International Competitiveness: Product Deregulation and Internal Devaluation

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Abstract

Echoing recent developments within the Euro area, the paper investigates the role of price- and market-driven policies in enhancing international competitiveness. In a theoretical framework, we investigate the effects of an internal devaluation that reduces labor cost and a product market deregulation that improves market competition on the real exchange rate. These policies affect international competitiveness along the extensive margins of trade (i.e. number of firms) and the terms of trade. We show that both reforms improve international competitiveness of a country through real exchange rate depreciation, even though they work along opposite channels on these two determinants of trade. Additionally, the pricing-to-market behavior substantially reinforces the effectiveness of the product market deregulation on trade competitiveness while the opposite holds for the internal devaluation. The former reform generates a competition effect on domestic markups which improves price-competitiveness while the later reform causes a relative-price effect on markups which bring the opposite result.

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1 Introduction

Since the beginning of the 2000s, European countries have been confronted to growing divergence in international competitiveness. Peripheral countries (GIIPS, for Greece, Italy, Ireland, Portugal and Spain) experienced a substantial deterioration in trade competitiveness whereas those of Core countries have been rather stable or in slight reduction. This gap has been associated with growing discrepancies in current account positions (i.e. growing current account surpluses in Core countries, primarily Germany, versus sustained trade deficits in GIIPS) all over the 2000s. It also has been enlarged with the financial and sovereign-debt crises experienced from 2008 by GIIPS countries (see ECB (2012)).
This diverging trend in competitiveness is notably captured by the fact that the real exchange rate of the GIIPS has steadily appreciated all over the 2000-2008 period, in particular relative to their European partners. Figure 1 (upper panel) illustrates this stylized fact, by reporting the weighted average of the Harmonized Competitiveness Indicator (HCI), as a measure of the real effective exchange rate, for both groups of countries.[1]

[Insert Figure 1 here]

Noticing that a rise in the HCI corresponds to an increase in the relative cost of production (and therefore a loss in competitiveness, Figure 1 strikingly highlights a much lower international competitiveness for the GIIPS, relative to the non-GIIPS, in particular over the period 2005-2014.
Diverging trends in international competitiveness can also be captured by unit labor costs (UCL, henceforth). The upper right panel of Figure 1 displays the average ULC for the two groups of countries from 2000 to 2013.[2] The figure reports two distinct periods. From 2001 to 2007, peripheral countries of the Euro Zone have experienced a stronger increase in their unit labor cost relative to the Core countries. Things have reversed since the 2008 crisis though, suggesting that some of these countries have combined a stronger productivity gains and wage moderation generating a slowdown in UCL (see ECB (2012), OECD (2012)).

In front of the severity of the European crisis, repeated calls have been made pointing out the urgency to make reforms to restore international competitiveness in GIIPS. Beyond resolving external imbalances within EMU members, such reforms are also viewed as key for Europe to renew economic growth, as testified by the following statement of M. Borroso (President of the European Commission):

[1]The HCI, based on the consumer price indices, provides a measure consistent with the real effective exchange rate, which is comparable across countries. It is calculated on the basis of weighted averages of bilateral exchange rates vis-à-vis the currencies of the trading partners of each euro area country and are deflated by appropriate cost or price indices" (see ECB (2012)). It aims at providing a comparable measure of price and cost competitiveness across countries.

[2]The unit labor cost index (2010 index = 100) is extracted from OECD annual indicators database. It is measured as the ratio of total labor costs over real output.

"[...] the biggest problem we have for growth in Europe is the problem of lack of competitiveness that has been accumulated in some of our Member States, and we need to make the reforms for that competitiveness." (State of the Union Speech, December 2012).

How to correct for the competitiveness losses in peripheral European countries? There is wide agreement that the issue can be addressed with a number of price- and market-driven reforms, reflecting the consensus that both price-cost factors and non-price competitiveness factors can be held responsible for the real exchange rate appreciation in GIIPS (ECB (2012)).

Internal devaluation constitutes the typical case of a "price-driven" reform. For instance, ECB (2012) points out the role of the marked heterogeneity in labor tax wedges between Euro Zone countries. As an illustration of this, one can note the difference between the payroll tax rate in GIPPS over 1998-2003, that amounts to 21.5%, 5 percentage points higher than in Core countries. In this respect, this suggests there is room for gains in price-competitiveness in peripheral countries through the means of a labor tax wedge reduction. By alleviating the labor tax burden, price-driven policy aims at reducing domestic production prices, which in turn leads to a real exchange rate depreciation. Such policy is particularly relevant for countries within a monetary union, that can not rely on external devaluation to play on competitiveness. As such, internal devaluation has been implemented in many European countries in the recent years (Denmark in 1988, Sweden, in 1993, Germany in 2006, or France in 2012).[3]

As notably pointed out by ECB (2012), non-price competitiveness factors also matter in external imbalances within Europe. Further, solving these issues may be addressed through various channels, such as the product quality, the human capital formation as well as the business climate environment. In the paper, we focus on the extent of product market regulation that relies on the stylized fact that peripheral countries exhibit more regulated, less competitive markets, than core countries. As reported in the lower left panel of Figure 1, if barriers to entry exhibit a certain downward trend over the period for both groups of countries, they indeed remain more restrictive for GIIPS countries.[4] This suggests that peripheral countries might also rely on product market deregulation to gain on international competitiveness. The intuition is straightforward: By removing barriers to entry, boosting firm creation and raising competition, product market deregulation is expected to improve the country's economic performances by helping firms to compete on the international market.

These empirical facts open the question of how gains in international competitiveness might be achieved. Precisely, one might query how tax reforms (as internal devaluation) or structural reforms (such as product market deregulation) are effective in this purpose. Further, if the effects of both reforms sound fairly intuitive, they yet rely on some assumptions underlying the firms' pricing behavior. As for internal devaluation, that the labor tax cut is fully passed to the producer prices,

[3]The reduction of labor taxes may be compensated by an increase in indirect taxes, in which case it is referred to as "fiscal devaluation". In the paper, we focus attention on internal devaluation, and we study the case of fiscal devaluation as a robustness case.

[4]This panel displays the legal barriers to entry in average for GIIPS and non-GIIPS in 2003, 2008 and 2013. This index is one of the OECD Indicators of Product Market Regulation.

thereby excluding any rent extraction behavior. As for product market deregulation, that the increasing competition entailed on the goods market drives firms to reduce their markup rents, therefore gaining on price competitiveness. In this respect, the margin behavior of firms is likely to play a central role in the effectiveness of both reforms. Besides, markup adjustments are likely to differ across destination markets in presence of international markets segmentation. As pointed out by several empirical studies, the firms' "pricing-to-market" behavior has key implications on real exchange rate, therefore international competitiveness (see Burstein and Gopinath, 2014, for a survey).

In the paper, we thus evaluate the ability of price- and market-driven reforms to improve international competitiveness, taking into account the endogenous pricing-to-market behavior of firms. Precisely, our research question is twofold: First, through which channels the reforms like internal devaluation and product market deregulation do restore international competitiveness? Second, to which extent the effectiveness of these policies is affected by the firms' pricing decisions in a context of segmented international markets?

We answer these questions by developing a two-country static model with monopolistic competition and endogenous firm entry *à la* Krugman (1980) featuring international trade costs and sunk entry cost. With this simple set-up, we can capture the key effects on both reforms on trade performances: the price-competitiveness dimension of the real exchange rate (i.e., the relative price of exports versus imports, that is the terms of trade), as well as both the intensive and the extensive margins of trade (i.e., the volume of individual exports and the number of exporters). Beyond being consistent with a large number of papers in the New Trade literature that emphasizes the importance of adjustments along the extensive margin of trade (Ghironi and Mélitz (2005)), we show that this dimension indeed plays a key role in shaping the real exchange rate response to both reforms.

This theoretical framework is enriched with a structure of competition that generates endogenous markups. In presence of international trade costs, this implies that firms discriminate across markets' destination by charging different markups.[5] Precisely, the markup extracted on each market depends on both the relative price of exports and the number of foreign competitors: the larger the market share of domestic firms, the lower the price-elasticity of demand for the domestic variety, i.e. the higher the markup extracted by each firm. Additionally, when varieties are more expensive than domestic ones, the price-elasticity of demand for the goods domestically produced reduces,

[5]In our model, each country contains a large number of sectors, each of them being made of a finite number of differentiated firms. While sectors are in a standard CES monopolistic competition setting, within each sector, firms behave like oligopolists, i.e. taking into account the effect that the pricing and quantity decisions of the other firms have on the demand for its own good. This market structure is close to Atkeson and Burstein (2008), amended by endogenous firm entry. Atkeson and Burstein (2008) show that trade costs and oligopolistic competition are key features to match main empirical facts on trade volume. Devereux and Lee (2001) investigate the gains of trade with a similar competition structure. However, they do not introduce international trade cost, which shut down a potential pricing-to-market behavior. Floetotto and Jaimovich (2008), Colciago and Etro (2010) and Lewis and Poilly (2012) resort to this type of framework in a closed economy.

leading to higher domestic markups. The model is calibrated for the Euro Area and it is assumed that one (Home) country carries out a reform: either the government subsidies entry or it reduces payroll tax in order to reduce the share of lump-sum tax to GDP by 5%. Comparing the effects of such reforms when markups are constant and when they are variables allows us to investigate how the "primary" effect of both reforms on the relative price of exports and the number of exporters is altered by the firms' pricing decisions.

