



HAL
open science

Reforms and the real exchange rate: The role of pricing-to-market

Lise Patureau, Céline Poilly

► **To cite this version:**

Lise Patureau, Céline Poilly. Reforms and the real exchange rate: The role of pricing-to-market. Journal of International Economics, 2019, 119, pp.150-168. 10.1016/j.jinteco.2019.04.005 . hal-02194106

HAL Id: hal-02194106

<https://amu.hal.science/hal-02194106>

Submitted on 3 Oct 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

1 Reforms and the Real Exchange Rate:
2 The Role of Pricing-to-Market

3 Lise Patureau* Céline Poilly^{†‡}

4 October 2018

5 **Abstract**

6 The paper investigates how endogenous markups affect the extent to which policy reforms
7 can influence international competitiveness. In a two-country model where trade costs allow
8 for international market segmentation, we show that endogenous pricing-to-market behavior of
9 firms acts as an important transmission channel of the policies. By strengthening the degree
10 of competition between firms, product market deregulation at home leads to a reduction in
11 domestic markups, which generally leads to an improvement in the international competitiveness
12 of the Home country. Conversely, the power of competitive tax policy to depreciate the real
13 exchange rate is dampened, as domestic firms take the opportunity of the labor tax cut to
14 increase their markups. The variability of markups also affects the normative implications of
15 the reforms. This indicates the importance of taking into account endogenous pricing-to-market
16 behavior when intending to correctly evaluate the overall effects of the reforms.

17 *JEL classification:* E32, E52, F41

18 *Keywords:* Exchange Rate, Product Market Deregulation, Fiscal Reform, Endogenous Firm
19 Entry, Pricing-to-Market, Endogenous Markups.

*Corresponding author. Université Paris-Dauphine, PSL Research University, LEDa, France. Place du Maréchal de Lattre de Tassigny, 75016, Paris, France. Email: lise.patureau@dauphine.fr

[†]Aix-Marseille Univ., CNRS, EHESS, Centrale Marseille, AMSE, France. Email: celine.poilly@univ-amu.fr

[‡]We would like to thank Philippe Bacchetta, Drago Bergholt, Mónica Correa-López, Mick Devereux, Julien Matheron, Mathieu Parenti and Carlos Thomas for their comments. We are also grateful to conference participants at RIEF (2015, Orléans), DEGIT Conference (2015, Geneva), T2M conference (2016, Paris), AMSE-BdF Policy Spillovers Workshop (2018, Marseille) and to several seminar participants at the Bank of Spain, the Université Paris-Dauphine, University of Lausanne, Aix-Marseille University, University of Pamplona, University Paris I. This research was funded by the French Agence Nationale de la Recherche (ANR) under grant ANR-11-JSH1002 01.

1 Introduction

The severity of the recession that hit a large number of countries over the last decade forced policy-makers and economists to evaluate the structural fragilities that have become apparent in developed countries throughout the 2000s. Current account imbalances and sustained real exchange appreciation have notably been pointed out as serious failures for the peripheral euro-zone countries (Lane & Milesi-Ferretti, 2011). Accordingly, the literature attests to a renewed interest in studying the effects of fiscal and/or structural policies on external imbalances. Playing on the fiscal tool has thus been studied as a way of depreciating the real exchange rate in the short run (Farhi et al., 2014). Deregulating the goods market may also help firms compete on international markets (see Cacciatore et al. (2015a) for a survey).

In this paper, we investigate the channels through which policy reforms – such as product market deregulation or payroll tax cuts – affect the real exchange rate, in both long- and short-run perspectives. As pointed out by several empirical studies, firms’ pricing-to-market behavior (PTM hereafter) has key implications on the real exchange rate (see Burstein & Gopinath, 2014 for a survey). In this context, it is likely that the ability of a given reform to reduce prices depends on markup adjustments, which differ across destination markets in presence of international market segmentation. A main contribution to the existing literature is thus to shed light on the role of endogenous markup adjustments on the effectiveness of the reforms to affect international relative prices.

This question will be addressed on theoretical grounds. Precisely, we develop a two-country dynamic model with imperfect competition and endogenous firm entry, featuring international trade costs and sunk entry cost, close to Corsetti et al. (2007). With this framework, we capture two dimensions that have been shown to be key elements in shaping real exchange rate behavior, the relative price of exported goods and the relative number of exporters i.e. the extensive margin of trade (see the seminal contribution of Ghironi & Mélitz (2005)). This theoretical framework is further expanded to include a structure of oligopolistic competition that generates endogenous markups, in a similar way to that described by Atkeson & Burstein (2008). Further, international trade costs allow firms to discriminate across countries by charging different markups specific to the destination market. The markup extracted on each market can thus be shown to depend on two elements:

49 First, the competition effect, i.e. on the number of competitors in the market. The lower the
50 number of competitors, the lower the price elasticity of demand for a given variety, hence the
51 higher the markup extracted by the producer. Due to the open economy structure, markups are
52 also determined by the relative price effect: When imported varieties are more expensive than local
53 ones, the price elasticity of demand for the goods produced at Home contracts, allowing domestic
54 firms to extract higher markups. Markup adjustments are shown to serve as a major transmission
55 channel of these reforms onto international relative prices. More precisely, we study the effects of the
56 Home country implementing either a reform to alleviate the goods market entry cost (i.e. product
57 market deregulation) or to reduce the labor tax wedge by switching from direct labor taxation to
58 indirect consumption taxes (i.e. a competitive tax policy), contrasting the cases where markups are
59 constant or endogenously adjusted to the economic policy. For our benchmark calibration, we find
60 that a competitive tax policy is successful in improving international competitiveness through a
61 permanent reduction in the terms of trade and a real exchange depreciation, while product market
62 deregulation is not. Importantly, PTM behavior of firms is seen to play a key role in the propagation
63 of both of the aforementioned reforms.

64 The underlying transmission mechanisms behind these results can be accounted for as follows: In
65 the long run, the product market deregulation at Home improves the market position of domestic
66 firms which has been seen to contribute to a real exchange depreciation, all other things being equal.
67 Yet, this effect is counteracted by a rise in the relative labor cost at Home, which is detrimental to
68 the price competitiveness of Home goods meaning that the terms of trade, i.e. the relative price
69 of exports, go up. The competitive tax policy has an effect on firms' market share and terms
70 of trade, but in the opposite direction, entailing a reduction in the relative unit labor cost at
71 Home, to balance with a reduction in the relative number of country's domestic firms active on
72 the world market. For our benchmark calibration, the relative labor cost effect dominates, such
73 that a competitive tax policy engenders a real exchange rate depreciation while product market
74 deregulation engenders an appreciation. These responses of international relative prices hold in the
75 long run as well as throughout the transitional dynamics. Specifically, both reforms lead to an
76 overshooting of the real exchange rate, as the magnitude of its immediate response is larger than
77 its permanent one. This is attributable to the immediate adjustment of the labor cost contrasting
78 with the sluggishness in firm entry.

79 A key contribution of the paper is to show the importance of the endogenous PTM behavior
80 of firms as a propagation channel of both reforms. Precisely, endogenous markup adjustments
81 dampen the impact of both reforms on international relative prices. The intuition is as follows: By
82 reducing the entry cost, product market deregulation sets the competition effect in motion: A larger
83 number of competitors on the domestic market exerts a downward pressure on the markups that
84 can be extracted at Home. This, in turn, moderates the real exchange appreciation. By contrast,
85 domestic firms take the opportunity of the labor tax cut to increase their markups, in particular
86 on the local market. Under international goods market segmentation, markups extracted at Home
87 increase more than abroad, which lessens the real exchange rate depreciation. Endogenous PTM
88 also has implications in a normative perspective. While both reforms can have an effect of welfare
89 improvement under constant markups, an allowance for endogenous PTM behavior amplifies the
90 welfare gains of the competitive tax policy whilst reducing those of the product market deregulation
91 in both countries. Viewed from different perspectives, our results thus point out the importance of
92 taking into account the endogenous PTM behavior when intending to correctly evaluate the overall
93 effects of the reforms.

94 Our paper contributes to the growing recent literature on the effects of fiscal and structural reforms
95 in an open-economy setting. Farhi et al. (2014) and Engler et al. (2017) focus on the effects of the
96 competitive tax policy on the price competitiveness of the home goods in the short term, leaving
97 aside the potential long-term effects that also incorporate the effects on firm entry. Conversely,
98 Auray et al. (2018) point out that it is also important to consider the effects of this tax policy on
99 the extensive margin of trade. Studying the role of firm entry also lies at the heart of numerous
100 papers investigating the effects of product market deregulation. Forni et al. (2010), Andrés et al.
101 (2017) or Eggertsson et al. (2014) investigate the effects of product market deregulation in vari-
102 ous open-economy contexts. However, they adopt a reduced form approach by modeling market
103 deregulation by an exogenous markup reduction. Conversely, our paper shows the importance of
104 taking into account the endogeneity of markup adjustment. Closest to us, Cacciatore et al. (2015,
105 2016) extensively study the open-economy effects of product market deregulation on interaction
106 with monetary policy. We focus on the effects of the structural reforms *per se*, leaving aside the
107 interaction with monetary policy. This is consistent with the view that many countries, in partic-
108 ular in Europe, are currently facing severe structural inefficiencies that require more than a mere

109 stabilization policy. Overall, while the literature has studied either product market deregulation
110 or labor tax policy as two distinct phenomena, we study the two policies in a unified framework.
111 Our results help to understand the transmission channels of those two reforms. In particular, we
112 show the importance of taking into account the endogenous pricing behavior of firms on interna-
113 tionally segmented markets. In a two-country context close to ours, Bergin & Feenstra (2001),
114 Corsetti & Dedola (2005) or Atkeson & Burstein (2008) point out the importance of the PTM
115 behavior of firms to account for deviations from the law of one price and the imperfect exchange
116 rate pass-through.¹ Our paper differs from these others in two main aspects: First, we explicitly
117 relate endogenous PTM decisions to firm entry in an international setup. In this respect, our study
118 bridges a gap between Floetotto & Jaimovich (2008) (in a closed-economy framework) and Atkeson
119 & Burstein (2008) (in a two-country model with exogenous firm entry), to show the importance
120 of both the extent of competition between firms and the relative price effect as key determinants
121 of markups. Second, we interrogate our supposition, focussing on how endogenous markups may
122 affect the outcomes of structural/fiscal reforms.

123 The following section lays out the model. In Section 3, we evaluate the effects of the reforms on
124 the determinants of the real exchange rate and the current account, both over the long run and
125 the short run. In Section 4, we ensure the robustness of our results before extending the analysis
126 to the welfare comparison in Section 5. Section 6 concludes.

127 **2 The Model**

128 We model a world economy made up of two countries, with \bar{L} households in the Home country and
129 \bar{L}^* in the Foreign country.² We assume a cashless economy with one unit of account common to both
130 countries. In each country, the final good consumed by the local household is made up of two types
131 of goods, both produced and sold locally. However, one is produced with local labor only, whereas
132 the second is produced through a richer production structure that incorporates foreign inputs (as

¹Devereux & Lee (2001) and Edmond et al. (2015) investigate the gains of trade with a similar production structure. However, Devereux & Lee (2001) do not introduce international trade costs, which shuts down a potential pricing-to-market behavior. Edmond et al. (2015) deal with a different question since they stress the conditions under which trade affects markups distortions.

²All of the Foreign country's variables are indexed with a star. Home and Foreign countries are symmetric in the sense that they feature the same preferences and technologies. When the Foreign decisions are identical to those of Home one, we describe only the latter.

133 described below). Accordingly, we refer to these two goods as “non-tradable” and “tradable” final
 134 goods. These two sectors also differ by the type of competition. While the non-tradable homogenous
 135 good is produced in a perfect competition set-up, the tradable sector features imperfect competition
 136 with endogenous firm entry decision, as in Bilbiie et al. (2012) (among others), and the structure
 137 of competition also induces endogenous markups in the spirit of Atkeson & Burstein (2008) and
 138 Floetotto & Jaimovich (2008). Importantly, combining endogenous markups with international
 139 trade costs allows firms to adopt a pricing-to-market (PTM) behavior, i.e. to discriminate across
 140 destination market by charging different markups.

141 In this section, we provide a brief overview of the model, putting particular emphasis on the key
 142 aspects tied to the imperfect competition structure. More details are provided in the appendix
 143 and an extensive version of the model is made in an online appendix, available on the authors’
 144 webpages.

145 2.1 Tradable Good: Competition Structure

146 The final tradable good (denoted C_{Tt}) is made up of Home and Foreign intermediate inputs through
 147 a two-layer vertical production structure, namely industry and firm levels (with t the temporal
 148 index). Precisely, there is a fixed range of industries of measure 1, indexed by $s \in [0, 1]$ both
 149 in the Home and the Foreign country. In each industry, the industrial good s (C_{st} is produced
 150 by a continuum of competitive firms which bundle intermediate (firm-level) goods produced by a
 151 discrete number of domestic and foreign firms. Therefore, within each industry s , there is a mass
 152 n_{st} of Home firms indexed by k , for $k = 1, 2, \dots, n_{st}$, and a mass n_{st}^* of Foreign firms indexed by
 153 k^* , for $k^* = n_{st} + 1, n_{st} + 2, \dots, n_{st} + n_{st}^*$, producing each one differentiated good. Intermediate
 154 goods producers behave like oligopolists within each industry, i.e. taking into account the effect
 155 of their pricing decision on the price index of the industry. Ultimately, the price elasticity of the
 156 demand for their variety varies with the market share of the firm, at the root of endogenous
 157 markups. Endogenous pricing-to-market is modeled along the lines of Atkeson & Burstein (2008)
 158 or Floetotto & Jaimovich (2008), as this competition set-up enables us to retrieve the standard
 159 Dixit & Stiglitz (1977) case of a constant markup. We describe here the market structure of these
 160 two levels of aggregation.

161 **2.1.1 Tradable Final Good**

162 A time t , a continuum of perfectly competitive final-good producers produce the homogeneous
 163 tradable final good C_{Tt} through a bundle of domestic industrial goods denoted by C_{st} with $s \in [0, 1]$
 164 according to the CES aggregator such that

$$C_{Tt} = \left(\int_0^1 C_{st}^{\frac{\theta-1}{\theta}} ds \right)^{\frac{\theta}{\theta-1}}, \quad (1)$$

165 where $\theta > 1$ is the elasticity of substitution across industries. Given $P_{Tt}C_{Tt} = \int_0^1 P_{st}C_{st}ds$, with P_t
 166 denoting the consumption price index and P_{st} the price index of each industrial good, the optimal
 167 demand for industrial goods and the associated aggregate price index can be written as

$$C_{st} = \left[\frac{P_{st}}{P_{Tt}} \right]^{-\theta} C_{Tt}, \quad \text{and} \quad P_{Tt} = \left(\int_0^1 P_{st}^{1-\theta} ds \right)^{\frac{1}{1-\theta}}. \quad (2)$$

168 Since all industries are identical, it turns out that $P_{st} = P_{Tt}$ and $C_{st} = C_{Tt}$ at the symmetric
 169 equilibrium.

