\ \ 0.02]$
$\tau = 1.25$, $\mu = 0.3$,	$\sigma = 3$	$[\,0.07\,;\ \ 0.25]$
No Productivity Gap	$\sigma = 5$	$[\,0.06\,;\ \ 0.37]$
	$\sigma = 7$	$[\,0.05\,;\ \ 0.57]$
$\tau = 1.25$, $\mu = 0.7$,	$\sigma = 3$	$[-0.08\,;-0.20]$
No Productivity Gap	$\sigma = 5$	$[-0.07\,;-0.33]$
	$\sigma = 7$	$[-0.05\,;-0.52]$

(a) Interval in which $\xi_{RER}^{\theta} = \frac{\partial RER}{\partial \theta}\frac{\theta}{RER}$ varies when θ increases from 0.5 to 1.

(b) $RelA^T = A_H^T/A_F^T$ is H's relative productivity in the traded good sector.

Table 4: Descriptive Statistics of the Variables of Interest in a sample of OECD countries

	Period	$\bar{\theta}_H^{(a)}$	$\bar{\mu}_H^{(b)}$	$\bar{\mu}_F^{(c)}$	$\bar{g}_{RER}^{(d)}$	$\bar{g}_{BS}^{(e)}$	$\bar{g}_{\lambda}^{(f)}$	$\bar{g}_{\rho}^{(g)}$
Australia	88-01	1.85	17	14	0.68	-2.31	-2.16	1.54
Austria	88-02	0.89	41	26	-0.87	0.39	9.31	-3.75
Belgium	88-02	1.07	75	26	-0.54	0.15	5.55	-1.16
Canada	88-00	3.23	33	12	-0.80	-1.42	-0.01	1.00
Czech Republic	0.61	95-00	59	27	4.37	1.99	4.05	1.37
Denmark	88-02	0.58	32	22	-4.00	0.75	10.30	-2.62
Finland	88-02	0.51	29	25	-0.47	0.03	7.62	-2.64
France	88-01	6.22	22	27	-1.24	0.79	-0.25	-1.91
Germany	88-01	8.59	25	27	-0.83	0.47	-0.37	1.98
Greece	95-02	0.68	24	27	2.30	-0.99	7.76	1.75
Hungary	92-02	0.47	59	27	12.98	2.75	15.62	7.19
Italy	88-02	5.79	22	25	0.95	-0.84	3.41	0.79
Japan	88-01	13.64	7	18	-2.28	-0.89	-0.59	-1.68
Korea	89-99	2.57	44	12	2.97	3.04	1.91	-0.34
Mexico	88-01	3.23	26	12	14.94	-1.16	7.26	18.49
Netherlands	88-02	1.65	53	27	-0.30	-0.28	5.82	-0.58
New Zealand	89-98	0.30	9	15	-0.52	-0.72	-1.13	0.26
Norway	88-02	0.52	28	27	-0.35	-1.79	7.46	-0.44
Poland	92-01	1.44	27	28	15.58	5.56	4.17	8.85
Portugal	88-99	0.65	37	24	3.20	0.06	3.17	2.64
Spain	88-01	3.18	25	25	1.07	-0.82	0.50	3.30
Sweden	88-01	0.93	31	24	0.56	1.18	-0.74	-1.64
United Kingdom	88-02	5.73	23	28	0.83	-0.94	4.41	0.31
United States	88-01	36.03	11	21	-1.04	1.37	-0.18	-3.63

Sources : OECD and Economist Intelligence Unit.

For each country, calculations are made considering the rest of the sample as its partners, with a weighting scheme based on the share of each partner in the country's total trade (exports plus imports). Results are in %.

(a) Mean share in the total GDP of the sample.

(b)(c) Mean share of traded goods in the nominal consumption of the considered country (b) and of its partners (c).

(d) Mean annual growth rate of the effective real exchange rate (CPI based). A positive value means that, on average, the country's relative price level has increased, i.e. its real exchange rate has appreciated.

(e) Mean annual growth of the double productivity ratio : $BS = \frac{A^T_{tH}/A^N_{tH}}{A^T_{tF}/A^{tN}_{F}}$.

(f) Mean annual growth of the country's relative production of traded growth : $\lambda = \frac{GDP^T_{tH}}{GDP^T_{tH}+GDP^T_{tF}}$.

(g) Mean annual growth of the country's relative cost to produce the traded good : $\rho = \frac{W_{tH}/A^T_{tH}}{W_{tF}/A^T_{tF}}$

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