Our results may be summarized in two points. First, we show that both an internal devaluation (modeled through a reduction in the payroll tax rate) and a product market deregulation (through an entry subsidy) improve international competitiveness of the Home country. However, both policies work along opposite channels on trade performances. A product market deregulation improves the market position of domestic firms (extensive margin of trade) despite the deterioration in price-competitiveness (the relative price of exports goes up). On the opposite, an internal devaluation induces a real exchange rate depreciation which mostly channels through the relative price of exports (which reduces with the labor tax cut).

Second, we show that the effectiveness of both reforms in depreciating the real exchange rate is strongly affected by the endogenous pricing-to-market behavior of firms. Precisely, it reinforces the effectiveness of the product market deregulation, whereas it slightly reduces that of internal devaluation. This conclusion channels through opposite adjustments in markups. By reducing the entry cost, product market deregulation raises the extent of competition on the domestic market, which exerts a downward pressure on the markups extracted on this market by both domestic and foreign firms. In presence of trade costs though, the effect is stronger for domestic firms, which everything else equal tends to reduce the relative price of exports. That is, endogenous markups strengthen the ability of a product market deregulation to depreciate the real exchange rate primarily through improvements in price-competitiveness. By contrast, the effectiveness of internal devaluation in depreciating the real exchange rate is limited by the endogenous margin behavior of firms. Domestic firms indeed use the labor tax cut to increase their markups (on both the local and export markets). If this entices more firms to enter the domestic market (improvement along the extensive margin of trade), this also moderates the reduction in the relative price of exports, that is the gains in price-competitiveness that may be achieved with this reform.

Our work investigates how structural and fiscal reforms may be used in front of international competitiveness issues. In this respect, it is related to one branch of the literature on the link between structural reforms and external imbalances. In the wake of the recent crisis, the literature on the subject has been rapidly expanding over the recent years. Cacciatore and Fiori (2014), Andrés *et al.* (2014), among others, investigate the effects of product market deregulation in the short run in a closed-economy context. Closer to us, Forni *et al.* (2010) or Eggertsson *et al.* (2014) extend the analysis in a monetary union set-up. However, they capture product market deregulation by an exogenous markup reduction. Conversely, our paper demonstrates the importance of taking into account the endogeneity of markups adjustment if willing to correctly assess the effects of

such a structural reforms. Schiantarelli (2014) provides some empirical relevance of such a link, by showing that stringent product market regulation affects markups upwards and firm entry downwards. On the effects of price-driven reforms, the literature reaches contrasted results on the aggregate effects of fiscal devaluation in a monetary union. Using a DSGE model calibrated on the Euro Zone, Engler *et al.* (2014) obtain that fiscal devaluation yields moderate gains regarding the real exchange rate, whereas Auray *et al.* (2000) point out the importance of also taking into account the effects of fiscal devaluation on the extensive margin of trade, as an important dimension of international competitiveness gains. If our paper shares this view in common with Auray *et al.* (2000), our originality is to demonstrate how such gains are likely to be affected, and as a matter of fact, dampened, by the firms' endogenous markup behavior
Through this dimension, our paper is also related to a second strand of papers that study the role of endogenous markups adjustments in macroeconomic performances. Floetotto and Jaimovich (2008), Bilbiie *et al.* (2012a), Bilbiie *et al.* (2012b) thus investigate how endogenous firm entry and variable markups do affect the business cycles properties of a closed-economy subject to exogenous real and nominal shocks. In a two-country context closer to ours, Bergin and Feenstra (2001), Corsetti and Dedola (2005) or Atkeson and Burstein (2008) point out the importance of the pricing-to-market behavior of firms to account for deviations from the law of one price and the imperfect exchange rate pass-through.[6] Our paper first differentiates from these papers, by explicitly relating endogenous pricing-to-market decisions to firm entry in an international set-up (thereby, bridging a wedge between Atkeson and Burstein (2008) and Floetotto and Jaimovich (2008)). Second, we confront this to an original question, that focuses on how endogenous markups do affect the effects of structural/fiscal reforms in a long-run perspective.

The paper is structured as follows. Section 2 lays out the full model. After presenting the calibration of the model (Section 3), we study the effects of both reforms, focusing on the issue of international competitiveness first (Section 4). In Section 5, we enlarge the scope by assessing the effects of both reforms regarding a larger set of macroeconomic variables. Section 6 concludes.

2 The Model

The world consists of two countries. There are $\bar{L}$ households in the Home country and $\bar{L}^*$ in the Foreign country, which correspond to the size of the country. As in Corsetti *et al.* (2007), we introduce endogenous labor supply decision in the standard Krugman's (1980) model, in order to have some effect of distortionary labor taxation. As a result, the representative consumer in each

[6] As surveyed by Burstein and Gopinath (2014), there are a number of ways to introduce pricing-to-market in a model with international trade costs. Departing from the CES demand is one option (e.g. for instance Bergin and Feenstra (2001), Atkeson and Burstein (2008), Melitz and Ottaviano (2008) or Gust *et al.* (2010)). Alternatively, Corsetti and Dedola (2005) suggest introducing additive distribution costs. In both ways, the price-elasticity of demand is variable and firms adjust their markups across destination. In the paper, we adopt the modeling structure of Atkeson and Burstein (2008) or Floetotto and Jaimovich (2008). As we detail later, one reason is that this competition set-up enables us to retrieve the standard Dixit and Stiglitz (1977) case of a constant mark-up. Accordingly, we refer to this case as our "benchmark" model, to which we will compare the model with varying markups.

country arbitrages between leisure and the consumption of a final good. Further, our modeling of endogenous markups follows Atkeson and Burstein (2008) and Floetotto and Jaimovich (2008), as we assume that the production structure economy features a two-layer production structure. Precisely, the final good is made of a continuum of "sectoral goods", indexed by s where $s \in [0,1]$ (s^* in the Foreign country). Each sector produces its sectorial good by aggregating Home and Foreign differentiated goods produced by monopolistic competitive firms, with preferences exhibiting love for variety. The differentiated goods, indexed by d when they are produced in the Home country – where $d \in \Omega_D \equiv [0,n]$ – and $f \in \Omega_f \equiv [0,n^*]$ in the Foreign one, are produced using labor. Finally, the government collects tax revenue on labor and consumption, as well as through administrative fees when firms enter the market. Such fiscal resources are transferred to households through lump-sum transfers as the government holds a balanced budget.

In what follows, all Foreign country variables are indexed with a star. Home and Foreign countries are symmetric in the sense that they feature the same preferences and technology. When the Foreign decisions are identical to the Home one, we describe only the later.

2.1 Households

The representative household in the Home country maximizes her individual utility which reads:

$$\mathcal{U}(C,H) = \frac{C^{1-\frac{1}{\psi}}}{1-\frac{1}{\psi}} - \sigma_H \frac{H^{1+\eta}}{1+\eta}, \tag{1}$$

where $\psi > 0$ determines the curvature of the utility function, $1/\eta > 0$ is the Frisch parameter and σ_H is a scale parameter. The household's budget constraint is:

$$(1+\tau_c)PC + I = WH + \Pi + T, \tag{2}$$

where C denotes the aggregate consumption in the Home country at price P (expressed in terms of some numéraire), H denotes worked hours which provide a nominal wage W. Let T represent lump-sum transfers from the government, Π total dividends revenues (collected from the local firms) and I investment in domestic firms. Setting ζ_d as the share invested in a domestic firm (and assuming symmetry among households), it comes that $I = 1/\bar{L}\int_0^n \zeta_d \mathrm{d}d$. In turn, the household perceives an equal share of Home profits $\Pi = 1/\bar{L}\int_0^n \Pi_d \mathrm{d}d$, where Π_d denotes the profit from an individual firm.[7] First-order conditions with respect to consumption and labor supply can be summarized in the following Euler equation

$$\sigma_H H^\eta C^{\frac{1}{\psi}} = \frac{W}{(1+\tau_c)P} \tag{3}$$

Note that ψ and η govern the strength of the substitution effect versus the income effect in shaping the arbitrage between consumption and leisure. Let consider a rise in labor income. On the one

[7] In this static model, there is no investment decision in a mutual funds of firms (I), as all profits are mechanically invested in domestic firms. Accordingly, introducing a distortionary tax on dividend is pointless. This is no longer the case in a dynamic setting, as shown in Chugh and F. (2011). However, in the corresponding steady-state, the tax on dividends jointly intervenes with the entry tax so that effects can be thought as equivalent.

hand, the positive *income effect* exerts an upward pressure on both consumption and leisure. On the other hand, the opportunity cost of leisure in terms of consumption increases. This *substitution effect* makes consumption and leisure move in opposite direction. For a high value of η or a low value of ψ, the substitution effect is weak, therefore aggregate consumption and hours slightly raises with labor income. Given that labor income is ultimately a function of both direct and indirect tax rates (as we show later), the relative magnitude of the substitution effect will turn out to have important consequences in shaping the response of aggregate consumption to internal devaluation, as already emphasized by Corsetti *et al.* (2007) (in a different perspective though).

2.2 Technology

Following Atkeson and Burstein (2008) (among others), we assume that each country contains a continuum of sectors, each of them being made of a finite number of differentiated firms. While sectors are in a standard CES monopolistic competition setting *à la* Dixit and Stiglitz (1977), firms behave like oligopolists within each sector, i.e. taking into account the effect of their pricing decision on the price index of the sector, and ultimately of the price-elasticity of the demand for their variety, at the root of endogenous markups.