170 **2.1.2 Industrial Good Producers**

171 For each industry $s \in [0, 1]$, the industrial good C_{st} is produced by a continuum of competitive
 172 representative firms: they bundle differentiated intermediate goods c_{skt} and c_{sk^*t} , produced by a
 173 discrete number of type- k Home and type- k^* Foreign firms respectively, according to the production
 174 function

$$C_{st} = \left(\sum_{k=1}^{n_{st}} c_{skt}^{\frac{\sigma-1}{\sigma}} + \sum_{k^*=n_{st}+1}^{n_{st}+n_{st}^*} c_{sk^*t}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \quad (3)$$

175 where $\sigma > 1$ is the elasticity of substitution between goods within an industry.

176 In the Home country, the optimal demand for each intermediate input, locally produced (c_{skt}) and
 177 imported from the Foreign country (c_{sk^*t}) as well as the associated price of the type- s industrial
 178 good (P_{st}) have the usual expressions, with p_{kt} and p_{k^*t} the prices of the local and imported varieties

$$c_{skt} = \left[\frac{p_{skt}}{P_{st}} \right]^{-\sigma} C_{st}, \quad \text{and} \quad c_{sk^*t} = \left[\frac{p_{sk^*t}}{P_{st}} \right]^{-\sigma} C_{st}, \quad (4)$$

$$P_{st} = \left[\sum_{k=1}^{n_{st}} p_{skt}^{1-\sigma} + \sum_{k^*=n_{st}+1}^{n_{st}+n_{st}^*} p_{sk^*t}^{1-\sigma} \right]^{\frac{1}{1-\sigma}}, \quad (5)$$

180 with $k = 1, 2, \dots, n_{st}$ and $k^* = n_{st} + 1, n_{st} + 2, \dots, n_{st} + n_{st}^*$. Similar expressions apply for the Foreign
181 demand functions and CPI, as detailed in Appendix A.

182 2.2 Production of Intermediate Goods

183 We now turn to describe the production of the intermediate goods used as inputs for the industrial
184 goods. Within a given industry, each individual firm produces a differentiated good using labor
185 domestically-supplied labor, given a linear production technology. For a Home firm producing the
186 variety k , it is written as

$$y_{skt} = h_{skt}, \quad (6)$$

187 where h_{skt} denotes firm's labor demand used to produce the type- k variety in type- s industry. Each
188 variety is sold on the domestic and the foreign markets, with international trade being subject to
189 iceberg trade costs. Firms are free to enter the market, provided that they pay a sunk cost to start
190 producing, imputed in labor, as in Corsetti et al. (2007).

191 2.2.1 Optimizing program

192 The program of the intermediate firms may be broken down into two steps. First, they take the
193 decision to enter the market, given the sunk cost of entry which ultimately determines the number
194 of firms within each country. Second, once entered, they maximize the operating profit. We now
195 solve the problem backwards.

196 **Profit Maximization** Once entered, the type- k Home firm maximizes its operational profit π_{skt}

$$P_t \pi_{skt} = \bar{L} p_{skt} c_{skt} + \bar{L}^* p_{skt}^* c_{skt}^* - \tau_t^w W_t h_{skt}, \quad (7)$$

197 with p_{skt} and p_{skt}^* the prices charged by firm k of industry s at home and abroad respectively,
198 W_t is the nominal wage and $\tau_t^w > 0$ denotes gross payroll taxes on labor paid by firms. Firm k
199 in industry s maximizes its operational profit (7) subject to technological constraint (6) and the

200 equilibrium condition for its variety

$$y_{skt} = \bar{L}c_{skt} + \tau\bar{L}^*c_{skt}^*, \quad (8)$$

201 where $\tau > 1$ denotes the international trade costs. Further, in an imperfect competition setting,
 202 each type- k firm knows the demand functions for its good that emanates from the final good
 203 industry in each country (c_{skt} , from Equation (4) and c_{skt}^* from (A-33)).

204 International trade costs give rise to market segmentation, such that each firm is able to “price-
 205 to-market” by setting a price specific to each destination market. Accordingly, maximizing profit
 206 with respect to prices p_{skt} and p_{skt}^* given the demand functions (4) and (A-33), leads to optimal
 207 pricing decisions for the local (Home) and export (Foreign) markets respectively

$$p_{skt} = \mu_{skt}\tau_t^w W_t, \quad \text{and} \quad p_{skt}^* = \tau \frac{\mu_{skt}^*}{\mu_{skt}} p_{skt}, \quad (9)$$

208 where μ_{skt} and μ_{skt}^* represent the markups extracted by the Home firm locally and abroad respec-
 209 tively. As standard, the markup rates are a decreasing function of the price elasticity of demand
 210 on each market according to

$$\mu_{skt} = \frac{\varepsilon_{skt}}{\varepsilon_{skt} - 1}, \quad \text{and} \quad \mu_{skt}^* = \frac{\varepsilon_{skt}^*}{\varepsilon_{skt}^* - 1}, \quad (10)$$

211 where ε_{skt} and ε_{skt}^* denote the price elasticity of demand for the Home variety k from the Home
 212 and Foreign markets respectively, which we characterize deeper in Section 2.2.2.

213 **Firm Entry Decision** Consider now the first step of entry decision at the symmetric equilibrium
 214 which allows us to drop the k index. Firm entry is subject to a sunk entry cost f^e measured in
 215 labor units. As in Chugh & Ghironi (2011), we assume that the entry cost can be subsidized or
 216 taxed by public authorities at the gross rate $\tau_t^e \geq 1$. Adjusting from this tax system, the effective
 217 entry cost (in terms of composite good) is $\tau_t^e f^e W_t / P_t$, where W_t / P_t is the real wage. The setting
 218 up of n_t^e startups requires H_t^e units of labor, such that the labor demand for new firm creation is
 219 $H_t^e = f^e n_t^e$.

220 Ignoring the integer constraint, entry occurs until firm value v_t is equalized with the entry cost,

221 leading to free-entry condition³

$$v_t = \tau_t^e f^e \frac{W_t}{P_t}. \quad (11)$$

222 Entrants at time t only start to produce at time $t + 1$. Both new firms and incumbents may be hit
 223 by an exogenous exit shock, that occurs at the very end of the period (after production and entry)
 224 with probability δ . Accordingly, the law of motion for the number of firms in the Home country is
 225 given by

$$n_{t+1} = (1 - \delta) [n_t + n_t^e]. \quad (12)$$

226 2.2.2 Markups and PTM

227 Within a given industry, due to the limited number of firms, each firm takes into account the effects
 228 of its pricing decision on the industrial price index, which ultimately affects the price elasticity of
 229 demand for its variety. This Bertrand competition setup establishes a link between the price
 230 elasticity of demand for a variety and the firm's market share. Consider the case of the demand for
 231 a Home variety emanating from the Home and Foreign country respectively. Using the symmetry
 232 across industry – and therefore dropping the s index – and defining the firm's market share on the
 233 local market $m_{kt} \equiv \frac{p_{kt} \bar{L} c_{kt}}{n_t p_{kt} \bar{L} c_{kt} + n_t^* p_{k^*t} \bar{L}^* c_{k^*t}}$, we obtain the following link between the price elasticities
 234 of domestic and foreign demand ε_{kt} and ε_{kt}^* , and the Home firm's market share on each market

$$\varepsilon_{kt} = \sigma - (\sigma - \theta) m_{kt}, \quad (13)$$

$$\varepsilon_{kt}^* = \sigma - (\sigma - \theta) m_{kt}^*, \quad (14)$$

235 where, making use of the optimal demand functions (4) and (A-33), the market shares of type- k
 236 firm can be rewritten as

$$m_{kt} = \left[n_t + n_t^* \left(\frac{p_{k^*t}}{p_{kt}} \right)^{1-\sigma} \right]^{-1} \quad \text{and} \quad m_{kt}^* = \left[n_t + n_t^* \left(\frac{p_{k^*t}}{p_{kt}^*} \right)^{1-\sigma} \right]^{-1}. \quad (15)$$

³As the number of firms is supposed to be an integer value, free-entry condition cannot not hold exactly under oligopoly meaning that the net profit is not necessary zero. Following a large strand of the literature, we ignore the integer constraint by treating n_t and n_t^* as continuous variables at this stage (see for instance Brander & Krugman, 1983 or Devereux & Lee, 2001).

237 **Price-elasticity, market share and PTM** As noted by Atkeson & Burstein (2008), one advantage of this modeling structure is that it uncovers the standard Dixit-Stiglitz case in a very straightforward way. When goods are as substitutable within industries as across industries ($\sigma = \theta$), the competition structure reduces to a constant price elasticity of demand ($\varepsilon_{kt} = \sigma \forall t$ in Equation (13)), hence a constant markup $\mu = \sigma/(\sigma - 1)$, identical across destination markets. In this case, the mill pricing rule applies as result of optimal pricing decisions, such that: $p_{kt}^* = \tau p_{kt}$.

243 As long as $\sigma \neq \theta$, price-elasticities of demand, as well as markups, are no longer constant and vary endogenously with the economic environment. As in Atkeson & Burstein (2008), this setup implies that the price elasticity of demand, rather than being constant, is negatively related to the market share of a firm (see Equations (13) and (14)). Precisely, we will focus on the case where $\sigma > \theta$, based on the empirical evidence of Broda & Weinstein (2006) that varieties are more substitutable within industries than across them.

249 In an open-economy setting, this market structure also implies PTM being optimal for price makers. Under $\sigma \neq \theta$, the price-elasticities of local and foreign demand for the same good are no longer necessary equal (Equations (4) and (A-33) for a domestic variety). Accordingly, it is optimal for firms to set a specific markup for each destination market (see Equation (9)). This bridges a supplementary price gap (on top of the iceberg trade cost) for the same variety across markets (i.e., $p_k^* \neq \tau p_k$ under $\sigma \neq \theta$, as shown with more details in Appendix A.2). In this respect, having $\sigma > \theta$ implies both endogenous markups and PTM, implying that one can use both terms interchangeably.

256 **Markup determinants** Linking Equation (10) with Equations (13), (14) and (15) allows us to get some insights about the driving forces behind markup decisions. We focus here on the decisions made by a type- k Home firm. From Equation (15), the firm's market share on a given market (hence its markup) depends on two dimensions: the number of competitors, both domestic and foreign, so-called "competition effect" and the price of its good relative to that of their foreign competitors on the market (p_{k^*}/p_k), which we refer to as the "relative price effect". Combining the above set of equations and reasoning in deviation from the symmetric steady state, the change

263 in the markups made by a Home firm on its local and export market can be written as⁴

$$\widehat{\mu}_k = -\frac{1}{\Delta_1} \overbrace{[\widehat{n} + \phi \bar{\kappa}^{1-\sigma} \widehat{n}^*]}^{\text{Competition effect}} + \frac{\sigma-1}{\Delta_1} \phi \bar{\kappa}^{1-\sigma} \overbrace{[-\widehat{RULC} + \widehat{\mu}_{k^*}]}^{\text{Rel. price effect}}, \quad (16)$$

$$\widehat{\mu}_k^* = -\frac{1}{\Delta_2} [\widehat{n}^* + \phi \bar{\kappa}^{1-\sigma} \widehat{n}] + \frac{\sigma-1}{\Delta_2} [-\widehat{RULC} + \widehat{\mu}_{k^*}^*] \quad (17)$$

264 where $\widehat{RULC}_t \equiv \widehat{W}_t - \widehat{W}_t^* + \widehat{\tau}_t^w - \widehat{\tau}_t^{w*}$ denotes the relative unit labor cost, and Δ_1, Δ_2 positive
 265 constant terms defined in Appendix A, which also reports similar expressions for the markups set
 266 by the Foreign firms. In the above expressions, $\bar{\varepsilon} \equiv \varepsilon_k = \varepsilon_{k^*}^*$ is the price elasticity of Home demand
 267 for the locally-produced goods and $\bar{\varepsilon}_X \equiv \varepsilon_k^* = \varepsilon_{k^*}$ is the price-elasticity on the export market at
 268 the steady state.

269 From Equations (16) and (17), we can decompose markup changes in two components. The “compe-
 270 tition effect” relates to the number of competitors the firm is confronted with. Given the oligopolis-
 271 tic type of competition within each industry, a marginal firm entry (whatever the country it is
 272 located in) raises the price elasticity of demand addressed to each domestic producer, thereby ex-
 273 erting a downward pressure on its markup on both destination markets. However, due to trade
 274 costs, the weight of foreign competitors is dampened relative to that of local incumbents. Put
 275 differently, *ceteris paribus* the Home firms reduce their markup set on the Home market when a
 276 marginal firm enters, but with a lower magnitude when the new competitor is a foreigner (Equation
 277 (16)). For the same reason (but working in the opposite direction), the markup extracted by Home
 278 firms abroad is more sensitive to the number of foreign competitors than to the number of other
 279 domestic firms that compete with it on its export market (see Equation (17)). Accordingly, both
 280 μ_k^* and μ_k reduce with a marginal domestic firm entry, but not to the same extent. This is a first
 281 source of markup divergence across market destinations.

282 The “relative-price effect” depends on both the relative unit labor cost and the markup charged by
 283 foreign competitors on the local market. As reported in Equation (16) (and (A-35)), an increase in
 284 Home unit labor cost relative to Foreign reduces the price-competitiveness of Home goods. This,
 285 in turn, pushes domestic firms to reduce their markups on both destination markets; conversely, it
 286 enables foreign firms to raise theirs (Equations (16) and (17)), versus Equations (A-35) and (A-36)).

⁴In what follows, \widehat{x}_t denotes the log-deviation of variable x_t from the steady-state in a model with symmetric countries. We drop the time dimension subscript t here for the sake of notational simplicity.

287 The relative-price effect also depends on the markup set by Foreign competitors on this market. On
 288 the Home market for instance, the lower the markup set by the Foreign competitors (μ_{k^*}), the lower
 289 the price of imports, all other things being equal. In order to preserve their market share, Home
 290 firms have to reduce their own markup as well (μ_k). Further, due to market segmentation, the
 291 factor exerting the most influence on markup setting on each destination market is the markup set
 292 by the foreign firms (μ_{k^*} for μ_k , but $\mu_{k^*}^*$ for μ_k^*). In case of an asymmetric shock across countries,
 293 this constitutes a second source that amplifies the divergence between countries by disconnecting
 294 markups set by the same firm across destination markets.

