GLOBALIZATION, MARKET STRUCTURE AND THE FLATTENING OF THE PHILLIPS CURVE

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ABSTRACT. The decline in the sensitivity of inflation to domestic slack observed in developed countries over the last 25 years has been often attributed to globalization. However, this intuition has so far not been formalized. I develop a general equilibrium setup that can rationalize the flattening of the Phillips curve in response to a fall in trade costs. In order to do so, I add three ingredients to an otherwise standard two-country new-Keynesian model: *strategic interactions* generate time varying desired markup; *endogenous firm entry* makes the market structure change with globalization; *heterogeneous productivity* allows for self-selection among firms. Because of productivity heterogeneity, only high-productivity firms (that are also the bigger ones) enter the export market. They tend to transmit less marginal cost fluctuations into inflation because they absorb them into their desired markup in order to protect their market share. At the aggregate level, the increase in the proportion of large firms reduces the pass-through of marginal cost into inflation.

Keywords: Inflation; Phillips curve; Macroeconomic Impacts of Globalization.

JEL Classification Numbers: E31,F41,F62.

Non Technical Summary:

In spite of the dramatic economic contraction following the Lehman collapse and the ensuing subdued growth dynamics, inflation has displayed a remarkable stability. This "missing disinflation" puzzle has renewed attention in academic and policy circles on the fundamental forces behind the loosening of the inflation-output tradeoff observed in advanced countries since the mid 1980's. The *missing disinflation puzzle* terminology is introduced by Gordon (2013), or Coibion and Gorodnichenko (2015) among others. Among the possible explanations, globalization has stood as one of the prime suspects, ever since Chairman Bernanke's speech "Globalization and Monetary Policy" in 2007. Intuitively, as openness to international trade increases, producers adjust their pricing behavior for fear of losing their market share. This should in principle feedback on the slope of the Phillips curve. Yet, in spite of its appeal, it has proven extremely difficult to formalize this simple story in the workhorse new-Keynesian paradigm.

In this paper, I provide a novel analytical framework that can replicate the flattening of the Phillips curve in response to globalization, in the context of a two-country new-Keynesian model. Key is the inclusion of three ingredients: *Strategic interactions* due to oligopolistic competition; *Endogenous entry* on the export market due to fixed penetration costs; and *Heterogeneity in firms' productivity*.

Globalization is defined as a fall in international per-unit trade costs. The set of competitors endogenously changes as it becomes profitable for new firms to export (*Endogenous Entry assumption*). By the *Productivity Heterogeneity assumption*, only the more productive firms choose to export and they are also the largest firms. Because of the *Strategic Interactions assumption*, largest firms are the most prone to act strategically by absorbing marginal cost movements into their markup in order to protect their market share. Hence, large firms transmit less marginal cost fluctuations into price adjustments compared to smaller firms. At the aggregate level, the increase in the relative proportion of more productive/larger firms, due to globalization, engenders a flattening of the aggregate Phillips curve.

As soon as one of the three key assumptions is relaxed, the model predicts opposite results, i.e. either no change or a steepening of the Phillips curve. I demonstrate that two forces are simultaneously playing in opposite directions in response to globalization. On the one hand, the increase in the number of goods competing on the domestic market reduces firms' market power. This decline in real rigidities renders price adjustments more responsive to marginal cost fluctuations. Thus, the pro-competitive force favors a steepening of the Phillips curve.

On the other hand, the distribution of firms changes because the share of big producers in the economy increases due to the self-selection of high-productivity firms. The post-globalization economy comprises relatively more large firms. As large firms have more market power than the average population, the overall degree of real rigidities in the economy increases. This composition effect reduces the responsiveness of inflation to marginal cost shocks.

At the aggregate level, the Phillips curve does flatten if the composition effect dominates the pro-competitive effect. I show that it is indeed the case: for a parameterization of the model that replicates standard features of international trade, the sensitivity of domestic production price inflation to domestic marginal cost decreases by 11%.

1. Introduction

In spite of the dramatic economic contraction following the Lehman collapse and the ensuing subdued growth dynamics, inflation has displayed a remarkable stability. This "missing disinflation" puzzle has renewed attention in academic and policy circles on the fundamental forces behind the loosening of the inflation-output tradeoff observed in advanced countries since the mid 1980's.[1] Among the possible explanations, globalization has stood as one of the prime suspects, ever since Chairman Bernanke's speech "Globalization and Monetary Policy" in 2007. Intuitively, as openness to international trade increases, producers adjust their pricing behavior for fear of losing their market share. This should in principle feedback on the slope of the Phillips curve.[2] Yet, in spite of its appeal, it has proven extremely difficult to formalize this simple story in the workhorse new-Keynesian paradigm.

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Globalization is defined as a fall in international per-unit trade costs. The set of competitors endogenously changes as it becomes profitable for new firms to export (*Endogenous Entry assumption*). By the *Productivity Heterogeneity assumption*, only the more productive firms choose to export and, they are also the largest firms.[3] Largest firms are the most prone to act strategically by absorbing marginal cost movements into their markup in order to protect their market share. Because of the *Strategic Interactions assumption*, large firms are less prone to transmit marginal cost fluctuations into price adjustments compared to smaller firms. At the aggregate level, the increase in the relative proportion of more productive/larger firms, due to globalization, engenders a flattening of the aggregate Phillips curve.

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[1] A non exhaustive selection among the numerous publications since the mid 2000's includes Peach et al. (2011), Kohn (2006), Bernanke (2007), International Monetary Fund (2006), International Monetary Fund (2013)). The *missing disinflation puzzle* terminology is introduced by Gordon (2013), or Coibion and Gorodnichenko (2015) among others.