2.2.1 Competition Structure

Production of the final good In Home country, the sectorial goods is denoted by C_s where $s \in [0, 1]$, are bundled by perfectly competing firms into a final consumption good, C, according to a CES aggregator such that:

$$C = \left(\int_0^1 C_s^{\frac{\theta-1}{\theta}} \mathrm{d}s \right)^{\frac{\theta}{\theta-1}},$$

where $\theta > 1$ is the elasticity of substitution across sectorial goods. Given $PC = \int_0^1 P_s C_s \mathrm{d}s$, the representative final good producer solves her profit maximization program, which yields a demand for sectorial goods and the associated welfare aggregate price index, P_s,

$$C_s = \left(\frac{P_s}{P} \right)^{-\theta} C, \quad \text{and} \quad P = \left(\int_0^1 P_s^{1-\theta} \mathrm{d}s \right)^{\frac{1}{1-\theta}}. \tag{4}$$

Anticipating the symmetric equilibrium between sectors, it turns out that $P_s = P$ and $C_s = C$.

Production of the sectoral good Each good produced in sector s combines differentiated goods produced by domestic and foreign firms. Therefore, firms have some markup power, which (under conditions we describe below) notably depends on the number of competitors on the market. Let $c_{s,d}$ denote the type-d intermediate goods produced in the Home country and $c_{s,f}$ denote type-f intermediate goods produced in the Foreign country, both being used by the Home sector s. At the symmetric equilibrium, $c_{s,x} = c_{s',x}$ for any sector s, s'. For the sake of notational clarity, we thus denote $c_x \equiv c_{s,x}$ for $\forall x = d, f$. Therefore, the type-s sectorial good is produced according to the production function:

$$C_s = \mathcal{N} \left(\int_0^n c_d^{\frac{\sigma-1}{\sigma}} \mathrm{d}d + \int_0^{n^*} c_f^{\frac{\sigma-1}{\sigma}} \mathrm{d}f \right)^{\frac{\sigma}{\sigma-1}}, \tag{5}$$

where $\sigma > 1$ is the elasticity of substitution between goods within a sector. Additionally, $\mathcal{N}$ is as:

$$\mathcal{N} \equiv (n + n^*)^{\nu - \frac{1}{\sigma-1}},$$

where $\nu \geq 0$ captures the degree of "taste for variety" by households. The larger ν, the more love for variety for the consumer. A larger number of varieties spreading a certain amount of consumption over a greater number of differentiated products rises household's utility. Notice that $\nu = (\sigma - 1)^{-1}$ implies that $\mathcal{N} = 1$, corresponding to the typical CES specification.

The optimal Home demand for differentiated goods produced domestically (c_d) and abroad (c_f) in sector s (emanating from final good producers) are given by:

$$c_d = \mathcal{N}^{\sigma-1} \left(\frac{p_d}{P_s} \right)^{-\sigma} C_s, \tag{6}$$

$$c_f = \mathcal{N}^{\sigma-1} \left(\frac{p_f}{P_s} \right)^{-\sigma} C_s, \tag{7}$$

while the price of the type-s sectoral good is a combination of individual prices (from both countries), p_d and p_f:

$$P_s = \mathcal{N}^{-1} \left(\int_0^n p_d^{(1-\sigma)} \mathrm{d}d + \int_0^{n^*} p_f^{(1-\sigma)} \mathrm{d}f \right)^{\frac{1}{1-\sigma}}. \tag{8}$$

Notice that, under symmetry between sectors ($P = P_s$, $\forall s$), this also corresponds to the consumption price index expression. Due to love-for-variety preferences, with a larger number of firms, the amount to pay in order to get a given utility is lower, such that the welfare-based price index (P) decreases (remind that at the symmetric equilibrium, $P = P_s$).

2.2.2 At the Sector Level: Firm Entry and Profit Maximization

Within a given sector, each individual firm produces a differentiated good using labor domestically supplied. Each variety is sold on the domestic and the foreign markets, with international trade being subject to iceberg trade costs ($\tau > 1$). As a result, the equilibrium condition for each differentiated Home variety $d \in \Omega_D$ (in sector s) is:

$$y_d = \bar{L} c_d + \tau \bar{L}^* c_d^*, \tag{9}$$

where c_d^* denotes consumption of type-d goods in the Foreign country. For the Home country, the production function is such that:

$$y_d = Z h_d, \tag{10}$$

where h_d denotes firm's labor demand used to produce the type-d variety, and Z is the aggregate labor productivity.[8] There is free entry in the manufacturing sector, but firms have to pay a fixed

[8] Note that we assume the same productivity level across sectors.

cost to start producing. As standard in the related literature, the fixed entry cost is imputed in labor. In the context of increasing returns to scale, each firm produces one single variety, such that n (resp. n^*) corresponds to both the number of Home (resp. Foreign) firms and varieties. The firms program may be decomposed in two steps. First, they take the decision to entry, given the fixed cost of entry they face (which ultimately determines the number of firms in each country). Second, once entered, they maximize the operating profit. As standard, we solve the problem backwards.

Once entered, the Home firm (producing variety d) maximizes its operational profit, given by:

$$\Pi_d = \bar{L} p_d c_d + \bar{L}^* p_d^* c_d^* - (1+\tau_w) W h_d, \tag{11}$$

under the production function (10) and the demand functions for its good that emanate from the final good sector in each country (c_d, from Equation (6) and its equivalent abroad denoted by c_d^*), with τ_w denotes the payroll labor tax rate.
Solving this profit maximization problem leads to the optimal pricing decisions for the Home and export (Foreign) markets respectively:

$$p_d = \mu_d (1+\tau_w) \frac{W}{Z}, \quad \text{and} \quad p_d^* = \tau \frac{\mu_d^*}{\mu_d} p_d, \tag{12}$$

where μ_d and μ_d^* represent the Home markups extracted on the Home and Foreign-export markets, respectively. We show below that markups depends on the number of competitors on the market and the relative price of goods. The price setting equations (12) deserve two comments. First, departures from the perfect competition setting come from two sources: payroll taxation ($\tau_w > 0$) and the firms markup behavior ($\mu_d > 1, \mu_d^* > 1$). Second, the price of type-d good that is exported (p_d^*) may differ from the local price (p_d) for two reasons: *i°)* Trade costs, as the iceberg trade cost is transferred from the firm to the Foreign household (standard mill-pricing strategy), *ii°)* markup differentiation between export and local market. Otherwise stated, beyond trade costs, firms may optimally price to market (i.e., set different prices for the same variety), as long as the price-elasticities of the demand for their good differs across countries. This will turn to be key in the international transmission of the tax reforms implemented in the Home country, hence on its trade competitiveness.

Consider now the first step of entry decision. Firm's entry is subject to a sunk entry cost – measured in labor units – made up of regulation costs (f_R) and the R&D expenditures (f_T), as in Cacciatore and Fiori (2014). We assume that the regulation cost can be subsidized by the government, at the rate $\tau_e < 0$. Under free entry, firms enter the market until the operational profit is just sufficient to cover the overall entry cost:

$$\Pi_d = (f_T + f_R(1+\tau_e))\, W. \tag{13}$$

2.2.3 Markups and Pricing-to-Market

Within a given sector, due to the limited number of firms, each firm takes into account the effects of its pricing decision on the sectorial price index, which ultimately affects the price-elasticity of demand for its variety.[9] As in Atkeson and Burstein (2008), this setup implies that the price-elasticity of the demand addressed to one firm, rather than constant, is negatively related to the market share of a firm. Let ε_d denote the price-elasticity of Home demand for a domestic variety (multiplied by -1) such that $\varepsilon_d \equiv -\frac{\partial c_d}{\partial p_d}\frac{c_d}{p_d}$. We similarly define ε_d^* the price-elasticity of export (Foreign) demand for a Home variety (also mutilplied by -1). It can be shown that:

$$\varepsilon_d = \sigma - (\sigma - \theta)\, m_d > 0, \quad \text{with} \quad m_d = \frac{1}{n + n^* \left(\frac{p_f}{p_d}\right)^{1-\sigma}}, \tag{14}$$

$$\varepsilon_d^* = \sigma - (\sigma - \theta)\, m_d^* > 0, \quad \text{with} \quad m_d^* = \frac{1}{n + n^* \left(\frac{p_f^*}{p_d^*}\right)^{1-\sigma}}, \tag{15}$$

where $m_d \equiv \frac{p_d c_d}{n p_d c_d + n^* p_f c_f}$ is the market share of a Home firm on its local market, and m_d^* its market share on its export market.[10] Notice that markups are related to price-elasticity of demand on each markets, according to:

$$\mu_d \equiv \frac{\varepsilon_d}{\varepsilon_d - 1}, \quad \text{and} \quad \mu_d^* \equiv \frac{\varepsilon_d^*}{\varepsilon_d^* - 1}. \tag{16}$$

When goods are as substitutable within sectors than across sectors ($\sigma = \theta$), the competition structure implies a constant price-elasticity of demand ($\varepsilon_d = \sigma$ in Equation (14)), hence a constant markup, and identical across destination markets. Precisely, from Equation (16), it comes $\mu = \sigma/(\sigma-1)$ as in the standard Dixit and Stiglitz's (1977) monopolistic competition model. In a typical calibration though, varieties are more substitutable within than between sectors, i.e. $\sigma > \theta$.[11] In that case, markups are variable. From Equations (14)-(15), we infer that they depend on two dimensions: the number of competitors, and the relative price of the goods. Let us briefly comment on each dimension.