295 **2.3 Non-Tradable Good**

296 In contrast to the tradable sector, the non-tradable sector is assumed in perfect competition with
 297 costless firm entry. A continuum of identical firms produce a homogenous non-tradable good, y_{NTt} ,
 298 sold at price P_{NTt} and labor is perfectly mobile within tradable and non-tradable sectors. The
 299 representative firm chooses labor demand, h_{NTt} , so as to maximize its profit π_{NTt} , standardly
 300 defined by $P_{NTt}\pi_{NTt} = P_{NTt}y_{NTt} - \tau_t^w W_t h_{NTt}$, using the production function $y_{NTt} = h_{NTt}$. The
 301 optimization problem simply yields $P_{NTt} = \tau_t^w W_t$. Non-tradable consumption goods produced
 302 in perfect competition are consumed by local households and the local government with public
 303 spending denoted G_t such that the non-tradable good market equilibrium condition writes as⁵

$$y_{NTt} = \bar{L}C_{NTt} + G_t. \quad (18)$$

304 **2.4 Households**

305 The household's optimizing behavior can be decomposed into a consumption good allocation choice
 306 and an utility maximization program.

307 **Consumption basket allocation** The final consumption good in the Home country C_t is a
 308 basket of tradable and non-tradable goods, C_{Tt} and C_{NTt} respectively, bundled with the Cobb-

⁵Assuming that public spending is allocated to the non-tradable sector is a convenient way to include government spending in the model so as to implement a public revenue-neutral policy. In the Euro Area in 2016, 75.8% of the general government expenditure consists in services as health, education, social protection and general public services (source: Eurostat, COFOG).

309 Douglas aggregator

$$C_t = \left(\frac{C_{Tt}}{\varpi} \right)^\varpi \left(\frac{C_{NTt}}{1 - \varpi} \right)^{1 - \varpi}, \quad (19)$$

310 where $\varpi \in [0, 1]$ is the weight of tradable goods C_{Tt} relative to the non-tradable ones C_{NTt} in
 311 the consumption basket. The representative household minimizes the total cost of its consumption
 312 basket, leading to the optimal demand function for each type of good

$$C_{Tt} = \varpi \left(\frac{P_t}{P_{Tt}} \right) C_t, \quad \text{and} \quad C_{NTt} = (1 - \varpi) \left(\frac{P_t}{P_{NTt}} \right) C_t, \quad (20)$$

313 along with the consumption-based price index, P_t

$$P_t = (P_{Tt})^\varpi (P_{NTt})^{1 - \varpi}. \quad (21)$$

314 **Intertemporal utility maximization** For a Home household, the intertemporal utility function
 315 is given by

$$\mathcal{W}_t = \sum_{t=0}^{\infty} \beta^t \left\{ \frac{C_t^{1 - \frac{1}{\psi}}}{1 - \frac{1}{\psi}} - \sigma_H \frac{H_t^{1 + \eta}}{1 + \eta} \right\}, \quad (22)$$

316 with C_t aggregate consumption and H_t total hours worked. $0 < \beta < 1$ is the subjective discount
 317 factor, $\psi > 0$ drives the curvature of the utility function, σ_H is a scale parameter and $\eta^{-1} > 0$ is
 318 the Frisch labor supply elasticity. The household in the Home country maximizes the intertemporal
 319 flow of utility (22) subject to the sequence of flow budget constraint, expressed in terms of the final
 320 Home good

$$\begin{aligned} & x_{t+1} \int_0^1 \left(\sum_{k=1}^{n_{st} + n_{st}^e} P_t v_{skt} \right) ds + \tau_t^c P_t C_t + B_{t+1} + P_t \frac{\psi_B}{2} \left(\frac{B_{t+1}}{P_t} \right)^2 \\ & = x_t \int_0^1 \left(\sum_{k=1}^{n_{st}} P_t (\pi_{skt} + v_{skt}) \right) ds + (1 + i_t) B_t + W_t H_t + P_t T_t. \end{aligned} \quad (23)$$

321 The representative household can consume the Home final good bundle C_t , at the consumption
 322 price index P_t and given the gross value added tax rate τ_t^c . As standard in the literature (see
 323 Bilbie et al., 2012 among others), we assume that households hold shares x_t in a mutual fund,
 324 that covers all domestic intermediate firms in t (both incumbents and new entrants). Savings can

325 also be made through the buying/selling of nominal international bonds issued at the world level,
326 B_t denoting the non-contingent stock of bonds at the beginning of t , yielding the interest rate i_t .⁶
327 Issuing new bonds is subject to adjustment costs on portfolio, paid to the government and scaled
328 by the parameter ψ_B , following the modeling of Cacciatore et al. (2016b). The household perceives
329 labor income, the returns of financial assets as well as the return of past investments, that depend
330 on the share invested x_t and the value of the incumbent firms at the beginning of the period (v_t)
331 plus the dividends (profits) perceived from them (π_t). Resources are also made up of lump-sum
332 transfers T_t from the government.

333 Solving the household's intertemporal program with respect to C_t , H_t , B_{t+1} and x_{t+1} yields the
334 set of first-order conditions

$$\frac{W_t}{\tau_t^c P_t} = \sigma_H H_t^\eta C_t^{\frac{1}{\psi}}, \quad (24)$$

$$1 + \psi_B \frac{B_{t+1}}{P_t} = \beta \left[\frac{\tau_t^c P_t C_t^{\frac{1}{\psi}}}{\tau_{t+1}^c P_{t+1} C_{t+1}^{\frac{1}{\psi}}} (1 + i_{t+1}) \right], \quad (25)$$

$$v_t = \beta (1 - \delta) \left[\frac{\tau_t^c C_t^{\frac{1}{\psi}}}{\tau_{t+1}^c C_{t+1}^{\frac{1}{\psi}}} (\pi_{t+1} + v_{t+1}) \right]. \quad (26)$$

335 2.5 Closing the Model

336 **Government** We assume that in each country, the government runs a balanced budget every
337 period. Distortive taxes are collected to finance public spending and lump-sum transfers according
338 to the following budget constraint

$$\bar{L}P_t T_t + P_{NTt} G_t = (\tau_t^w - 1) W_t (n_t h_t + h_{NTt}) + (\tau_t^c - 1) \bar{L}P_t C_t + (\tau_t^e - 1) f^e n_t^e W_t + \bar{L}P_t \frac{\psi_B}{2} \left(\frac{B_{t+1}}{P_t} \right)^2, \quad (27)$$

339 given $h_t = y_t$ and $h_{NTt} = y_{NTt}$. The product market deregulation is modeled by a total entry
340 cost subsidy through a reduction in τ_t^e . The competitive tax reform consists in a reduction of the
341 payroll tax rate τ_t^w , that is financed by a rise in VAT rate τ_t^c , so as to ensure the government's
342 balanced budget (27).

⁶In this setup, the two countries can be viewed as belonging to a monetary union. In the absence of nominal rigidities, the monetary policy is irrelevant and the interest rate ensures equilibrium in the bond market.

343 **Market-clearing conditions** At each period, the market for international financial assets clears,
 344 such that $\bar{L}B_{t+1} + \bar{L}^*B_{t+1}^* = 0$. In each country, the labor market is perfectly competitive. Ac-
 345 cordingly, labor supply is fully used either in the production of manufactured goods or for paying
 346 entry costs, implying the following labor market equilibrium condition

$$\bar{L}H_t = n_t y_t + f^e n_t^e + y_{NTt}. \quad (28)$$

347 From the Home household budget constraint, incorporating firms' pricing decisions, the fact that,
 348 in the symmetric equilibrium, each household holds an equal share of the mutual funds (i.e., $x_t =$
 349 $1/\bar{L} \quad \forall t$), the free-entry condition as well as the government budget constraint and the various
 350 market equilibrium conditions, we can derive the balance of payments equilibrium condition for the
 351 Home country

$$\bar{L}B_{t+1} - (1 + i_t)\bar{L}B_t = n_t \bar{L}^* p_{kt}^* c_{kt}^* - n_t^* \bar{L} p_{k^*t} c_{k^*t}, \quad (29)$$

352 with $n_t \bar{L}^* p_{kt}^* c_{kt}^*$ equal to Home exports and $n_t^* \bar{L} p_{k^*t} c_{k^*t}$ to Home imports (in value). Equation
 353 (29) states that a current account deficit (the RHS being negative) has to be financed by foreign
 354 indebtedness (the LHS should be negative). Notice that we can also express the GDP as

$$P_t Y_t = \bar{L} P_t C_t + \bar{L}^* n_t p_{kt}^* c_{kt}^* - \bar{L} n_t^* p_{k^*t} c_{k^*t} + P_{NTt} G_t, \quad (30)$$

355 see online appendix for details.

356 **3 Reforms, the Real Exchange Rate and Endogenous Markups**

357 A key objective of this paper is to assess the potential of the two reforms (product market deregulation,
 358 through τ^e and competitive tax policy, through the switch (τ^w, τ^c)) to affect the country's
 359 international competitiveness. In order to better understand the underlying mechanisms at work
 360 here, we will conduct an analysis of the real exchange rate's determinants.

3.1 A Decomposition of the Exchange Rate Effects

We define the real exchange rate q_t as the relative price of the Foreign basket of goods in terms of that of the Home country, such that $q_t \equiv P_t^*/P_t$. As explained in Ghironi & Méltz (2005), endogenous firm entry induces changes in the composition of consumption baskets across countries which are not captured in the data. Indeed, the empirical CPI measures do not reflect changes in the availability of new varieties which, in turn, induces a potential difference between the “welfare-based” and the “data-consistent” real exchange rate. This is not the case in our baseline model, where we can show that the welfare-based real exchange rate, q_t , and its data-consistent counterpart, coincide exactly under Cobb-Douglas preferences (19).

In order to analyze the determinants of the real exchange rate, we rely on its expression in deviation from the symmetric steady state, incorporating the CPI expressions (5) and (A-34) so as to get:

$$\begin{aligned} \hat{q} &= \varpi \left[\hat{P}_T^* - \hat{P}_T \right] + (1 - \varpi) \left[\hat{P}_{NT}^* - \hat{P}_{NT} \right], \\ &= \varpi \frac{1 - \phi \bar{\kappa}^{1-\sigma}}{1 + \phi \bar{\kappa}^{1-\sigma}} \left[- \underbrace{\widehat{RULC}}_{(a)} + \frac{1}{\sigma - 1} \underbrace{[\hat{n} - \hat{n}^*]}_{(b)} + \frac{1}{1 - \phi \bar{\kappa}^{1-\sigma}} \underbrace{[\hat{\mu}^* - \hat{\mu}]}_{(c)} \right] - (1 - \varpi) \widehat{RULC} \quad (31) \end{aligned}$$

where $\hat{\mu} \equiv \hat{\mu}_k + \phi \bar{\kappa}^{1-\sigma} \hat{\mu}_{k^*}$ is the Home-market markup, i.e. the weighted value of the markups set on the Home market by both local and foreign firms and $\hat{\mu}^* \equiv \hat{\mu}_{k^*} + \phi \bar{\kappa}^{1-\sigma} \hat{\mu}_k$ is the Foreign-market markup, i.e. the weighted value of the markups in the Foreign market. In these expressions, $\bar{\kappa} \equiv \bar{\mu}_k^*/\bar{\mu}_k$ denotes the export markup ratio in the pre-reform steady state and $\phi \equiv \tau^{1-\sigma}$ the freeness of trade (between 0 and 1, decreasing in τ).

Since Ghironi & Méltz (2005), it is well understood that the real exchange rate not only relies on the terms of labor ($\hat{W}_t - \hat{W}_t^*$, through term (a)), but also on the relative number of exporting firms ($\hat{n}_t - \hat{n}_t^*$, term (b)). Provided $\phi \bar{\kappa}^{1-\sigma} < 1$, which we assume, the real exchange rate depreciates with a reduction in the relative unit labor cost at Home (term (a)) and/or an increase in the relative number of Home firms (term (b)), in line with the literature.⁷ Further, the non-tradable sector

⁷Throughout the paper, we assume $\tau \bar{\kappa} > 1$, ensuring $1 - \phi \bar{\kappa}^{1-\sigma} > 0$. This condition has an economic interpretation tied to optimal pricing decisions (Equation (9)). When firms can price-to-market ($\sigma > \theta$), they have an incentive to absorb part of the trade costs (rather than passing it onto the foreign consumer), by reducing the export markup relative to the local one (pushing $\bar{\kappa} < 1$ everything else equal, as shown in Appendix A.2 with more details). The condition $\tau \bar{\kappa} > 1$ states that endogenous reduction of the export-to-local markup gap is not sufficiently strong to overcome the trade costs, such that the steady state export price remains higher than the local one ($p_d^* > p_d$ in Equation (9)). Also notice that this condition is reminiscent of the condition that relates the extent of law of one

382 ($\varpi \neq 1$) breaks the typical link between the real exchange rate and the relative price of traded
 383 goods. In a model with perfect competition in the non-tradable sector, we find that this sector
 384 reinforces the effects of the relative unit labor cost on exchange rate movements (see last term in
 385 (31)), as in Cacciatore et al. (2015b).

386 The originality of our work in relation to the existing literature is that we point out the role of a
 387 third determinant that channels through endogenous markup adjustment ($\sigma \neq \theta$) with Term (c), at
 388 the root of markup differentiation across countries. All else being equal, an increase in the Foreign-
 389 market markup relative to Home ($\widehat{\mu}^* - \widehat{\mu} > 0$) pushes individual prices in the Foreign country
 390 upwards in relative terms.⁸ This induces an increase in the Foreign CPI (relative to Home), i.e. a
 391 real exchange rate depreciation.

392 In conclusion, it is worth noting that endogenous markups break the equality between the relative
 393 cost of labor and the terms of trade s_t defined as the relative price of Home exports (to Home
 394 imports), i.e. $s_t \equiv p_{kt}^*/p_{k^*t}$. Using Equation (9) and its Foreign counterpart, one can show that

$$\widehat{s} = \widehat{RULC} + \widehat{\mu}_k^* - \widehat{\mu}_{k^*}. \quad (32)$$

395 Higher labor costs in the Home country relative to Foreign lead to higher prices of the exported
 396 Home goods, hence a lower price-competitiveness of the Home firms abroad (the terms of trade
 397 deteriorate, $\widehat{s} > 0$). Yet this effect can be counterbalanced by endogenous markup adjustment, as
 398 long as it induces a reduction in the export markup set by the Home firms relative to Foreign
 399 ($\widehat{\mu}_k^* - \widehat{\mu}_{k^*} < 0$), since this loosens some pressure on the exporting price of Home firms and limits
 400 deterioration of the terms of trade.

401 Having highlighted the connections between the number of firms, relative prices, markups and the
 402 real exchange rate, we now turn to studying the effects of the two reforms.

price deviations to trade costs in Atkeson & Burstein, 2008.

⁸Given that the terms $1 - \phi\bar{\kappa}^{1-\sigma}$ at the numerator and the denominator cancel each other out in Equation (31), the elasticity of the real exchange rate to the markup gap (Term (c)) is always positive and lower than 1, decreasing with the term $\phi\bar{\kappa}^{1-\sigma}$.

403 3.2 Parametrization

404 We assume that at the pre-reform steady-state, the two countries are identical in all aspects, $\bar{L} = \bar{L}^*$
405 and $\tau^x = \tau^{x*}$ for $x = \{w, e, c\}$. The number of firms in both countries are identical ($n = n^*$) and
406 all goods are sold abroad at an identical price, such that $q = 1$. As standard in the literature, we
407 assume an initial zero-trade balance. The model is calibrated on a quarterly basis based on either
408 values commonly retained in the literature or by ensuring that the steady-state model matches
409 several empirical targets. These are based on empirical evidence gathered in European countries
410 over the recent period.⁹ Table 1 illustrates the set of calibrated structural parameters and empirical
411 targets, as well as the implied values for the remaining deep parameters, that will be considered as
412 fixed in our subsequent experiments. Home labor is considered as numeraire, implying $W = 1$.
413 The elasticities of substitution across goods and across industries are set to $\sigma = 5$ and $\theta = 2$
414 respectively, in line with empirical estimates, though there is no clear consensus on these values.
415 Broda & Weinstein (2006) estimate the elasticity of substitution among goods at the industry
416 level for the US. Their median estimate of the substitution elasticity between 3-digit level goods
417 (corresponding roughly to our θ) is 2.50 over the sample 1972-1988. At their most disaggregated
418 level (our σ), they estimate a median substitution elasticity equal to 3.7. Benkovskis & Wörz (2014)
419 estimate σ to a value close to 2 for the US and between 2 and 2.17 for several countries of the Euro
420 Area (see also Soderbery (2017)). However, Anderson & van Wincoop (2004) suggest a range
421 between 5 and 10 for σ . Atkeson & Burstein (2008) allow for strong pricing-to-market behavior by
422 setting $\sigma = 10$ and θ close to 1. We set $\psi = 1$, implying a log specification on consumption, as is
423 standard in the related literature (see Floetotto & Jaimovich (2008)). The Frisch elasticity of labor
424 supply is set to $\eta^{-1} = 0.5$, in line with the empirical estimates of MaCurdy (1981). The trade costs
425 are set to $\tau = 1.2$ which is close to the value suggested by di Mauro & Pappadà (2014) for countries
426 of the Euro Area and is in line with Ravn & Mazzenga (2004) who focus on the transportation
427 cost. It is worth noting that iceberg costs seem to be a reasonable representation of trade costs in a
428 monetary union like the Euro Area since European trade excludes tariffs and quotas. The firm exit
429 rate is set to $\delta = 0.029$, as standard in the literature (see for instance Cacciatore & Fiori, 2016).

⁹We aim at targeting empirical data for the peripheral European countries, i.e. Greece, Ireland, Italy, Portugal and Spain (GIIPS), as long as we can get empirical targets suited to these countries (based on the GDP weighted average of the national data). If not, we retain data for the European Area. A detailed representation of the model's steady state and the calibration procedure is provided in the online appendix.

Table 1: Parametrization

Deep parameters		Value	Reference
σ	Elast. of substitution. btw goods	5	Anderson & van Wincoop (2004)
θ	Elast. of substitution across industries	2	Broda & Weinstein (2006)
τ	Trade costs	1.2	di Mauro & Pappadà (2014)
δ	Firm destruction rate	0.029	Cacciatore & Fiori (2016)
$1/\eta$	Frisch labor supply elasticity	0.5	MaCurdy (1981)
ψ	Curvature of utility function	1	Floetotto & Jaimovich (2008)
ψ_b	Bond adjustment cost	0.001	
Pre-reform targets			
H	Hours worked	0.3	Normalization
μ_k	Markup on Home market by Home firms	1.36	Eggertsson et al. (2014)
τ^w	Gross payroll tax rate	1.36	Own calculations, Eurostat data
τ^c	Gross VAT rate	1.16	Own calculations, Eurostat data
τ^e	Firm entry cost subsidy	1.00	Normalization
$n_e f_T W / PY$	R&D entry costs (% of GDP)	1.94	Cacciatore & Fiori (2016)
$\bar{L} W f_R / PY$	Regulation entry costs (% of GDP per capita)	22.74	Ebell & Haefke (2009)
$P_{NT} G / PY$	Public expenditure (% of GDP)	19.4	Own calculations, Eurostat data
$\varpi n (p_{k^*} / P_T)^{1-\sigma} (C/Y)$	Imports (% of GDP)	30	Own calculations, Eurostat data
Implied parameters			
f_R	Regulatory entry cost	0.093	
f_T	R&D entry cost	0.016	
\bar{L}	Home country size	0.94	
ϖ	Share of non-tradable goods	0.87	
σ_L	Scale parameter	29.17	
G	Government spending	0.005	

Note: In the pre-reform steady state, Home and Foreign countries are symmetric.

430 The bond adjustment costs parameter ψ_b is set at a value sufficiently small to enable the steady
431 state to be pinned and to ensure the model's stationarity without overstating the impact of this
432 parameter on dynamics.

433 We also endogenously derive the values of some structural parameters so that the pre-reform steady
434 state matches some empirical targets, the reference country being the GIIPS countries over the
435 recent period. We set $\mu_k = 1.36$, based on the figures reported by Eggertsson et al. (2014) for Italy
436 and Spain. The (gross) payroll tax rate is calibrated to $\tau^w = 1.36$, while the VAT rate is set to
437 $\tau^c = 1.16$, in line with values observed in GIIPS countries over the period 2000-2012. The weight
438 of tradable goods in total consumption, ϖ , matches the import share set to 30% as was the case
439 for GIIPS countries over 1995-2017. The regulation cost instrument τ^e is set to 1 in the pre-reform
440 steady state. As in Cacciatore et al. (2016c), we assume that the fixed entry cost f_e is made up

441 of regulation costs (f_R) and the R&D expenditures (f_T). Administrative entry costs, in terms of
 442 GDP per capita, are set equal to 22.74%, based on the values reported for the GIIPS countries
 443 by Ebell & Haefke (2009). The aggregate R&D expenditures in GDP is set to 1.94%, as observed
 444 in the Euro Zone (Cacciatore et al., 2016a). The public expenditure share in GDP is 19.4% as
 445 observed for the GIIPS countries over the period 1995-2017. As usual in the literature, we calibrate
 446 the aggregate hours worked as one third of the total amount of time, normalized to one, $H = 0.3$.
 447 Altogether, these targets allows us to deduce values for f_R , f_T (hence f_e), σ_H , \bar{L} , ϖ and G from
 448 the model's steady state (see bottom of Table 1), which are thus invariant during the experiments.
 449 We conduct our analysis by contrasting our benchmark model featuring endogenous markups ($\sigma >$
 450 θ), with constant markups setup (imposing $\theta = \sigma = 5$). Both reforms are set such that they imply
 451 a 1 percentage point decrease in the long-term value of Home lump-sum transfer-to-GDP ratio in
 452 the case featuring the endogenous markup. The corresponding reduction of τ^e implies a decrease
 453 in total entry costs from 13.15% of GDP to 12.3%. The payroll tax cut is implemented together
 454 with a rise in VAT which ensures government revenue neutrality.¹⁰ This amounts to a reduction in
 455 the payroll tax rate from 34% to 19% and increasing the VAT from 16% to 24%.

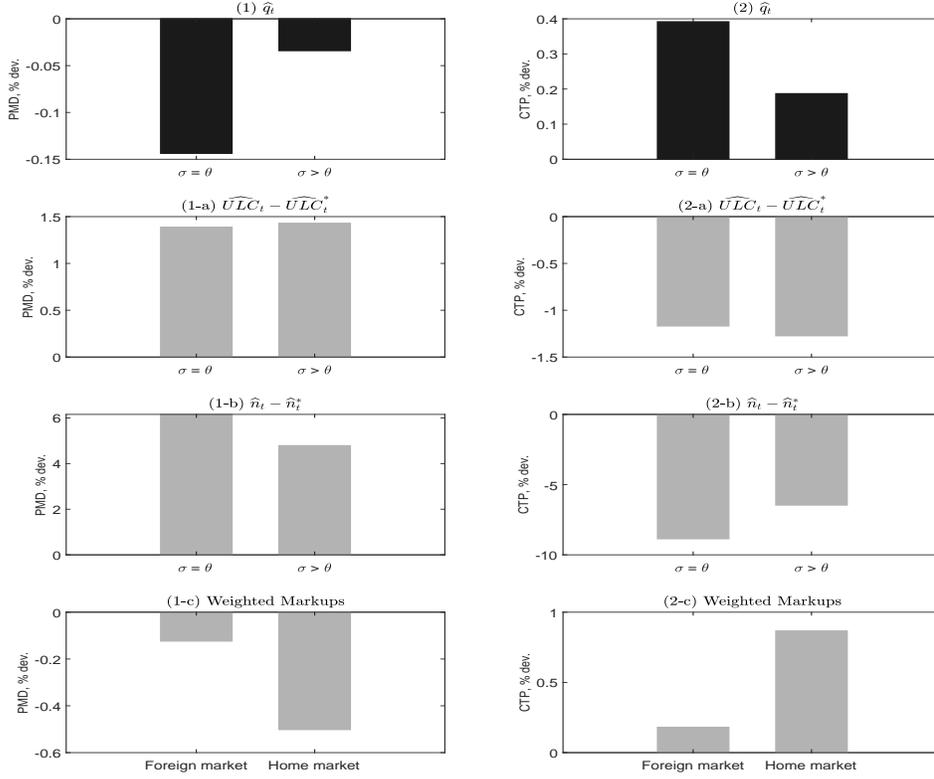
456 3.3 Reforms and the Real Exchange Rate: Long-run impact

457 Figure 1 reports the long-run effects of product market deregulation (left-hand side panel (1)) and
 458 a competitive tax policy (right-hand side panel (2)) on the real exchange rate under constant and
 459 variable markups. To allow a better insight into the transmission channels, we also report, for
 460 each reform, the change in the three determinants of the real exchange rate identified in Equation
 461 (31), namely the relative unit labor cost in the Home country (Term (a)), the relative number of
 462 Home firms (Term (b)) and the overall markup by country (i.e, Term (c)) broken down into its
 463 two components, $\hat{\mu}^*$ and $\hat{\mu}$). In Appendix B, we also report on the responses of the terms of trade
 464 (i.e., the relative price of Home exports to Home imports) and the different markups. Variables are
 465 expressed as in percentage deviation from their pre-reform steady state.

466 Two main comments emerge from Figure 1. First, a competitive tax policy is successful in improving

¹⁰We calculate the values of τ^w and τ^e such that $\bar{L}T/Y$ decreases from by 1 p.p. in the long run (under $\sigma > \theta$), going from 15% to 14%. In the case featuring the competitive tax policy, the reduction in tax revenues led by the decrease in τ^w is compensated by a rise in VAT, τ^c to ensure that total government spending ($\bar{L}T/Y + P_{NTG}/PY$) - hence, total revenues, stay at their pre-reform value.

Figure 1: Reforms and International Competitiveness: Long-Run Effects



Long-run responses to a permanent product market deregulation (PMD) and competitive tax policy (CTP) under constant ($\sigma = \theta$) and variable ($\sigma > \theta$) markups. Column 1 (2, resp.) displays the long-run effects of a permanent reduction in τ_t^c (τ_t^w combined with a rise in τ_t^c , resp.). Both shocks are normalized in order to decrease the long-run Home lump-sum transfer to GDP ratio by 1 percentage point in the model featuring endogenous markup. All deviations are expressed in percentage deviation from the pre-reform steady state. The first line shows the real exchange rate, \hat{q}_t . The second line shows the relative unit labor cost, with $\widehat{ULC}_t = \widehat{W}_t + \hat{\tau}_t^w$ and $\widehat{ULC}_t^* = \widehat{W}_t^* + \hat{\tau}_t^{w*}$. The third line shows the relative number of firms, $\hat{n}_t - \hat{n}_t^*$. The last line shows the total weighted markups extracted in the Home market ($\hat{\mu}_t = \hat{\mu}_{kt} + \phi \bar{\kappa}^{1-\sigma} \hat{\mu}_{k^*t}$) and in the Foreign market ($\hat{\mu}_t^* = \hat{\mu}_{k^*t} + \phi \bar{\kappa}^{1-\sigma} \hat{\mu}_{kt}$).

467 international competitiveness through a permanent real exchange rate depreciation while a product
 468 market deregulation is not. Second, endogenous markups lessen the impact of both reforms on the
 469 real exchange rate dynamics. This result thereby suggests an important role for endogenous PTM
 470 behavior. We will now go deeper into the analysis by considering each reform successively.

471 **Product Market Deregulation** Figure 1 (panel (1)) shows that product market deregulation
 472 at Home generates an appreciation in the real exchange rate. This finding is consistent with results
 473 obtained by Ghironi & Mélitz (2005) or Cacciatore et al. (2015b) who provide a comprehensive
 474 discussion of the effects of entry cost reduction on the real exchange rate under constant markups
 475 ($\sigma = \theta$). The primary effect of product market deregulation is the impact on the number of active
 476 firms. By reducing the cost of entry, the reform induces more firms to enter the Home market, until
 477 the free-entry condition (11) is restored. In the presence of trade costs, the induced variety effect
 478 should push to a real exchange rate *depreciation* all else being equal. Yet, this effect is counteracted
 479 by a rise in the relative labor cost in the Home country (panel (2-a)). This exerts a detrimental
 480 effect the price competitiveness of Home goods, which leads ultimately to an *appreciation* of the
 481 real exchange rate. The reason is that higher entry exerts upward pressures on Home labor demand
 482 which in turn raises the marginal cost for each incumbent firm. Under constant markups, this rise
 483 in the terms of labor ($\hat{W}_t - \hat{W}_t^*$) goes hand-by-hand with an increase in the terms of trade as shown
 484 in Equation (32) (see Figure 5, Appendix B) and therefore a deterioration of price competitiveness
 485 (s_t increases) in line with Corsetti et al. (2007), Cacciatore et al. (2016b) or Cacciatore et al. (2016c)
 486 findings.