First, the firm's market share is inversely proportional to the number of firms, whatever their location.[12] This so-called "competition effect" has a straightforward interpretation: given the oligopolistic-type of competition within each sector, a marginal entry raises the price-elasticity of demand addressed to each producer in place, thereby exerting a downward pressure on its markup. In our open-economy setting, the market share of a domestic firm thus depends on both the number of local but also imported varieties, n and n^*. However, due to trade costs, the effect of a marginal entry on the domestic market exerts a more dampening effect on the incumbent's markup, than when entry occurs on the foreign market.[13]

[9] We can interpret this setup as a model where firms are in an oligopolistic market and they compete on prices (Bertrand competition).

[10] It is straightforward to show that the market share m_d corresponds to the elasticity of the sectoral price to the firm price in the Home country: $\varepsilon_d^{Pp} \equiv \frac{\partial P_s}{\partial p_d}\frac{p_d}{P_s}$.

[11] Broda and Weinstein (2006) present empirical evidence that this is indeed the case.

[12] Note that our set-up includes the closed-economy case of Floetotto and Jaimovich (2008), where $m_d = 1/n$.

[13] This can be shown combining the optimal value of p_f (using the foreign counterpart of Equation (12)) in Equation (14) that gives the market share m_d:

$$m_d = \left[n + n^* \phi \left(\frac{\mu_f}{m_f^*} \frac{p_f^*}{p_d} \right)^{1-\sigma} \right]^{-1},$$

Second, the market share of a given firm depend on the price of its good relative to that of their foreign competitors on the market, that is p_f/p_d in the case of Home firms on the Home market. This "relative-price effect" also has a straightforward interpretation. An increase in the relative price of imports, raises the market share of the Home firms selling on the local market, inducing them to increase their markups (μ_d). Further, *on a given destination market*, if the "competition effect" affects the market share of both domestic and foreign firms symmetrically (an increase in n or n^* reducing the markup extracted by each incumbent, wherever it is located), the "relative-price effect" conversely plays asymmetrically across firms, allowing those of relative price has decreased to extract higher markups, but forcing the others to reduce their rents extracted on the market.[14]

2.3 Government

Government in each country runs a balanced budget. Absent public spending, collected distortive taxes are rebated to the households as lump-sum transfers, according to the following budget constraint:[15]

$$\tau_e f_R nW + \tau_w nWH + \tau_c \bar{L}PC = \bar{L}T. \tag{17}$$

In our policy experiments, we will consider distortive tax rates as exogenous, balancing the government budget constraint with lump-sum transfers.[16]

2.4 Market Clearing Conditions

The labor market In each country, labor market is perfectly competitive, accordingly, labor supply is fully used either in the production of manufactured goods or for paying entry costs. Given the technological constraint (10), the labor market equilibrium thus writes:

$$\bar{L}H = n\frac{y}{Z} + n\left(f_T + f_R\right). \tag{18}$$

Balance of payments Under financial autarky, the zero trade balance necessarily holds, such that:

$$\bar{L}^* n p_d^* c_d^* = \bar{L} n^* p_f c_f. \tag{19}$$

with $\phi \equiv \tau^{1-\sigma}$ taking values between 0 and 1 (increasing with the "freeness of trade"), this indicates that larger trade costs (i.e., lower ϕ) reduce the relative "weight" of the number of foreign competitors in affecting the market share of a domestic incumbent.

[14] This can be seen from the market share of Foreign firms on the domestic market, which can be expressed as $m_f = 1/(n^* + n(p_d/p_f)^{1-\sigma})$, which decreases with an increase in p_f/p_d.

[15] Anticipating on the labor market equilibrium condition.

[16] Our framework also enables us to study of the effects of fiscal devaluation (switching from τ_w to τ_c, for a given value of transfers). As mentioned in the introduction, this is not likely to substantially modifies the results, as long as this amounts reducing the labor tax wedge ($(1+\tau_c)(1+\tau_w)$ in our terminology).

3 Calibration

Normalization We retain the domestic good as numéraire ($p_d = 1$). We define the terms of trade $s = p_d^*/p_f$ as the export price relative to import prices for the Home country. The real exchange rate is defined as $q \equiv P^*/P$. In addition, as standard in trade models, we define $\phi \equiv \tau^{1-\sigma}$ as measuring the "freeness" of trade. With $\tau > 1$, it is scaled between 0 (autarky) to 1 (free trade). Appendix A summarizes the model's equations.

Calibration At the symmetric equilibrium, the two countries are identical in all aspects, $\bar{L} = \bar{L}^*$, $Z = Z^*$ and $\tau_x = \tau_x^*$ for $x = \{w, e, c\}$. The number of firms in both countries are identical ($n = n^*$) and all goods are sold abroad at an identical price, such that $s = 1$.
Table 1 summarizes the calibrated values.

[Insert Table 1 here]

The elasticities of substitution across goods and across sectors are set to $\sigma = 5$ and $\theta = 2$, respectively, which are line with empirical estimates.[17] Additionally, we need to calibrate one markup in order to deduce the number of firms per sector, n. We assume that $\mu_d = 1.3$, which is in the range suggested by Eggertsson *et al.* (2014) for European countries.[18] We assume a typical CES preference function by setting $\nu = (\sigma - 1)^{-1}$. We set $\psi = 1$, implying a log specification on consumption, as standard in the related literature (see Corsetti *et al.* (2007), Floetotto and Jaimovich (2008), among others). The Frisch parameter is set to $\eta^{-1} = 0.5$, in line with the empirical estimates of MaCurdy (1981) and the scale parameter σ_H is set to ensure that $H = 0.30$. Finally, country's size and technology ($\bar{L}$ and Z) are normalized to unity. The trade costs are set to $\tau = 1.3$, as suggested by di Mauro and Pappadà (2014) for countries of the Euro Area. To calibrate the size of regulatory entry cost, we rely on Djankov *et al.* (2002), which provide measures for fees required for entry provided in 1997, expressed as a percentage of annual per capita GDP, for a large set of countries. We take the mean value observed in the Euro Zone countries, that gives us a ratio of the cost of entry regulation that amounts to 20% of GDP.
With these calibrated values, we solve the initial symmetric equilibrium of the world economy that reveal the values of some deep parameters, that we consider as fixed in our further experiments. In particular, the initial equilibrium implies that the markup rate set on the export market is lower than on the local market, such that $\mu_d^* = 0.97\mu_d$ (symmetrically, $\mu_f = 0.97\mu_f^*$), in accordance with

[17] Broda and Weinstein (2006) estimate the elasticity of substitution among goods at the sectoral level for the US. Their median estimate of the substitution elasticity between 3-digit level goods (corresponding roughly to our θ) is 2.50 over the sample 1972-1988. At the most disaggregated level, their median substitution elasticity (our σ) is 3.7. However, J. and van Wincoop (2004) suggest a range between 5 and 10 for σ. Benkovskis and Wörz (2014) estimate σ to a value close to 2 for the US between 2 and 2.17 for several countries of the Euro Area. Soderber (2015) suggests estimates of a same range for these countries. Atkeson and Burstein (2008) calibrate $\sigma = 10$ and θ close to 1, meaning that they allow for a strong pricing-to-market behavior.

[18] Based on Ho j *et al.* (2007), Eggertsson *et al.* (2014) set markups for total private firms to 1.36 for Periphery countries (Italy and Spain) and 1.25 for Core countries (France and Germany). Notice that a markup calibration of 36% also corresponds to the value adopted by Ghironi and Mélitz (2005).

the empirical estimates of Moreno and Rodrguez (2004). The revealed value of the R&D entry cost f_T implies that overall technological entry costs amount to 2.36% of annual GDP, in line with Cacciatore and Fiori (2014).

In the initial state, the payroll tax is set to $\tau_w = 0.20$ and we assume that there is no entry subsidy such that $\tau_e = 0$. In our benchmark calibration, we also set aside the role of consumption taxation by setting $\tau_c = 0$. Starting from this equilibrium, we assume that the Home country carries out *1°)* product deregulation by subsidizing entry ($\tau_e < 0$) or *2°)* an internal devaluation, by reducing the payroll tax rate (τ_w). In both experiments, the reduction in τ_e and τ_w are calculated so as to imply a comparable reduction in lump-sum transfers (in proportion of GDP) of 5%.

4 Reforms, Competitiveness and the Role of Pricing-to-Market

In this section, we study the effects of either a product market deregulation or an internal devaluation on international price competitiveness, and how they are affected by the markup endogeneity. The case where markups are constant constitutes our first stage, as it allows us to clarify the mechanisms specific to each type of reform, putting aside the role of endogenous margins. This is achieved by calibrating $\sigma = \theta$.[19] In a second stage then, we add the variability of markups (by setting $\sigma \neq \theta$) into the model. This enables us to identify how the effects of both reforms on competitiveness are altered by the endogenous margin adjustments made by firms in an international setting.

4.1 Determinants of the Real Exchange Rate

The most common measure of international competitiveness is captured by the real exchange rate, q, that is the ratio of consumption price indices across countries. Since Ghironi and Mélitz (2005), it is well understood that the real exchange rate not only relies on the relative price of exports (i.e., the terms of trade), but also on the relative number of exporting firms (i.e., the extensive margin of trade).[20] We might wonder how variable markups affect the effectiveness of price- and market-driven reforms on international competitiveness. To this aim, Figure 2 reports the effects of a Home product market deregulation and an internal devaluation on the real exchange rate for the two setups (constant and variable markups). The reductions in τ_e and τ_w are determined so as to imply in both cases a reduction in the ratio of transfers to GDP by 5%.[21] The variations of the real exchange rate are expressed in percentage deviation from the symmetric state, i.e. in the absence of reform.

[Insert Figure 2 here]

[19]Precisely, the calibration is set identical to the one reported in Table 1, except that we set $\sigma = \theta = 2$. Notice that under $\sigma = \theta$, we can solve the model analytically if also imposing an infinite Frisch labor supply elasticity (i.e., $\eta = 0$), as shown in the online appendix. This model is borrowed from Corsetti *et al.* (2007). As long as we depart from this calibration, the model even with constant markups cannot be solved analytically.

[20]As explained in Ghironi and Mélitz (2005), endogenous firm entry decisions induces changes in the composition of the consumption baskets across countries, hence in the associated CPIs and the resulting real exchange rate.

[21]Precisely, this is achieved by a reduction in τ_w from 20% to 18.8%, and a reduction in τ_e from 0 to -3.65%. In this case, this implies a slight reduction in the overall regulation entry costs by 0.07 percentage points.

Both reforms do improve the Home country's competitiveness, as they induce a real exchange depreciation. Interestingly, it comes that internal devaluation is more effective than a product deregulation in depreciating the real exchange rate in the constant-markup setup. Allowing for variable markups reverses this result. This suggests that endogenous markups play a key role in the determination of the real exchange rate. To go further into this result, we express a linearized version of the real exchange rate[22]

$$\widehat{q} = \frac{1-\phi\bar{\kappa}^{1-\sigma}}{1+\phi\bar{\kappa}^{1-\sigma}} \left[\underbrace{-\widehat{s}}_{(a)} + \frac{1}{\sigma-1} \underbrace{(\widehat{n}-\widehat{n}^{*})}_{(b)} + \frac{1}{1-\phi\bar{\kappa}^{1-\sigma}} \underbrace{(\widehat{\kappa}_d - \widehat{\kappa}_f)}_{(c)} \right], \tag{20}$$

where $\bar{\kappa}$ is a constant and $\kappa_d \equiv \mu_d^*/\mu_d$, $\kappa_f \equiv \mu_f/\mu_f^*$ measure the extent of the pricing-to-market behavior by the Home and Foreign firms respectively. When markups are constant ($\sigma = \theta$), it turns out that $\bar{\kappa} = 1$ and Term (c) drops out since firms do not differenciate their markups.

Equation (20) deserves several comments. Everything else being equal, a reduction in the relative price of exported goods by the Home country boosts its price-competitiveness and raises the real exchange rate (Term (a)), thereby improving the international trade competitiveness of this country. Competitiveness also positively depends on the relative number of Home varieties (Term (b)): in a two-country world in presence of trade costs, the reduction of the Home CPI induced by a marginal variety is stronger when the firm entry occurs on the domestic market than abroad.[23] The mechanism channels through the love-for-variety effect that links the number of firms and the CPI. As it can be inferred from Equation (8), as the households has preferences towards more varieties, a larger number of available products reduces the aggregate price index (everything else equal).

In a model with endogenous markups ($\sigma \neq \theta$), the terms of trade and the extensive margin of trade, identified as key determinants of the real exchange rate in the constant-markup case still play a major role.[24] However, it makes the extent of price discrimination between Home and Foreign firms intervene as third determinant of the real exchange rate, see Term (c). Precisely, having $\widehat{\kappa}_d - \widehat{\kappa}_f > 0$ implies a real exchange rate depreciation.[25] To understand things clearly, consider the case where markups' changes emanate from Home firms, and such that the markup charged

[22] In what follows, $\hat{x} \equiv \frac{(x-x^{sym})}{x^{sym}}$ denotes the deviation of variable x from the symmetric state.

[23] Modeling trade costs ($\phi < 1$) thus appears as a condition for both Terms (a) and (b) to affect the real exchange rate. Under free trade and constant markups ($\phi \to 1$ and $\bar{\kappa} = 1$), it is straightforward to show that the law of one price holds, as well as purchasing power parity absent any home bias in preferences ($q = 1, \ \forall s$).

[24] Nothing ensures that $1-\phi\bar{\kappa}^{1-\sigma} > 0$, in which case the elasticity of Terms (a) and (b) on $\widehat{q}$ would be sign-reversed compared to the model with constant markups. However, we verify that our calibration implies that the effects of the two determinants remain qualitatively similar to the constant-markup case. Precisely, our calibration indeed implies that $\bar{\kappa} = 0.974$, i.e. lower than 1, in accordance with the data. Combined with our calibration for σ and ϕ, this implies that $\frac{1-\phi\bar{\kappa}^{1-\sigma}}{1+\phi\bar{\kappa}^{1-\sigma}} > 0$. Theoretically, the condition to be respected is $\bar{\kappa} > \frac{1}{\sigma-1}$

[25] Indeed, it can be shown that

$$\frac{\partial \widehat{q}}{\partial(\widehat{\kappa}_d - \widehat{\kappa}_f)} = \frac{(\sigma-1)\phi\bar{\kappa}^{1-\sigma}}{(1+\phi\bar{\kappa}^{1-\sigma})^2} > 0.$$

In contrast to the terms of trade and the extensive margin of trade, the derivative is positive whatever the value of $\bar{\kappa}$.

on the export (Foreign) market increases by more than on the local market (or, contracts by less, i.e., $\widehat{\kappa}_d > 0$). Everything else equal, this implies that the Foreign consumption price index raises more than the domestic one, leading to a real exchange rate depreciation. Would the Foreign firms apply a similar markup extraction on their export market (relative to their local one), there would be no impact on the real exchange rate (since $\widehat{\kappa}_d = \widehat{\kappa}_f$). Otherwise stated, it is the asymmetric pricing-to-market behavior between Home and Foreign firms, that matter in affecting the extent of international competitiveness.

This analysis sheds light on the two key determinants of the real exchange rate, the extensive margin of trade and the relative price of exports. In presence of endogenous markups, price discrimination also affects international competiveness since it might reverse the effectiveness of the reforms, as shown in Figure 2. As a consequence, a further investigation is needed to understand the transmission channels of the two reforms, product market deregulation and internal devaluation, on international competiveness.

4.2 How do Reforms Affect International Competitiveness?

We now study the effects of the two reforms on the real exchange rate, by taking into account how each dimension is affected by the reform under focus. We stress that the transmission channels strikingly differ across the two reforms, explaining why their effectiveness might be altered by endogenous markups.

4.2.1 Product Market Deregulation

Figure 3 reports the effects of implementing a product market deregulation on the number of firms in each country and on the terms of trade. The left bar displays the percentage deviation from the initial state under constant-markups ($\sigma = \theta$) and the right bar provides the counterpart under endogenous markups ($\sigma \neq \theta$). As previously, the Home country reduces τ_e in both cases so as to imply a reduction in the ratio T/Y by 5%.

[Insert Figure 3 here]

Figure 3 shows that the real exchange rate depreciation, highlighted in Figure 2, is attributable to the extensive margin of trade, despite an increase in the relative price of exports, i.e. a deterioration of the terms of trade. Interestingly, the later effect is mitigated under variable markups which explain our main result: product market deregulation is more effective when markups are endogenous. The endogenity of markups, if it does not change the direction of the effects, substantially affects their magnitude, so as to reverse the ranking between both reforms regarding their ability to depreciate real exchange rate.

The mechanisms behind these results can be understood by first focusing on the model with constant markups ($\sigma = \theta$). The primary effect of product market deregulation is to play on the number of active firms. By reducing the cost of entry, the reform induces more firms to enter the domestic market, until the free-entry condition (13) is restored.[26] As exposed above, the increase in the number of domestic firms (relative to foreign) then induces a real exchange rate depreciation, by reducing the Home CPI more than abroad.

This improvement in international competitiveness holds despite the deterioration of the terms of trade. The underlying effects can be uncovered from the zero-trade balance Equation (19), which, given the optimal demand functions, can be written according to

$$s^{(\sigma+\psi-1)} = \frac{\bar{L}^*}{\bar{L}} \left(\frac{P^*}{P}\right)^{\sigma-\psi} \underbrace{\left(\frac{n}{n^*}\right)}_{(a)} \underbrace{\left(\frac{\mu_d^*}{\mu_f} \frac{\tau_w}{\tau^{w*}}\right)^{\psi}}_{(b)}. \tag{21}$$

Notice that under constant markups, $\mu_d^*/\mu_f = 1$. The increase in the relative number of domestic firms $(n - n^*)$ implies that the relative demand for imports coming from the foreign households also raises (given the love-for-variety preferences, as more domestic varieties are available). Everything else equal, this pushes the relative price of the Home exports upwards (i.e. s rises with an increase in Term (a) in Equation (21)). This induces deterioration of the price-competitiveness of the Home economy thus limits the magnitude of the real exchange rate depreciation.

How do variable markups affect this result? To complement Figure 3, Figure 4 displays the elasticity (multiplied by 100) of the markups applied on the domestic and foreign markets by the Home firms (Panel (a)) and the Foreign firms (Panel (b)) respectively, to the entry subsidy implemented in the Home country.

[Insert Figure 4 here]

Markups' variations are mostly driven by the competition effect: the reduction in the entry cost boosts entry in the Home country. By intensifying competitive pressures between oligopolistic producers, the arrival of an entrant reduces the market share of incumbents which reduces their markups, as explained with Equations (14)-(15). This competition effect implies that markup rents extracted for both varieties on the Home market (μ_d and μ_f) decrease substantially. As displayed in Figure 4, the markup reduction is much weaker on the Foreign market. Indeed, the price-elasticity of Foreign demand is less sensitive to a marginal entry which emanates from the Home country due to the trade costs, allowing a lower markup contraction on the Home export market (μ_d^* decreases by less than μ_d). For a similar reason, Foreign firms, if they suffer from the reduction of markups on the domestic market, due to tougher competition, are less affected than the Home firms (μ_f reduces by less than μ_d). Further, the deterioration of price-competitiveness of the domestic firms enables the Foreign ones to raise their markups on their local market ($\widehat{\mu}_f^* > 0$).