487 How do variable markup affect this result? As explained in Section 2.2.2, markups' variations are
 488 driven by the “competition effect”, as reducing entry cost intensifies competitive pressures between
 489 oligopolistic producers and reduces the market share of incumbents on this market. Markup rents
 490 extracted on the Home market by both domestic and foreign firms thus decrease substantially
 491 ($\hat{\mu}_k < 0$, $\hat{\mu}_{k^*} < 0$, see Appendix B, Figure 5, panel (a)). As a result, endogenous markups limit the
 492 deterioration of price competitiveness for the Home firms (Appendix B, Figure 5, panel (c)). The
 493 transmission channel to the real exchange rate can be decomposed through the lens of Equation
 494 (31). On the one hand, the markup reduction at Home moderates the increase in operational
 495 profit and therefore, fewer Home firms are needed to restore free-entry condition. Consequently,

496 the increase in the relative number of Home firms ($\hat{n}_t - \hat{n}_t^*$) is of lower magnitude when endogenous
 497 markups adjustment (Figure 1, panel (1-b)). The extensive margin is therefore less powerful in
 498 counteracting the deterioration of price-competitiveness, which should lead to an even stronger real
 499 exchange rate appreciation than would be the case under constant markups.¹¹ On the other hand,
 500 as illustrated by Term (c) in Equation (31), the direct effect of lower markups at Home is to drive
 501 the weighted markup at Home downwards ($\hat{\mu} < 0$). This effect is all the more pronounced, as the
 502 markup reduction is much weaker on the Foreign market. Indeed, in the presence of trade costs, a
 503 marginal entry from the Home country has a lower impact on the price elasticity of Foreign demand
 504 than on Home demand elasticity. This enables the Home firms to reduce their export markups less
 505 than domestically (μ_k^* reduces but less than μ_k). The result of deregulation of the product market
 506 is a stronger markup reduction in the Home country than in the Foreign one (Figure 1, panel (1-c)).
 507 This markup contraction at Home, in turn, implies a marked reduction in the domestic CPI that
 508 translates into a smaller real exchange rate appreciation compared to the case featuring constant
 509 markups.

510 **Competitive Tax Policy** As shown in the second column of Figure 1, the competitive tax policy
 511 induces a real exchange rate depreciation whose magnitude is however lessened under endogenous
 512 markups. As shown in Equation (31), a payroll tax cut implemented in the Home country has a
 513 direct impact on the real exchange rate through a reduction in the relative unit labor cost (see Figure
 514 1, panel (2-a)) while an increase in VAT works through general equilibrium effects. Consequently,
 515 the change in τ_t^w engenders the results we describe (and we also show in the online appendix that
 516 results are qualitatively similar in the case of a payroll tax cut along with constant VAT).

517 Consider first the case of constant markups ($\sigma = \theta$). The reduction in the relative Home unit
 518 labor cost driven by a reduction in τ_t^w pushes the relative price of Home goods down, inducing
 519 an improvement in price-competitiveness (Appendix B, Figure 5) which drives real exchange rate
 520 depreciation. Yet, this direct effect is counteracted by a reduction in the number of Home firms
 521 (in relative terms, panel (2-b)). As discussed by Corsetti et al. (2007), this notably depends on the
 522 strength of the substitution effect between consumption and leisure. Indeed, the reduction in the

¹¹Under endogenous markups, Foreign firms' lower market share reduces the rent they can extract, inducing a contraction in the equilibrium number of Foreign firms. However, due to trade costs, the magnitude of the effect is limited.

523 Home good price pushes the Home CPI downward (see Equation (9)) and the domestic real wage
524 upward. As illustrated by our calibration, we can see that when the substitution is small enough
525 relative to the wealth effect in consumption choices, the rise in real wages causes households to
526 favor leisure to consumption, the latter only moderately increasing. This effect is amplified by the
527 increase in the VAT burden borne by households which tends to reduce the domestic aggregate
528 demand. The contraction in the value of total sales leads to a contraction in operational profit and
529 therefore a reduction in firm entry in order to restore the zero-profit condition. Accordingly, the
530 equilibrium number of firms is lower after the competitive tax reform. From Equation (31), the
531 negative effect on the extensive margin of trade counters the effect of unit labor cost by limiting
532 the magnitude of the real exchange rate depreciation. In this respect, the VAT hike lessens the
533 effect of the payroll tax cut on the real exchange rate by making Home final goods more expensive
534 (see Figure 2 in the online appendix).

535 How are these mechanisms affected when markups endogenously adjust? As illustrated in Figure 1,
536 the magnitude of real exchange rate depreciation induced by the Home fiscal policy is substantially
537 lowered in this case. The lessening of the depreciation can be attributed to the “relative price
538 effect” on markups, that increases the overall markup in Home country relative to Foreign. As
539 discussed in Section 2.2.2, the reduction in the relative unit labor cost for Home firms enables
540 them to extract part of these competitiveness gains through higher markups on both destination
541 markets. Conversely, this drives Foreign firms to cut their markups (see Appendix B, Figure 5). As
542 a result, endogenous markup adjust limits the gain in price-competitiveness for Home firms (see
543 Appendix B, Figure 5, panel (e)). With regard to the real exchange rate, in the presence of trade
544 costs, a strong increase in the markup extracted by the Home firms on the Home market drives
545 the weighted average markup at Home upward, in absolute and in relative terms (Figure 1, panel
546 (2-c)). This raises the relative CPI at Home, thereby limiting the magnitude of real exchange rate
547 depreciation induced by gains in unit labor cost (see Term (c) in Equation (31)). Interestingly, this
548 compensates the fact that the negative extensive margin of trade effect is of lower magnitude under
549 $\sigma > \theta$.

550 **Summary** become apparent: First, a competitive tax policy succeeds in depreciating the real
551 exchange rate in the long run while product market deregulation does not. Second, these transmis-

552 sion channels are substantially affected by endogenous markup adjustments. With product market
553 deregulation, the “competition effect” (through the relative number of firms) reduces the weighted
554 average markup at Home. This, in turn, lessens the real exchange rate appreciation.¹² The “rel-
555 ative price effect” has an opposite effect on markups under the competitive tax policy. As Home
556 firms partly compensate the reduction in relative unit labor cost by an increase in markups, this
557 limits the possibility that the reform will engender a real exchange rate depreciation.

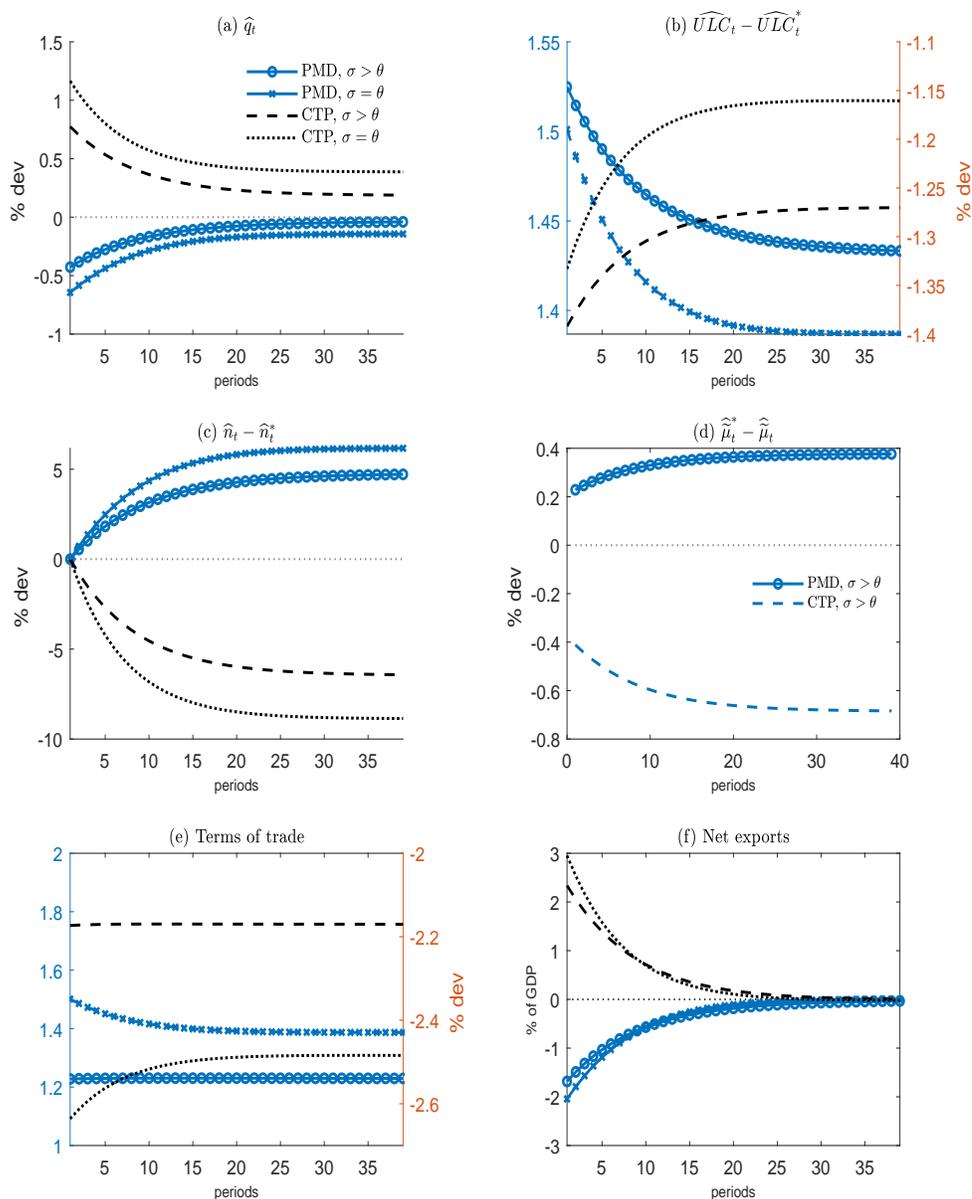
558 **3.4 Reforms and Real Exchange Rate: Transitional Effects**

559 Our model’s dynamic structure enables an evaluation of how endogenous markups affect the impact
560 of reforms on international relative prices throughout the transition. Figure 2 reports the transition
561 paths of the real exchange rate and its determinants, the terms of trade, and net exports to both
562 reforms all seen under the two cases of constant and varying markups.

563 **Product Market Deregulation** The increase in the relative number of Home firms (which
564 pushes toward a real exchange rate depreciation, all other things being equal), is only progressive
565 (Figure 2, panel (c)), in line with Equation (12). In the period during which the reform is to be
566 implemented, given the fixed number of active firms, the deterioration of the price-competitiveness
567 of Home goods (Panel (e)) expands the real exchange rate appreciation. This impact is all the more
568 pronounced in the case where the response of the unit labor cost is maximal (Panel (b)). From
569 the free-entry condition (11), the reduction in entry costs τ_t^e reduces the value of the firm, thereby
570 encouraging households to invest in firm creation, see Equation (26). All other things equal, the
571 demand for labour increases as required to pay the fixed cost, leading to an increase in the relative
572 Home wage. As long as new firms are created, this effect progressively reduces, such that the
573 relative unit labor cost decreases, to come back to its new long-run value (which remains higher
574 than its initial value, see also Figure 1). Accordingly, the maximum of the level of real exchange rate
575 appreciation is attained on impact, to decreasing progressively until reaching a new long-run value.
576 All along the transition path, markup endogeneity moderates the magnitude of the appreciation
577 through the dominant role of the competition effect. This reasoning also applies to the terms of
578 trade, whose maximal increase is on impact, competitiveness losses being progressively dampened

¹²The markup effect might even lead to an exchange rate depreciation for large values of τ or ϖ (see Section 4).

Figure 2: Reforms and International Competitiveness: Transition Dynamics



Transitional responses to a permanent product market deregulation (PMD) and competitive tax policy (CTP) under constant ($\sigma = \theta$) and variable ($\sigma > \theta$) markups. In panels (a) to (d), the variables are similarly defined as in Figure 1. The terms of trade refer to the relative price of Home exports to Home imports (\hat{s}) and net exports are the Home exports minus imports, in terms of current GDP. Except for the net exports, all variables are expressed in percentage deviation from their pre-reform levels. In Panels (b) and (e), the response of the difference in unit labor costs and in the terms of trade can be read on the left axis (in blue) for the product market deregulation, and on the right axis (in red) for the competitive tax policy.

579 by the relative markup adjustment. Associated with real exchange rate appreciation, net exports
580 from the Home country are negative all along the transition path, even if they are of slightly lower
581 magnitude under endogenous PTM (panel (f)).

582 **Competitive Tax Policy** On impact, with sluggishness in the number of firms, the real exchange
583 rate is mostly driven by a reduction in relative labor cost (Figure 2, panel (b)), leading to a large
584 depreciation. Progressive downward adjustment in the relative number of domestic firms then
585 reduces the extent of immediate depreciation through the variety effect (Panel (c)). Similarly to
586 product market deregulation but working in the other direction, the endogeneity of markups alters
587 the magnitude of the degree of overshooting induced by the competitive tax policy (Figure 2, panel
588 (d)). Endogenous PTM behavior progressively reduces the price-competitiveness gains of the Home
589 firms, with reduction in the relative price of Home exports being maximal on impact (panel (e)).
590 Consistent with the dynamics of international relative prices, such fiscal reform induces a rise in
591 net exports for the Home country, as reported in Panel (f).

592 **Summary** Consistent with Section 3.3, the effect of endogenous markup is still visible on the
593 short run. Additionally, both reforms induce an overshooting of the real exchange rate which can
594 be explained by the immediate reaction of the labor cost and the inertia in firm entry. In this respect,
595 the overshooting dynamics of the real exchange rate reminiscent of results from Dornbusch's (1976)
596 seminal paper, but in a setup without nominal price rigidity.¹³

597 4 Sensitivity Analysis

598 In this section, we perform a sensitivity analysis on our benchmark setup with endogenous markups,
599 focusing on the key parameters that may affect the magnitude of the markup channel highlighted
600 in Section 3. First, we study the role of the non-tradable sector since it directly impacts the real
601 exchange rate dynamics as suggested by Equation (31). Second, we assess the role of trade costs,
602 as they affect the extent of competition between local producers and their foreign competitors. For
603 all robustness exercises, the size of the reforms are set to their values calibrated in Section 3.2 so

¹³In Dornbusch's (1976) original setting, the delay of adjustment speeds is a product of the difference between the instantaneous adjustment of financial markets and the sluggish prices of the good market.

604 as to make the results comparable.