It follows that the *relative* markup extracted on the export market raises for the Home firms, while it contracts for the foreign firms ($\hat{\mu}_d^* > \hat{\mu}_d$, $\hat{\mu}_f < \hat{\mu}_f^*$). Product market deregulation reducing markups in the Home country more than in the Foreign one, then implies that the reduction in

[26] As in Corsetti *et al.* (2007), in the constant-markups model with $\eta = 0$, one can analytically show that a marginal entry reduces the incumbent's operational profit if $\sigma > \psi$, which is retained here. Under this calibration, it can be shown that $n = \bar{L}\tilde{P}C/y$, or similarly, $n = \bar{L}\left(f_T + f_R \tau^e\right)^{-1}$.

the CPI is also larger. Everything else equal, this induces a real exchange rate depreciation, in line with Term (c) in Equation (20).

Having in mind the effects of a product market deregulation on markups, we can investigate how the endogeneity of markups affects the two other determinants of the real exchange rate, i.e. the number of exporters and the terms of trade (Terms (a) and (b) in Equation (20), respectively), see Figure 3.
Consider first the effects regarding the extensive margin of trade. As mentionned above, the number of varieties in the Home country, n, increases when its government reduces entry taxes. In presence of endogenous markups though, the number of domestic firms is less sensitive to a product market deregulation. As reported in Figure 4, firm entry generates markup contraction in the Home country due to the competition effect. This moderates the reduction in the operational profit and therefore, less Home firms are needed to restore the free-entry condition. Given our calibration, the spillover effect of the reduction of τ_e on the Foreign number of firms is fully attributable to markup endogeneity (see Panel (b)). Indeed, n^* does not react to a Home product market deregulation when markups are constant. In that particular case, τ_e matters for the Foreign number of firms only through the love-for-variety effect captured in expression $(\tilde{P}^*)^{1-\psi}$. This channel is shut down for $\psi = 1$. Pricing-to-market behavior plays a key role to reverse this result. As reported in Figure 4, Home product market deregulation raises the rent that Foreign firms can extract on their local market (and even though margins perspectives are slightly deteriorated). For the given entry cost, this raises the profit opportunities, inducing new entry. Therefore, the strong competition effect makes product market deregulation at Home having positive spillover effects on the Foreign number of firms. Coming back to Equation (20), it results that the lower increase in $(\hat{n} - \hat{n}^*)$ resulting from endogenous markups limits the ability of the reform to raise the international competitiveness of the Home country through the extensive margin of trade.
Consider next the changes in terms of trade. As reported in Figure 3, the deterioration of terms of trade is of lower magnitude under variable markups (Panel (c)). As in the case with constant markups, this can be rationalized recalling the zero-trade balance condition, see Equation (21). As explained above, the competition effect generates a contraction in the export markups by Home firms, which is of stronger magnitude than the one supported by the Foreign firms (Figure 4, $\widehat{\mu}_d^*$ is more negative than $\widehat{\mu}_f$). This strong reduction in Home markups translates into higher purchasing power for domestic households, boosting their aggregate expenditures everything else equal (Term (b) in Equation 20). This makes the import demand for Foreign goods increase in relative terms. This exerts an upward pressure on the relative price of these goods, i.e. leading to a lower increase in s than in the constant markups case. Through this mechanism, the variability of markups mitigates the deterioration of the terms of trade incurred by the domestic goods.

Consequently, the endogenous pricing-to-market of firms plays a substantial role in the effects of the Home product deregulation on the real exchange rate. In comparison with the benchmark constant-markups case, it mitigates the ability of the reform to improve competitiveness along the extensive margin of trade. By contrast, it leads to less deteriorated performances regarding the relative price of exports (Terms (a) and (b) in Equation (20)). Further, as the reform induces a reduction of markups extracted on the Home market, by either domestic and foreign firms, this implies that the ability of firms to preserve their relative markup rent on the export market is higher for the domestic firms. This induces an asymmetric pricing-to-market behavior between domestic and foreign firms, that leads to a lower reduction in the Home CPI than abroad (Term (c) in Equation (20)). This, in turn, translates into a larger real exchange rate depreciation.

4.2.2 Internal Devaluation

We now turn to investigate through which channels an internal devaluation affects international competitiveness. Here again, we focus on the effects of the reform on the main components of the real exchange rate, namely the number of firms and the terms of trade. Figure 5 displays the elasticity (multiplied by 100) on these variables to a payroll tax cut implemented in the Home country in a model with constant markups ($\theta = \sigma$) and variable markups ($\theta < \sigma$), so as to reduce T/Y by 5%.

[Insert Figure 5 here]

Let us first consider the effects on the extensive margin of trade, described in Panels (a) and (b). Under constant markups and with $\psi = 1$ and $\eta = 0$, internal devaluation would not affect the number of Home firms.[27] For our calibration $\eta = 2$, the number of firms at Home decreases because the substitution effect is weak. Indeed, the raise in wages is translated into a small increase in hours supply to satisfy the given output per firm. This pushes n downward. This effect is lessens when markups endogenously adjust. To fully understand this result, we plot in Figure 6 the elasticity (multiplied by 100) of Home and Foreign markups to the internal devaluation.

[Insert Figure 6 here]

As observed in Equations (14)-(15), endogenous markups are driven by two effects: the "competition effect" and the "relative-price effect". The later is the main channel through which an internal devaluation affects markups. Indeed, a payroll tax cut reduces the price of Home goods relative to the price of imported goods (p_f/p_d increases). As explained above, this relative-price effect implies that Home firms increase their markups on both local and export markets (μ_d and μ_d^*). This raises the unit profit on each quantity sold: everything else equal, this enticing firms to enter the Home market. As a result, by raising the market share of the Home firms, internal devaluation improves the country's performances along the extensive margin of trade. Further, this structural reform exerts a negative spillover on the Foreign number of firms, by deteriorating their margin position. Markups extracted by Foreign firms (μ_f and μ_f^*) are reduced, which reduces the operational profit of the Foreign incumbents, discouraging entry.

[27] Let remind that in that particular case, $n = \bar{L}\left(f_T + f_R \tau^e\right)^{-1}$ and therefore the rise in total aggregate expenditures ($\tilde{P}C$) is exactly compensated by an increase in individual production y such that n remains constant, as for n^*.

Markup endogeneity also modifies the effects of the regulatory reform on the terms of trade since they decrease by less (see Panel (c)). Term (a) in Equation (21) helps us to understand the intuition behind this result. A reduction in $\hat{n} - \hat{n}^*$ depresses the relative imports demand by the Foreign country, which improves price-competitiveness (s is pushed downward). The internal devaluation also directly affects the "aggregate-expenditure effect", expressed by Term (b) in Equation (21). Indeed, a reduction in payroll tax boosts Home aggregate spendings and therefore the domestic prices for imported goods increase relative to the export prices, which improves price-competitiveness. Pricing-to-market behavior mitigates this effect since, as explained above, μ_d^*/μ_f unambiguously increases. Therefore, the reduction in s is lessened by the market share of Home firms.

To sum up, an internal devaluation in the Home country is beneficial international competitiveness of the country, although markups endogeneity reduces the effectiveness of this policy (unlike the product market deregulation). The intensive margin of trade is a key player for this result. Indeed, the price of imported goods relative to exported ones increases after a payroll tax cut, mostly because of the rise in Home aggregate spendings. Endogenous markups mitigates this effect but by a small amount.

5 Enlarging the Scope and Welfare

TBA

6 Conclusion

TBA

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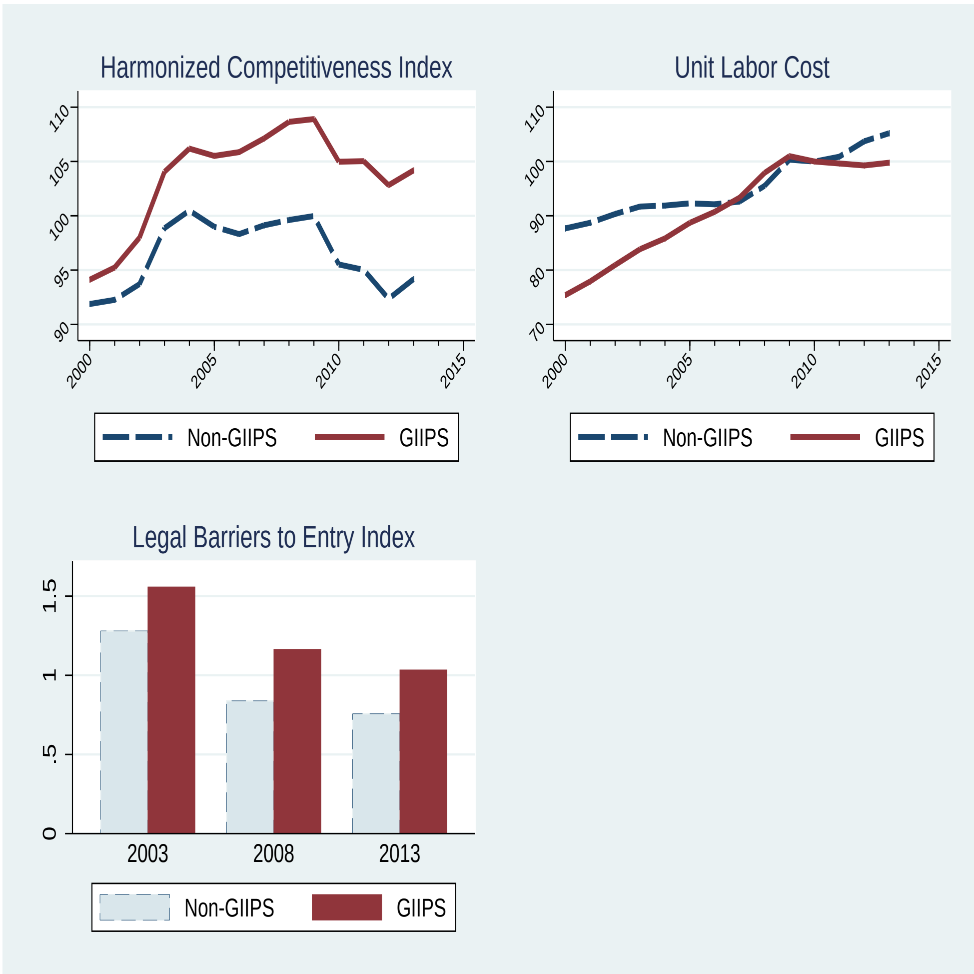
Table 1: **Calibration**

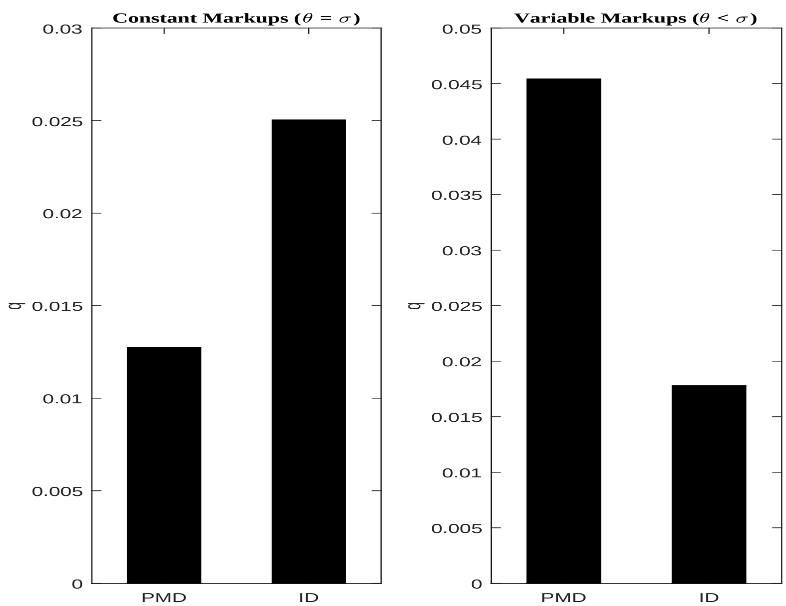
Production Function and Preferences		Value
σ	Elasticity of substitution btw goods	5
θ	Elasticity of substitution across sectors	2
μ_d	Markup rate	1.30
τ	Trade costs	1.30
$f_R \times (W/y)$	Regulation costs in % of GDP	9.00
v	Love-of-variety degree	$(\sigma - 1)^{-1}$
η	Frisch parameter	1.00
ψ	Curvature of utility function	1.00
σ_H	Scale parameter ($H = 0.3$)	8.92
Normalization		
p_d	Home goods price (numeraire)	1.00
L	Country size	1.00
Z	Productivity	1.00

Figure 1: **International Competitiveness, stylized facts**



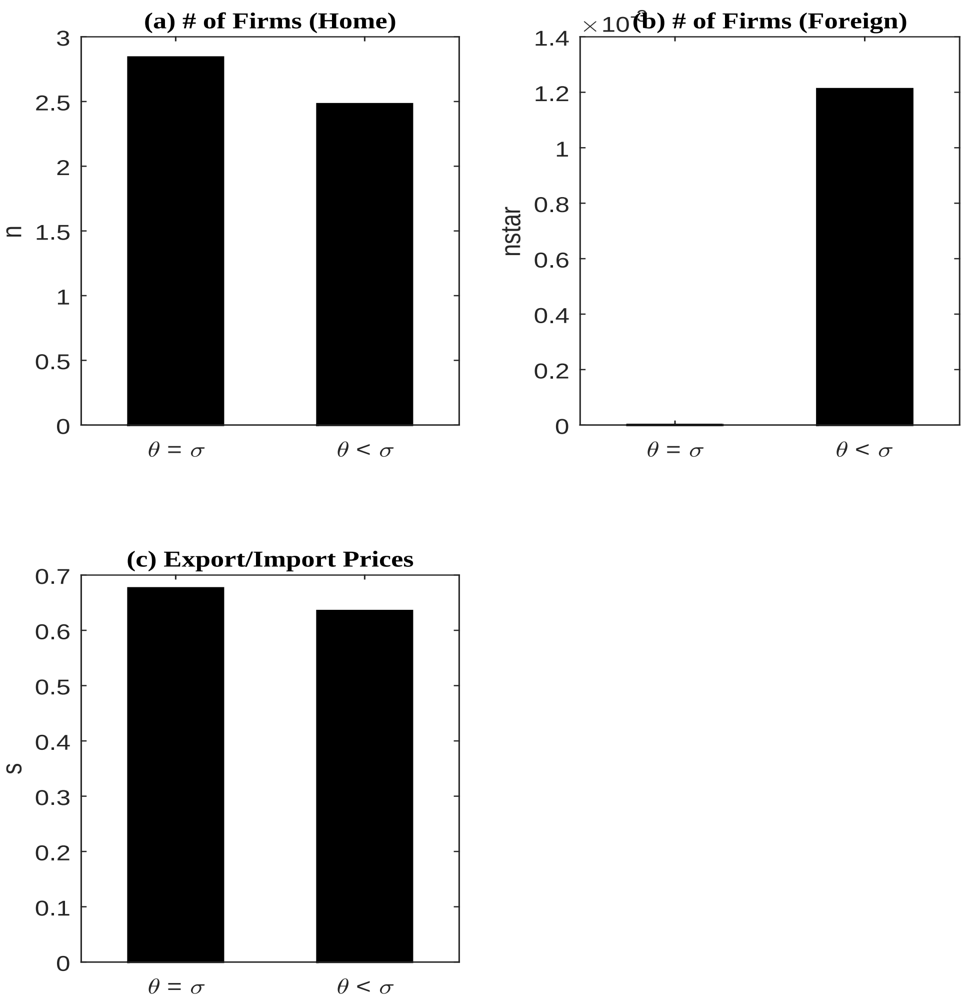
Note: The upper left panel displays the GDP-weighted average of the Harmonized Competitiveness Index for GIPPS countries (solid line) and non-GIIPS countries (dashed line). The upper right panel displays the GDP-weighted average of the Unit Labor Cost for GIIPS (solid line) and non-GIIPS (dashed line). The lower left panel displays the average of the Legal Barriers to Entry index (0: low barriers) for GIIPS (solid red bar) and non-GIIPS (dashed grey bar). GIIPS countries include Greece, Italy, Ireland, Portugal, Spain, while non-GIIPS countries include Austria, Belgium, Finland, France, Germany, Luxembourg, Netherland.

Figure 2: **Effect of a Product Deregulation and an Internal Devaluation on the Real Exchange Rate**



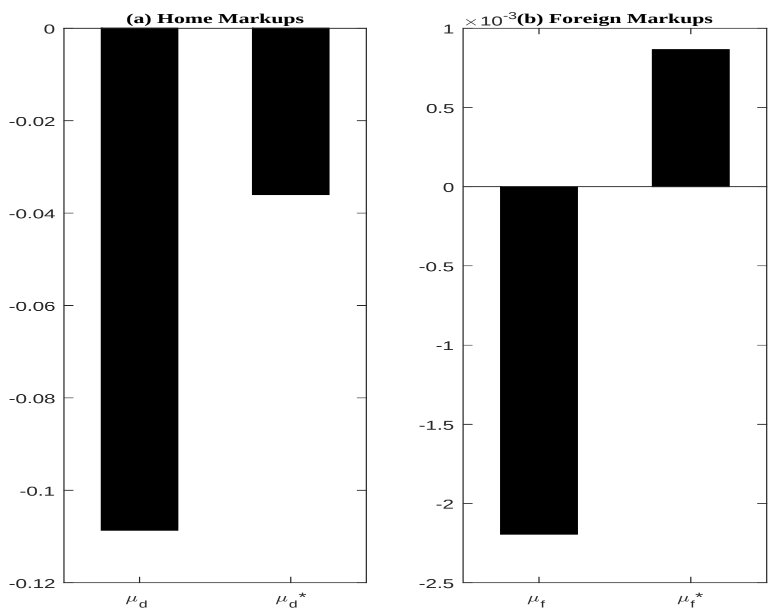
Note: The bars correspond to the percentage deviation from the symmetric equilibrium to a cut in τ_e aimed at reducing T/Y by 5 percent.