605 4.1 Non-Tradable Sector

606 The model described in Section 2 puts into evidence the amplification effect of endogenous markups
607 on real exchange rate dynamics. As shown in Equation (31), the magnitude of this markup channel
608 is conditional on the relative weight of the tradable sector (where oligopolistic competition stands)
609 in the consumption bundle. Movements in the real exchange rate are determined by the relative
610 aggregate Home price of both tradable and non-tradable goods. Their relative weight on real ex-
611 change rate changes with their share in the consumption basket $(1 - \varpi)$. Where the relative price
612 of tradable goods $(\hat{P}_T^* - \hat{P}_T)$ varies with the unit labor cost and also with the extensive margin
613 of trade and relative markup, our stylized modeling of the non-traded sector (perfect competition,
614 linear production function and exogenous firm entry) implies that the price of these goods are
615 driven by the production cost only, i.e. the relative labor cost. All else being equal, the larger
616 the share of non-tradable goods (i.e., the lower ϖ), the more significant the role of the relative
617 price effect in driving real exchange rate changes. Accordingly, one may expect the product market
618 deregulation to be less effective and the competitive tax policy more effective in depreciating the
619 real exchange rate as ϖ vanishes. We investigate the relevance of this intuition in quantitative
620 terms. Figure 3 displays the long-run deviation of the real exchange rate (from its pre-reform
621 value) following a product market deregulation (panel (a)) and a competitive tax policy (panel (b))
622 for different values of ϖ .¹⁴ In the case of product market deregulation, the rise in relative unit
623 labor cost compensates the markup effect (combined with further entry of firms) and amplifies the
624 real exchange rate appreciation. The other way round, the higher the share of tradable goods in
625 the consumption basket (high ϖ), the weaker the real exchange rate appreciation after a product
626 market deregulation, consistent with the above reasoning. In the most extreme case $\varpi = 1$ (model
627 without non-tradable goods), this reform leads to a depreciation rather than an appreciation.
628 On the opposite, a competitive tax policy might lead to an appreciation in the case $\varpi = 1$ while a
629 depreciation is strong in the case of a lower value of ϖ .¹⁵ The intuition explaining these results is

¹⁴In our baseline calibration, ϖ is set to 0.87. The case $\varpi = 1$ corresponds to a model without non-tradable goods and $\varpi = 0.7$ would correspond to an import share of 27.6%. The online appendix also offers a sensitivity analysis to the (non-unitary) elasticity of substitution between tradables and non-tradables assuming CES preferences.

¹⁵The rationale behind the real exchange rate appreciation under $\varpi = 1$ is the following. From Equation (31), the higher ϖ is, the lower the impact of the relative unit labor cost channel on the real exchange. While this channel

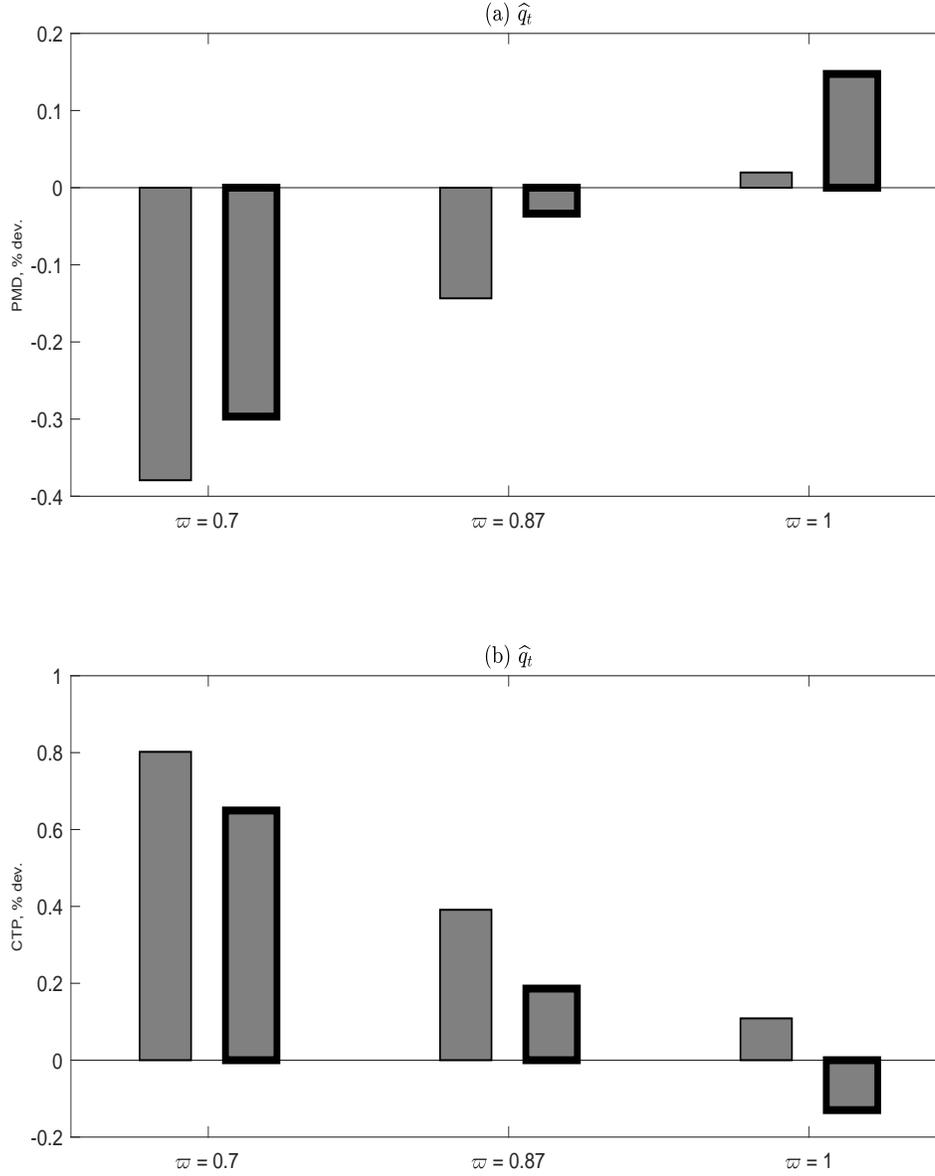
630 straightforward: Because the relative price of non-tradable goods ($\hat{P}_{NT}^* - \hat{P}_{NT}$) is driven by the unit
631 labor cost, a large share of non-tradable goods in the consumption basket (ϖ low) gives rise to a
632 unit labor cost channel which has a large influence on the real exchange rate. Accordingly, the lower
633 the ϖ , the more effective the fiscal policy in depreciating the real exchange rate through a dominant
634 role to the relative price effect, as reported in Figure 3, panel (b). It is also worth noting that in
635 all cases, firms' endogenous PTM behavior mitigates the impact of reforms on the real exchange
636 rate. Whatever the values of ϖ are considered, the appreciation induced by goods market reform
637 and the depreciation induced by tax reform are of lowered magnitude as firms endogenously adjust
638 their markups ($\sigma > \theta$).

639 4.2 Trade Costs

640 We now turn to studying the role of trade costs. With this aim in mind, we report in Figure 4
641 the long-run elasticity of the real exchange rate and its determinants in the case of product market
642 deregulation (left panel) and competitive tax policy (right panel) for several values of the trade cost
643 τ . The solid (dashed, resp.) lines correspond to the variable markups (constant markups, resp.)
644 model. Figure 4 makes clear that trade costs strongly affect the effectiveness of the two reforms.
645 We start looking at the effects of a product market deregulation. Figure 4 (panel (1)) shows that for
646 sufficiently high values of τ , subsidizing firm entry might generate an exchange rate depreciation,
647 which is stronger under varying markups. A case featuring constant markups should be considered
648 first: from Equation (31), the elasticity of the real exchange rate to the relative unit labor costs
649 (which drives an appreciation) and the relative number of Home firms (which conversely drives a
650 depreciation) increases with trade costs. As the primary effect of the reform is to boost the relative
651 number of firms, this drives the relative price of tradable goods at Home down and ultimately lead
652 to a real exchange rate depreciation when τ is large enough. This effect is more apparent when
653 endogenous markups are at play. The markup channel ($\hat{\mu}_t^* - \hat{\mu}_t$) carries more weight in the real
654 exchange rate determination for large values of τ , as illustrated by Term (c) in Equation (31) since
655 the elasticity of \hat{q}_t to $(\hat{\mu}_t^* - \hat{\mu}_t)$, given by $(1 + \phi\bar{\kappa}^{1-\sigma})^{-1}$, increases with τ . This direct effect is valid
656 all other things being equal. Equal, and furthermore, as explained in Section 2.2.2, the markup

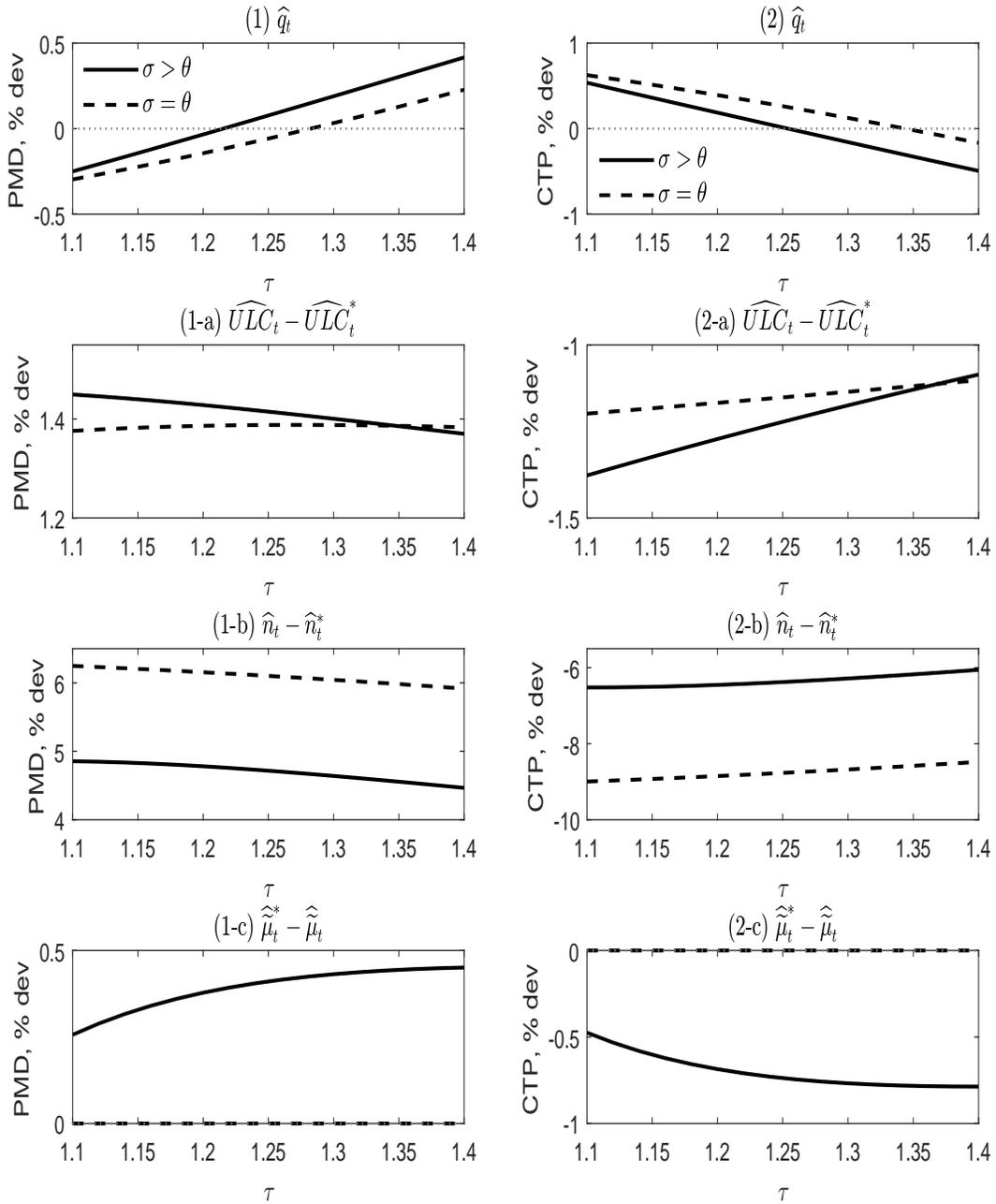
drives a depreciation following the CTP policy, the two opposite other forces (the relative number of Home firms and the markup channel) dominate for $\varpi = 1$, ultimately leading to a real exchange rate appreciation.

Figure 3: Reforms and International Competitiveness: The role of non-tradable goods



Sensitivity to ϖ Long-run responses to permanent product market deregulation (PMD, panel (a)) and competitive tax policy (CTP, panel (b)) under constant endogenous markups, for several values of tradable-goods weight. For each value of ϖ , the left-side bar is the percentage deviation of \hat{q}_t from its pre-reform steady-state in the constant-markups model and the right-side (highlighted) bar is the one in the variable-markups model.

Figure 4: Reforms and International Competitiveness: The role of trade costs



Sensitivity to τ Long-run responses to permanent product market deregulation (PMD, Column 1) and competitive tax policy (CTP, Column 2) in the model featuring variable markups, for several values of trade costs, expressed as in percentage deviation from their pre-reform level.

657 channel by itself is also sensitive to trade costs, causing an additional effect. When trade costs
658 are high, firms have more freedom to price discriminate between destination markets, inducing a
659 stronger disconnect between average markups across countries (see also Edmond et al. (2015) and
660 Behrens et al. (2018)). As a result, higher trade costs strengthen the cross-country divergence of
661 markups, in favor of more marked real exchange rate depreciation everything else equal (Figure
662 4, panel (1-c)). Altogether, both effects imply that product market deregulation depreciates the
663 real exchange rate for $\tau \geq 1.22$ under variable markups while the cut-off value is $\tau \geq 1.28$ under
664 constant markups. Those values are in the range suggested by the literature (see Kehoe et al., 2017
665 for a survey).

666 Under a competitive tax policy, the real exchange depreciation is less important for large values of
667 τ , especially under variable markups (Figure 4, panel (2)). Consider the case of constant markups
668 first. Through the effects of general equilibrium, a competitive tax policy raises the relative terms of
669 labor ($\hat{W}_t - \hat{W}_t^*$) that partially offset a reduction in payroll tax cuts at Home, thereby dampening the
670 total reduction in the relative unit labor cost. As reported in Panel (2-a), this effect becomes more
671 marked the higher the trade costs. Therefore, high trade costs limit the effect of the competitive
672 tax policy in inducing a real exchange rate appreciation. Endogenous markups act as an additional
673 obstacle for the reform being effective. As explained in Section 3.3, the competitive tax policy boosts
674 extracted-domestically markups, with firms taking advantage of the reduction in the relative unit
675 labor cost. Higher segmentation of international markets (i.e., τ large) amplifies the increase in
676 the average markup at Home, limiting the magnitude of the real exchange rate depreciation. The
677 markup channel is also sensitive to the value of τ since high trade costs raise the elasticity of the real
678 exchange rate to cross-country markup differentiation. The magnitude of the markup channel may
679 be sufficient that the fiscal reform induces a real exchange rate appreciation for $\tau \geq 1.25$ (versus
680 $\tau \geq 1.34$ under constant markups). Consistently with Petroulakis (2017), we find that trade costs
681 prevent the competitive tax policy from being effective while we stress the role of markups on this
682 result.