Figure 3: **Product Market Deregulation: Main Variables**



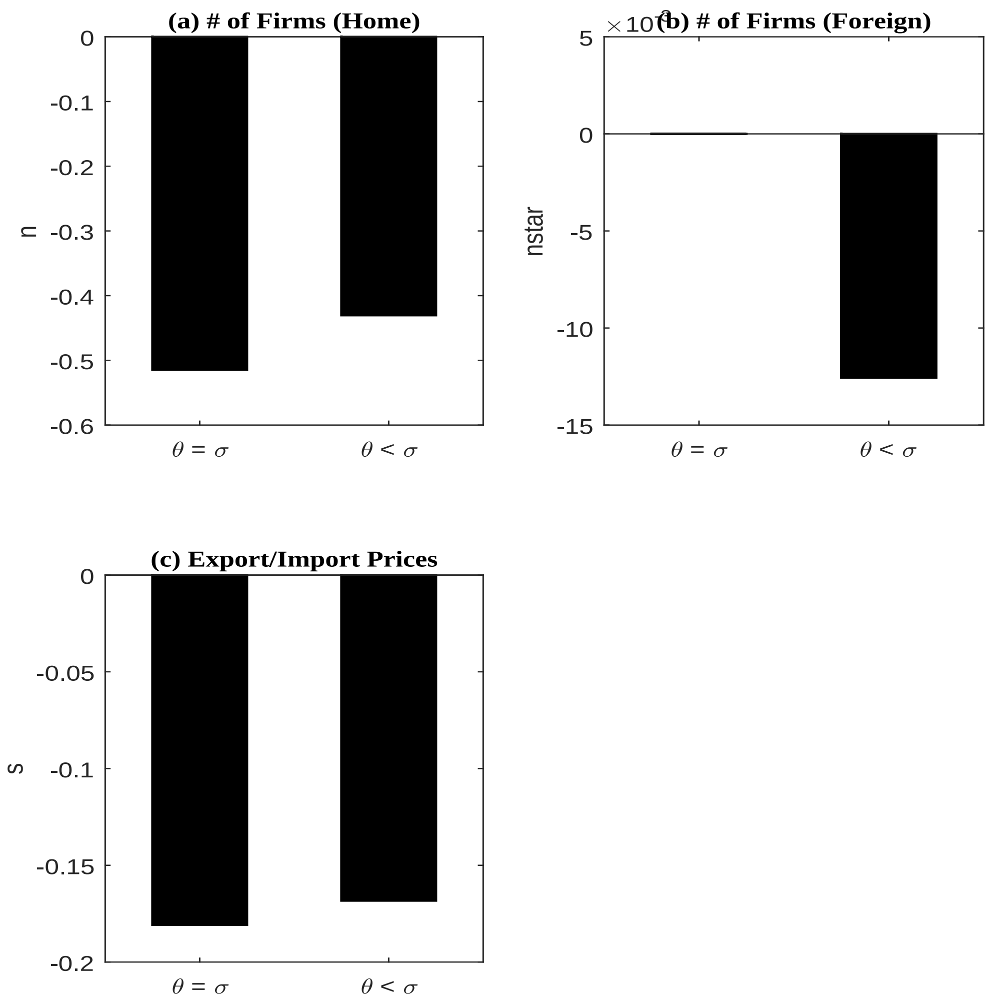
Note: The bars correspond to the percentage deviation from the symmetric equilibrium to a cut in τ_e aimed at reducing T/Y by 5 percent.

Figure 4: **Product Market Deregulation: Markups**



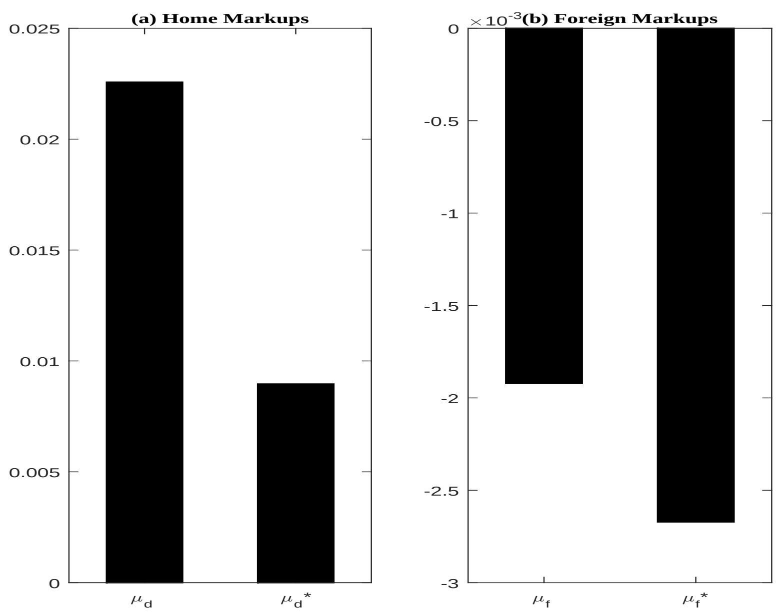
Note: The bars correspond to the percentage deviation from the symmetric equilibrium to a cut in τ_e aimed at reducing T/Y by 5 percent.

Figure 5: **Internal Devaluation: Main Variables**



Note: The bars correspond to the percentage deviation from the symmetric equilibrium to a cut in τ_w aimed at reducing T/Y by 5 percent.

Figure 6: **Internal Devaluation: Markups**



Note: The bars correspond to the percentage deviation from the symmetric equilibrium to a cut in τ_w aimed at reducing T/Y by 5 percent.

A Model's Summary

The model can be summarized as following (see online appendix for details).

$$C_s = C \quad ; \quad P_s = P \quad ; \quad \tilde{P} = P/p_d \quad ; \quad p_d = 1; \tag{22}$$

$$C_s^* = C^* \quad ; \quad P_s^* = P^* \quad ; \quad \tilde{P}^* = P^*/p_f^*; \tag{23}$$

$$\tilde{P} = (n+n^*)^{\frac{1}{\sigma-1}-\nu}\left[n + n^*\left[\frac{p_f}{p_d}\right]^{(1-\sigma)}\right]^{\frac{1}{1-\sigma}} \quad ; \quad \tilde{P}^* = (n+n^*)^{\frac{1}{\sigma-1}-\nu}\left[n\left[\frac{p_d^*}{p_f^*}\right]^{(1-\sigma)} + n^*\right]^{\frac{1}{1-\sigma}}; \tag{24}$$

$$c_d = (n+n^*)^{\nu(\sigma-1)-1}\tilde{P}^\sigma C \quad ; \quad c_f = (n+n^*)^{\nu(\sigma-1)-1}\left[\frac{p_f}{p_d}\right]^{-\sigma}\tilde{P}^\sigma C; \tag{25}$$

$$c_f^* = (n+n^*)^{\nu(\sigma-1)-1}\left(\tilde{P}^*\right)^\sigma C^* \quad ; \quad c_d^* = (n+n^*)^{\nu(\sigma-1)-1}\left[\frac{p_d^*}{p_f^*}\right]^{-\sigma}\left(\tilde{P}^*\right)^\sigma C^*; \tag{26}$$

$$\varepsilon_{p_d} = \sigma - (\sigma-\theta)\frac{1}{n + n^*\left[\frac{p_f}{p_d}\right]^{(1-\sigma)}} \quad ; \quad \varepsilon_{p_f} = \sigma - (\sigma-\theta)\frac{\left[\frac{p_f}{p_d}\right]^{1-\sigma}}{n + n^*\left[\frac{p_f}{p_d}\right]^{(1-\sigma)}}; \tag{27}$$

$$\varepsilon_{p_d}^* = \sigma - (\sigma-\theta)\frac{1}{n + n^*\left[\frac{p_f^*}{p_d^*}\right]^{(1-\sigma)}} \quad ; \quad \varepsilon_{p_f}^* = \sigma - (\sigma-\theta)\frac{\left[\frac{p_f^*}{p_d^*}\right]^{1-\sigma}}{n + n^*\left[\frac{p_f^*}{p_d^*}\right]^{(1-\sigma)}}; \tag{28}$$

$$\pi = \bar{L}pc_d + \bar{L}^*p_d^*c_d^* - \tau_w W\frac{y}{Z} \quad ; \quad \pi = (f_T + f_R\tau_e)\,W; \tag{29}$$

$$\pi^* = \bar{L}p_f c_f + \bar{L}^*p_f^*c_f^* - \tau^{w*}W^*\frac{y^*}{Z^*} \quad ; \quad \pi^* = (f_T + f_R\tau^{e*})\,W^*; \tag{30}$$

$$p_d = \left[\frac{\varepsilon_{p_d}}{\varepsilon_{p_d}-1}\right]\frac{\tau_w}{Z}W \quad ; \quad p_d^* = \tau\left[\frac{\varepsilon_d^*}{\varepsilon_d^*-1}\right]\frac{\tau_w}{Z}W; \tag{31}$$

$$p_f^* = \left[\frac{\varepsilon_{p_f}^*}{\varepsilon_{p_f}^*-1}\right]\frac{\tau^{w*}}{Z^*}W^* \quad ; \quad p_f = \tau\left[\frac{\varepsilon_{p_f}}{\varepsilon_{p_f}-1}\right]\frac{\tau^{w*}}{Z^*}W^*; \tag{32}$$

$$y = \bar{L}c_d + \tau\bar{L}^*c_d^* \quad ; \quad y^* = \bar{L}\tau c_f + \bar{L}^*c_f^*; \tag{33}$$

$$\sigma_H H^\eta\tilde{P}C^{\frac{1}{\psi}} = \frac{W}{p_d} \quad ; \quad \sigma_H H^{*\eta}\tilde{P}^*\left(C^*\right)^{\frac{1}{\psi}} = \frac{W^*}{p_f^*}; \tag{34}$$

$$\bar{L}H = n\frac{y}{Z} + n\left(f_T + f_R\right) \quad ; \quad \bar{L}^*H^* = n^*\frac{y^*}{Z^*} + n^*\left(f_T^* + f_R^*\right); \tag{35}$$

$$\bar{L}^*n\tau p_d^*c_d^* = \bar{L}n^*p_f c_f. \tag{36}$$