683 To conclude this section, the final effect of both reforms on the real exchange rate - that is, whether
684 it results in an appreciation or depreciation - is found to depend on the underlying structural
685 parameters of the economy. In this respect, the sensitivity analysis suggests that we cannot draw
686 a clear-cut conclusion regarding the effect of the reforms on international relative prices. However,

687 our finding that markup adjustments mitigate the impact of both reforms on the real exchange
688 rate, for the various values of τ and ϖ considered, remains valid.

689 5 Welfare Analysis

690 An investigation of the welfare effects of the two reforms will complete this analysis. Following
691 Lucas (1987), we express welfare in terms of consumption equivalent units, i.e. we define the
692 compensation Θ that should be given to the households each period for them to accept to stay in
693 the unreformed economy, versus being in the economy under reform. Let $\{C_t^{reform}, H_t^{reform}\}_{t=0}^{\infty}$
694 denote the dynamic paths of consumption and hours worked in the economy under reform and
695 $\mathcal{W}^{reform} \equiv \mathcal{W}\{C_t^{reform}, H_t^{reform}\}_{t=0}^{\infty}$ the associated welfare level. Let also $\{C_0, H_0\}$ be the levels
696 of consumption and hours in the initial steady state (i.e. in the absence of reform). The welfare
697 gain/loss associated with a given reform is then the Θ solution to: $\mathcal{W}[\{(1 + \Theta)C_0, H_0\}_{t=0}^{\infty}] =$
698 \mathcal{W}^{reform} .

699 Table 2 provides the compensation Θ needed after the two reforms, expressed in percentage points
700 of consumption in the initial steady state, in both cases of constant and varying markups.

Table 2: Welfare Analysis

Reform	Home Country		Foreign Country	
	$\sigma = \theta$	$\sigma > \theta$	$\sigma = \theta$	$\sigma > \theta$
Product market deregulation (τ^e)	0.223	0.068	0.033	-0.015
Competitive tax policy (τ^w, τ^c)	0.597	0.954	0.058	0.166

Note: Both reforms are sized to decrease the long-run lump-sum tax to GDP ratio at Home by one percentage point in the model featuring endogenous markups. Welfare gains are expressed in terms of consumption equivalent units, i.e. Θ , in % of the pre-reform consumption.

701 The welfare gains induced by the reforms are substantially affected by endogenous PTM, and in the
702 opposite direction: In the Home country, the welfare gains from product market deregulation are
703 almost cancelled by the endogenous markup adjustment (going from 0.22% to 0.07%); by contrast,
704 those induced by the competitive tax policy are doubled when markups endogenously adjust (going
705 from 0.60% to 0.95%).¹⁶

¹⁶Real final consumption expenditure in the Euro Area in 2015 were by about 21 104 euros per person. Therefore,

706 The intuition is the following: Both reforms induce a reduction in the Home CPI, i.e. an increase in
707 the real wage which pushes consumption and hours worked upwards in the cases of both constant
708 and varying markups. However, markup dynamics intervene with regard to the magnitude of the
709 real wage increase, thereby impacting substantially the welfare effects of the reforms. With product
710 market deregulation, a decrease in the incumbents' markups powers a reduction in the Home CPI.
711 This magnifies the rise in the real wage relative to the model featuring constant markups. On the
712 contrary, when it comes to the competitive tax policy, a rise in real wages is dampened under $\sigma > \theta$
713 due to a rise in domestic markups. Accordingly, the intuition behind the results is identical for both
714 reforms. Allow us to focus on product market deregulation. A more marked increase in the real
715 wage under variable markups boosts the labor supply, thereby accounting for a stronger increase
716 in hours worked. One might expect a sharper rise in consumption since higher real wages push
717 household income upwards. However, this surge in real wages combined with the decrease in markup
718 induces a reduction in dividends distributed to the households. This tends to dampen this positive
719 income effect and therefore cause a slowdown in consumption.¹⁷ Consequently, the considerable
720 increase in hours worked comes with with a moderate increase in consumption, implying positive
721 but lower welfare gains than under constant markups (Appendix B, Figure 6, panels (a) and (b)).
722 Contrasting with product market deregulation, the competitive tax policy entails larger welfare
723 gains under endogenous markups because the dampened rise in the real wages limits the increase
724 in hours worked. In combination with the increase in markups set by the Home firms, this pushes
725 dividends upwards, inducing a larger increase in consumption as well (Figure 6, panels (e) and (f)).
726 The welfare effects in the Foreign country are much less substantial. The endogeneity of the
727 markups still reduces the positive spillover gain of product market deregulation (going from 0.03%
728 to -0.01%) while they amplify those of competitive tax reform (going from 0.06% to 0.17%). From
729 Figure 6, this result is mainly attributable to consumption since hours worked are left virtually
730 unaffected by the reforms. The dynamics of the Foreign real wage plays a major role here as the

consumption would rise permanently by 47 euros (PMD) and 125 euros (CTP) per person and per year in the model featuring constant markups. Under variable markups, these gains amount to 14 euros (PMD) and 201 euros (CTP). In this respect, the effects of the product market reform are quite modest.

¹⁷By setting ψ high enough (e.g., $\psi = 2$), we can reverse the result on consumption, which increases by more under varying markups relative to constant markups. As the income effect is strengthened for high values of ψ (consumption reacts more greatly to the real wage), the stronger rise in real wages led by endogenous markups dominates the effect of dividends. However, this does not reverse the final result on welfare because the stronger rise in consumption under varying markups comes along with an even stronger amplification effect on the number of hours worked.

731 income effect that channels through dividends is of a second order effect (n_t^* slightly reacts to
732 the Home reform). Precisely, the Home product market deregulation reduces Foreign real wages
733 under variable markups while it does not under constant markups. This is notably explained by
734 the increase in markups extracted by the Foreign firms on their local market (Appendix B, Figure
735 5, panel (b)). Consequently, Foreign households bear a reduction in their income which pushes
736 consumption downward when $\sigma > \theta$ and leads to welfare losses. On the other hand, the Home
737 competitive tax policy forces Foreign firms to reduce their markups (Figure 5, panel (d)) which
738 stimulates consumption and magnifies Foreign welfare gains.

739 6 Conclusion

740 This paper shows how PTM behavior affects the channels via which labor and good markets reforms
741 affect a country's international competitiveness. We address this question in a theoretical way, by
742 developing a two-country dynamic model with endogenous firm entry. In presence of international
743 trade costs, our modeling of the production structure implies that firms can endogenously adjust
744 their pricing behavior for each destination market, i.e. generating endogenous PTM. The effects
745 of competitive tax policy on the one hand, and product market deregulation on the other, are
746 examined in the context of this setup.

747 By way of this framework, we provide a careful understanding of the manner in which both reforms
748 operate on the real exchange rate. Two main results emerge: First, the two reforms work along very
749 distinct channels. For our benchmark calibration, we find that competitive tax policy is successful
750 in improving international competitiveness through a permanent reduction in the terms of trade and
751 a real exchange rate depreciation, while a product market deregulation is not. This result also holds
752 throughout the transitional dynamics. Deregulating the goods market also leads to a deterioration
753 in the trade balance, whereas it turns into surplus following a competitive tax policy. Secondly,
754 the endogenous PTM behavior of firms is demonstrated to have an important role on international
755 relative prices, as a propagation channel of both these reforms. Specifically, endogenous markups
756 lessen the impact of both reforms on the real exchange rate. This effect is shown to be robust to
757 alternative calibrations of the model. Further, endogenous markup adjustment is also a factor in
758 the normative implications of the reforms. Our overall results thus point out the importance of

759 taking into account the endogenous PTM behavior if willing to correctly evaluate the overall effects
760 of the reforms.

761 **References**

- 762 Anderson, J. & van Wincoop, E. (2004). Trade costs. *Journal of Economic Literature*, 42, 691–751.
- 763 Andrés, J., Arce, O., & Thomas, C. (2017). Structural reforms in a debt overhang. *Journal of*
764 *Monetary Economics*, forthcoming.
- 765 Atkeson, A. & Burstein, A. (2008). Pricing-to-market, trade costs, and international relative prices.
766 *American Economic Review*, 98, 1998–2031.
- 767 Auray, S., Eyquem, A., & Ma, X. (2018). Competitive tax reforms in a monetary union with
768 endogenous entry and tradability. *European Economic Review*, 98, 126–143.
- 769 Behrens, K., Kichko, S., & Ushchev, P. (2018). *Intersectoral Markup Divergence*. Working paper
770 series 6965, CESifo.
- 771 Benkovskis, K. & Wörz, J. (2014). *What Drives the Market Share Changes? Price versus Non-Price*
772 *Factors*. Technical Report Working Paper 1640, ECB.
- 773 Bergin, P. & Feenstra, R. (2001). Pricing-to-market, staggered contracts, and real exchange rate
774 persistence. *Journal of International Economics*, 54, 333–359.
- 775 Bilbiie, F., Ghironi, F., & Mélitz, M. (2012). Endogenous entry, product variety, and business
776 cycles. *Journal of Political Economy*, 120(2), 304–345.
- 777 Brander, J. & Krugman, P. (1983). A reciprocal dumping model of international trade. *Journal of*
778 *International Economics*, 15, 313–321.
- 779 Broda, C. & Weinstein, D. (2006). Globalization and the gains from variety. *The Quarterly Journal*
780 *of Economics*, 121(2), 541–585.
- 781 Burstein, A. & Gopinath, G. (2014). International prices and exchange rates. In *Handbook of*
782 *International Economics* chapter 4, (pp. 391). Elsevier.
- 783 Cacciatore, M., Duval, R., Fiori, G., & Ghironi, F. (2016a). Market reforms in the time of imbalance.
784 *Journal of Economic Dynamics and Control*, 72, 69.
- 785 Cacciatore, M., Duval, R., Fiori, G., & Ghironi, F. (2016b). Short-term pain for long-term gain:
786 Market deregulation and monetary policy in small open economies. *Journal of International*
787 *Money and Finance*, 68, 358.
- 788 Cacciatore, M. & Fiori, G. (2016). The macroeconomic effects of good and labor markets deregulation.
789 *Review of Economic Dynamics*, 20, 1–24.

- 790 Cacciatore, M., Fiori, G., & Ghironi, F. (2015a). The domestic and international effects of euro
791 area market reforms. *Research in Economics*, 69, 555–581.
- 792 Cacciatore, M., Fiori, G., & Ghironi, F. (2016c). Market deregulation and optimal monetary policy
793 in a monetary union. *Journal of International Economics*, 99, 120–137.
- 794 Cacciatore, M., Ghironi, F., & Stebunovs, V. (2015b). The domestic and international effects of
795 interstate u.s. banking. *Journal of International Economics*, 95, 171–187.
- 796 Chugh, S. K. & Ghironi, F. (2011). *Optimal Fiscal Policy with Endogenous Product Variety*.
797 Working Paper 17319, NBER.
- 798 Corsetti, G. & Dedola, L. (2005). A macroeconomic model of international price discrimination.
799 *Journal of International Economics*, 67, 129–155.
- 800 Corsetti, G., Martin, P., & Pesenti, P. (2007). Productivity, terms of trade and the home market
801 effect. *Journal of International Economics*, 73(1), 99–127.
- 802 Devereux, M. & Lee, K. (2001). Dynamic gains from international trade with imperfect competition
803 and market power. *Review of Development Economics*, 5, 239–255.
- 804 di Mauro, F. & Pappadà, F. (2014). Euro area external imbalances and the burden of adjustment.
805 *Journal of International Money and Finance*, 48, 336–356.
- 806 Dixit, A. & Stiglitz, J. (1977). Monopolistic competition and optimum product diversity. *American*
807 *Economic Review*, 67(3), 297–308.
- 808 Dornbusch, R. (1976). Expectations and exchange rate dynamics. *Journal of Political Economy*,
809 84, 1161–1176.
- 810 Ebell, M. & Haefke, C. (2009). Product market deregulation and the u.s. employment miracle.
811 *Review of Economic Dynamics*, 12(3), 479–504.
- 812 Edmond, C., Midrigan, V., & Xu, D. Y. (2015). Competition, markups, and the gains from
813 international trade. *American Economic Review*, 105(10), 3183–3221.
- 814 Eggertsson, G., Ferrero, A., & Raffo, A. (2014). Can structural reforms help Europe? *Journal of*
815 *Monetary Economics*, 61, 2–22.
- 816 Engler, P., Ganelli, G., Tervala, J., & Voigts, S. (2017). Fiscal devaluation in a monetary union.
817 *IMF Economic Review*, 65(2), 241–272.
- 818 Farhi, E., Gopinath, G., & Itskhoki, O. (2014). Fiscal devaluations. *Review of Economic Studies*,
819 81(2), 725–760.
- 820 Floetotto, M. & Jaimovich, N. (2008). Firm dynamics, markup variations, and the business cycle.
821 *Journal of Monetary Economics*, 55(7), 1238–1252.

- 822 Forni, L., Gerali, A., & Pisani, M. (2010). Macroeconomic effects of greater competition in the
823 service sector: The case of Italy. *Macroeconomic Dynamics*, 14(5), 1–32.
- 824 Ghironi, F. & Mélitz, M. (2005). International trade and macroeconomic dynamics with heteroge-
825 neous firms. *The Quarterly Journal of Economics*, 120, 865–915.
- 826 Kehoe, T. J., Pujolas, P. S., & Rossbach, J. (2017). *Quantitative trade models: Developments and*
827 *Challenges*. Working paper 22706, NBER.
- 828 Lane, P. R. & Milesi-Ferretti, G. M. (2011). The cross-country incidence of the global crisis. *IMF*
829 *Economic Review*, 59(1), 77.
- 830 Lucas, R. (1987). *Models of Business Cycles*. Oxford: Basil Blackwell.
- 831 MaCurdy, T. (1981). An empirical model of labour supply in a life cycle setting. *Journal of Political*
832 *Economy*, (61), 1059–1085.
- 833 Petroulakis, F. (2017). *Internal devaluation in currency unions: the role of trade costs and taxes*.
834 Working Paper 2049, European Central Bank.
- 835 Ravn, M. O. & Mazzenga, E. (2004). International business cycles: the quantitative role of trans-
836 portation costs. *Journal of International Money and Finance*, 23(4), 645–671.
- 837 Soderbery, A. (2017). *Trade Elasticities, Heterogeneity, and Optimal Tariffs*. Mimeo.

838 A Complements on the model

839 A.1 More on the Foreign country

Optimal demand functions As in the Home country, the industrial good C_{st}^* is produced by a continuum of competitive representative firms according to the production function for each industry $s \in [0, 1]$:

$$C_{st}^* = \left(\sum_{k=1}^{n_{st}} (c_{skt}^*)^{\frac{\sigma-1}{\sigma}} + \sum_{k^*=n_{st}+1}^{n_{st}+n_{st}^*} (c_{sk^*t}^*)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}},$$

840 with c_{skt}^* (resp. $c_{sk^*t}^*$) a differentiated intermediate good produced by a domestic Home firm (resp.
841 Foreign). Symmetrically as for the Home country, the optimal demand functions that emanate from
842 the Foreign household for the Home and Foreign differentiated goods (c_{kt}^* and c_{kt}^* , respectively)
843 and the associated price index are given by:

$$c_{sk^*t}^* = \left(\frac{p_{sk^*t}^*}{P_{st}^*} \right)^{-\sigma} C_{st}^*, \quad \text{and} \quad c_{skt}^* = \left(\frac{p_{skt}^*}{P_{st}^*} \right)^{-\sigma} C_{st}^*, \quad (\text{A-33})$$

$$P_{st}^* = \left[\sum_{k=1}^{n_{st}} (p_{skt}^*)^{1-\sigma} + \sum_{k^*=n_{st}+1}^{n_{st}+n_{st}^*} (p_{sk^*t}^*)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}. \quad (\text{A-34})$$

844 **Markup determinants** Using a similar reasoning as for markups set by the Home firm (Section
845 2.2.2), the following formula shows that the markups set by a Foreign firm on both its local and
846 export market are:

$$\hat{\mu}_{k^*}^* = -\frac{1}{\Delta_1} [\hat{n}^* + \phi \bar{\kappa}^{1-\sigma} \hat{n}] + \frac{\sigma-1}{\Delta_1} \phi \bar{\kappa}^{1-\sigma} [\widehat{RULC} + \hat{\mu}_k^*], \quad (\text{A-35})$$

$$\hat{\mu}_k^* = -\frac{1}{\Delta_2} [\hat{n} + \phi \bar{\kappa}^{1-\sigma} \hat{n}^*] + \frac{\sigma-1}{\Delta_2} [\widehat{RULC} + \hat{\mu}_k^*]. \quad (\text{A-36})$$

847 with the positive constant terms Δ_1 and Δ_2 defined as:

$$\Delta_1 \equiv \frac{1}{\sigma - \bar{\varepsilon}} [\bar{\varepsilon}(\bar{\varepsilon} - 1) + \phi \bar{\kappa}^{1-\sigma} [\sigma(\bar{\varepsilon} - 1) + (\sigma - \bar{\varepsilon})^2]] > 0,$$

$$\Delta_2 \equiv \frac{1}{\sigma - \bar{\varepsilon}_X} [\bar{\varepsilon}_X(\bar{\varepsilon}_X - 1)(1 + \phi \bar{\kappa}^{1-\sigma}) + (\sigma - 1)(\sigma - \bar{\varepsilon}_X)] > 0.$$

848 Notice that these terms Δ_1 and Δ_2 are the same as those intervening in the markup expressions
849 for the Home firm, i.e. Equations (16) and (17).

850 A.2 Real exchange rate, markups: More details

851 This section aims to revisit the relation between endogenous markups and PTM which we made
 852 in Section 3.1. With this aim in mind, we start considering the expressions of the price elasticity
 853 of demand for the Home variety from the Home and Foreign markets (Equations (13) and (14)) in
 854 the initial symmetric steady state, denoted $\bar{\varepsilon}$ and $\bar{\varepsilon}_X$ for notational simplicity¹⁸

$$\bar{\varepsilon} = \sigma - (\sigma - \theta) \overbrace{\frac{1}{\bar{n}(1 + \phi\bar{\kappa}^{1-\sigma})}}^{\bar{m}}, \quad (\text{A-37})$$

$$\bar{\varepsilon}_X = \sigma - (\sigma - \theta) \underbrace{\frac{\phi\bar{\kappa}^{1-\sigma}}{\bar{n}(1 + \phi\bar{\kappa}^{1-\sigma})}}_{\bar{m}_X}, \quad (\text{A-38})$$

855 with $\phi \equiv \tau^{1-\sigma}$ the freeness of trade (between 0 and 1), $\bar{\kappa} \equiv \bar{\mu}_X/\bar{\mu}$ the export-to-local markup ratio
 856 (with $\bar{\mu}_X = \mu_k^* = \mu_{k^*}$ and $\bar{\mu} = \mu_k = \mu_{k^*}$ in the symmetric steady state) and \bar{m} and \bar{m}_X the market
 857 shares of the firm on the local and the export markets respectively.

Consider first the standard CES case ($\sigma = \theta$). As noted above, in this case price elasticity of demand and markups are constant and equal across destination markets. Trade costs however induce an asymmetry between the market shares a firm can obtain depending on the destination market, as in this case

$$\bar{m} = \frac{1}{\bar{n}(1 + \phi)}, \quad \bar{m}_X = \frac{\phi}{\bar{n}(1 + \phi)}.$$

858 As long as $\phi < 1$ (i.e., in presence of trade costs), the market share of the firm is higher when it
 859 sells on the local market relative to abroad. As can be inferred from Equation (9), under constant
 860 markups ($\sigma = \theta$), markups are identical among destination ($\bar{\kappa} = 1$ and $\tau\bar{\kappa} = \tau$), such that local
 861 firms fully pass on the trade cost on foreign households ($p_k^* = \tau p_k$). This mill-pricing strategy of
 862 firms on their export market (i.e., firms passing on the iceberg trade costs to foreign consumers)
 863 raises the relative price of imports. This drives consumers to favor locally-produced goods, hence
 864 an asymmetric market share in favor of local firms ($\bar{m} > \bar{m}_X$). Note that this holds in the absence
 865 of home bias in preferences within the basket of differentiated varieties.

866 As long as $\sigma > \theta$, positive trade costs ($\phi < 1$) also affect the price-elasticities of demand, hence the
 867 markups set by firms. As can be inferred from Equations (A-37) and (A-38), all else being equal,
 868 an increase in trade costs raises the price elasticity of the demand for imports, while it decreases
 869 the price elasticity of the demand for the local good ($\frac{\partial \bar{\varepsilon}_X}{\partial \phi} < 0$, $\frac{\partial \bar{\varepsilon}}{\partial \phi} > 0$). From Equation (10), this,
 870 in turn, affects markups differently depending on the destination market. Precisely, trade costs
 871 tend to induce lower markup on the export market, due to a higher price elasticity of demand than
 872 on the local market (i.e. pushing $\bar{\kappa} < 1$ all else being equal).

¹⁸In the initial symmetric steady state, payroll tax rates are identical ($\tau^w = \tau^{w^*}$) and the wage ratio $\frac{W}{W^*} = 1$, implying a ratio of unit labor cost equal to 1.

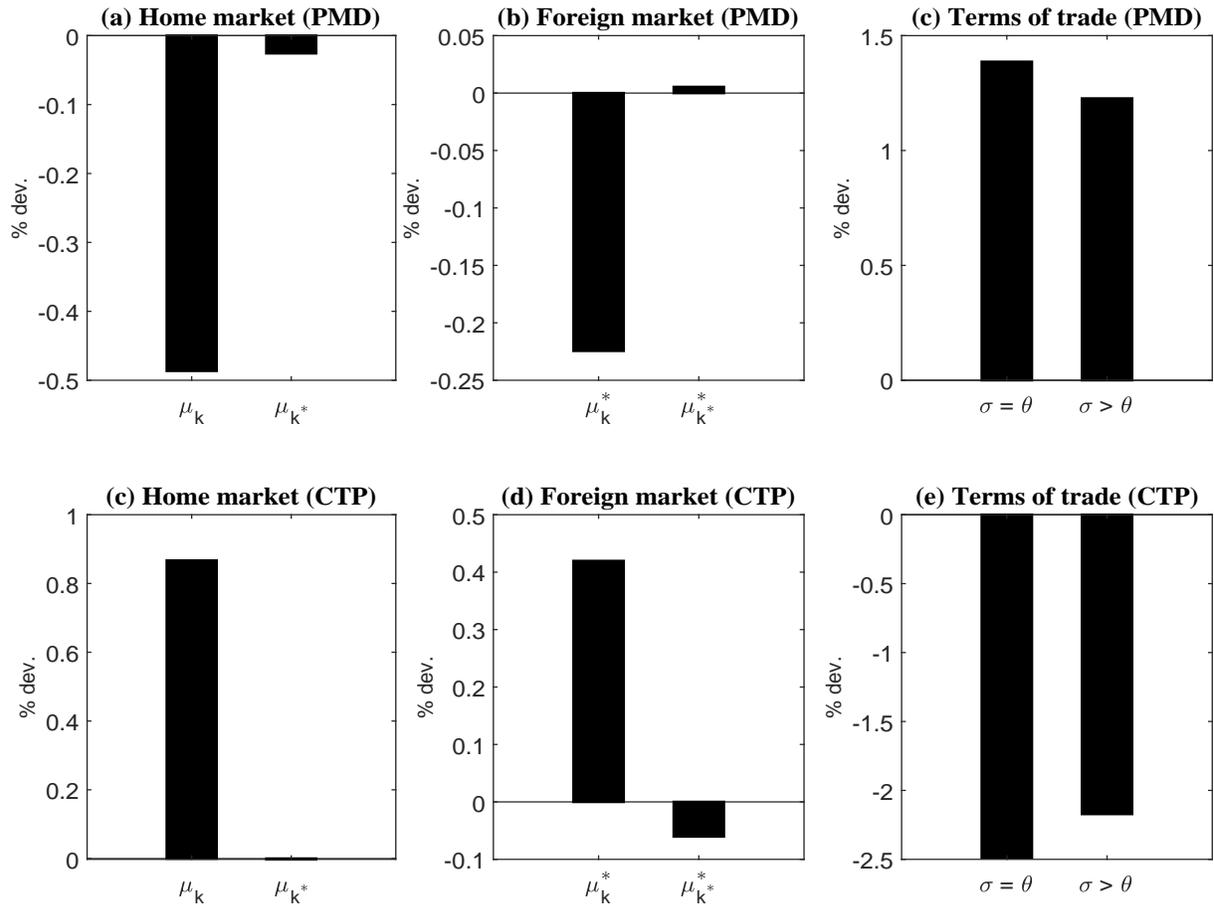
If in the initial steady state the magnitude of the PTM behavior is not strong enough to more than compensate for the effects of trade costs, then firms face a more elastic demand on the export market, leading to a lower export markup. From Equations (A-37) and (A-38), this is the case when $\phi\bar{\kappa}^{1-\sigma} < 1$, or equivalently $\tau\bar{\kappa} > 1$. In this case, the export price (p_X) remains higher than the local one (p), as

$$\frac{p_X}{p} = \tau \frac{\bar{\mu}_X}{\bar{\mu}} > 1.$$

873 Note that this is reminiscent of the condition $\frac{1}{\tau} < \frac{p_X}{p} < \tau$ for PTM to be sustainable in equilibrium
874 pointed out by Atkeson & Burstein (2008). Transposed in terms of markups, this condition becomes:
875 $1 < \tau \frac{\bar{\mu}_X}{\bar{\mu}} < \tau^2$. When $\phi\bar{\kappa}^{1-\sigma} < 1$ is imposed, the first part of the inequality condition is certain
876 to hold analytically. In our simulation, the calibration $\tau\bar{\mu}_X/\bar{\mu} = 1.3 \times 0.97 = 1.26$ works to ensure
877 that the inequality holds.

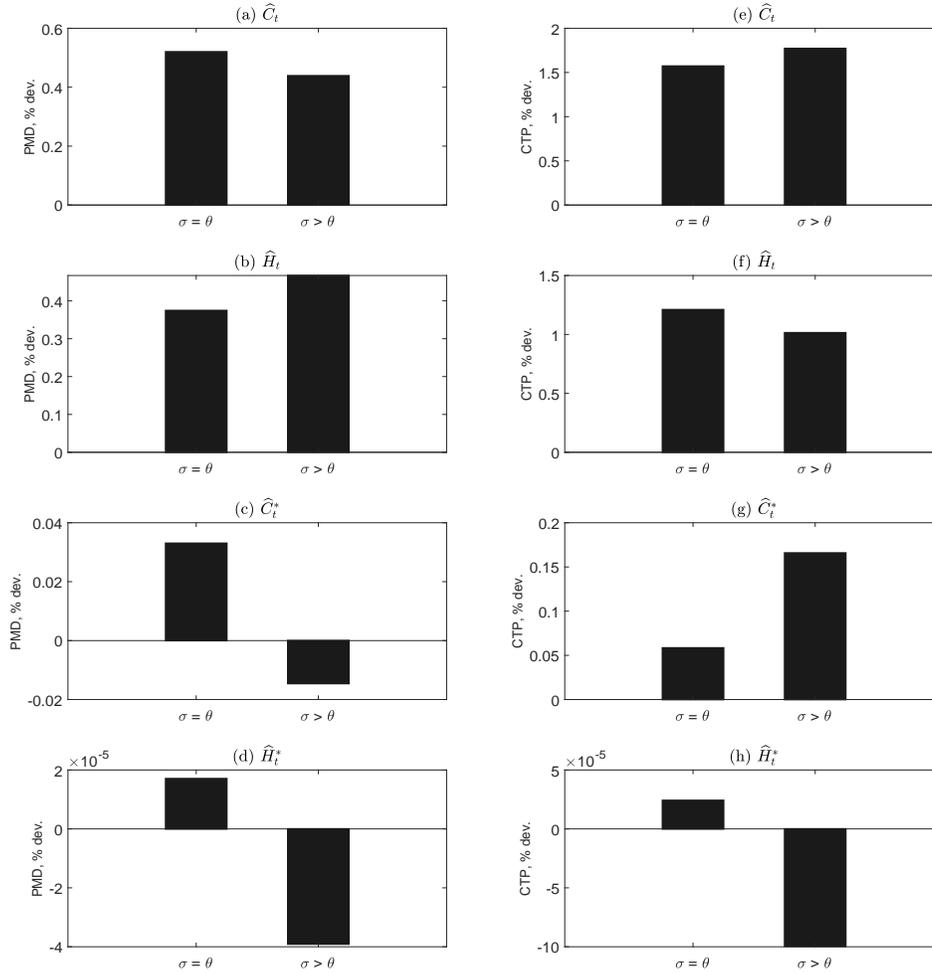
878 B Complements on the effects of the reform

Figure 5: Long-run effects of the reforms: Markups and the terms of trade



Detailed view of markups changes Long-run effects of product market deregulation (first line, PMD) and competitive tax policy (second line, CTP) on the markups by both Home and Foreign firms on the two destination markets, under constant markups ($\sigma = \theta$) and variable markups ($\sigma > \theta$).

Figure 6: Long-run effects of the reforms: Selected set of macroeconomic variables



Long-run effects on selected macroeconomic variables Long-run effects of product market deregulation (first line, PMD) and competitive tax policy (second line, CTP) consumption and hours worked in the Home and Foreign country, under constant markups ($\sigma = \theta$) and variable markups ($\sigma > \theta$).