[2] The Phillips curve slope is defined, in a broad way, as the responsiveness of inflation to any measure of the slack/tightness on the domestic production factors such as output gap, unemployment gap, marginal cost or capacity utilization.

[3] This result is in line with standard heterogenous-firm trade models à la Melitz (2003) or Chaney (2008) where the more productive price set a lower relative price and hence capture a larger market share. The empirical literature ((Bernard and Jensen, 1999)) indeed finds that exporters are larger and more productive than non exporters.

As soon as one of the three key assumptions is relaxed, the model predicts opposite results, i.e. either no change or a steepening of the Phillips curve. I demonstrate why each assumption is necessary to reproduce the flattening of the Phillips curve, but not sufficient by itself. To establish that point, the causality from globalization to the slope of the Phillips curve can be decomposed into two parts: (i) How does the elasticity of inflation to marginal cost vary with the market structure? (ii) How does the market structure change with globalization?

How does the slope of the Phillips curve vary with the market structure?
The view that the degree of competition might affect the slope of the Phillips curve presumes that firms act strategically. In order to capture the strategic interactions channel, I relax the standard fixed price elasticity of demand assumption. To that end, I introduce the *oligopolistic competition* assumption, stating that firms compete in prices, *à* la Bertrand, within sectors[4]. They internalize their influence on the sectoral price when setting their optimal price. This leads to a perceived price-elasticity of demand that co-moves with firm's relative price. In the end, the desired markup[5] also fluctuates over time, as in Atkeson and Burstein (2008) or Benigno and Faia (2010).[6]

Coupled with nominal rigidities, the *oligopolistic competition* assumption gives rise to an augmented new-Keynesian Phillips curve, whose slope is not fixed anymore. The responsiveness of inflation to marginal cost is decreasing in firm's market share, ξ.[7] As firms respond to a marginal cost shock by absorbing part of that shock into their desired markup, the pass-through of marginal cost into inflation is mechanically reduced.[8] The strategic "desired markup adjustment" is all the larger as the economy is composed of large players (with more market power). In the limit, if firms' market share becomes infinitely small, strategic interactions vanish and the model yields back to the standard fixed elasticity of demand case.
As in Woodford (2003), for a given degree of nominal rigidities, the higher the degree of strategic interactions (also sometimes referred to as real rigidities), the flatter the Phillips curve. The remaining question regards the impact of globalization on firms' market share/market power.

[4]In the vein of Dornbusch (1987).
[5]The one prevailing under flexible prices.
[6]Instead of supply side complementarities, Chen et al. (2009), Sbordone (2010) or Guerrieri et al. (2010) rely on demand side complementarities, introducing a *Kimball* demand function that directly relates the elasticity of substitution between goods to the number of available goods. Another option for generating time varying price elasticity of demand relies on distribution costs as in Berman et al. (2012).
[7]The inverse of the market share, $1/\xi$, can be interpreted as a measure of the competition toughness in steady state.
[8]Those results are in line with Sbordone (2010), Benigno and Faia (2010) and Guerrieri et al. (2010) .

How does the market structure change with globalization?
The answer depends on the way globalization is defined.
Sbordone (2010) and Benigno and Faia (2010) consider symmetric firms and model globalization as an increase in the overall number of goods (N), which, as a corollary, entails a decline in domestic firms market share ($\xi = 1/N$). Such a definition of globalization necessarily leads to a decline in firms' market power and a steepening of the Phillips curve as strategic interactions weaken.

Instead, I borrow from the new trade literature and I argue that globalization might favor the emergence of "big players". In the vein of Melitz (2003) or Chaney (2008), I introduce two assumptions: the *set of exporters is endogenous*, due to fixed penetration costs on the export market; and firms are *heterogeneous in productivity*.

When the iceberg trade cost falls, only the high-productivity firms choose to export and high-productivity firms are also large ones (as in (Atkeson and Burstein, 2008) or (Berman et al., 2012)). Therefore new firms who enter the market have more market power than the average. They are consequently relatively more prone to act strategically, by adjusting their desired markup, and exhibit a flatter Phillips curve. At the aggregate level, as globalization favors an environment with relatively more "large market share" firms, the aggregate Phillips curve flattens.

Related literature. My contribution connects three streams of the literature.

First, this paper is related to the new-Keynesian open economy literature.
From standard new-Keynesian open-economy models as Gali and Monacelli (2008), there is a broad agreement on how import prices have a direct effect on consumer price inflation proportionally to their share in the consumption basket. Besides, domestic producer price inflation is related to the terms of trade insofar as the latter influences the domestic real marginal cost.

I consider another channel that works through firm strategic behavior and directly affects the slope of the Phillips curve. In that sense, my work is very close to Sbordone (2010)[9], Benigno and Faia (2010) and Guerrieri et al. (2010) who embed strategic interactions into otherwise standard DSGE models in order to assess the impact of globalization on inflation dynamics. However, it differs in a crucial aspect: instead of defining globalization only as an increase in the number of goods, I define globalization as a fall in trade costs that allows for both *(i)* an increase in the number of available varieties and *(ii)* for the selection of the most productive firms (a mechanism for

[9] Sbordone studies a closed economy, but the impact of the rest of the world is captured through the number of varieties available to domestic customers.

which the international trade literature provides solid evidence).

Sbordone (2010), Guerrieri et al. (2010) or Benigno and Faia (2010) relax the fixed elasticity of demand hypothesis by relying respectively on demand side strategic complementarities (with preferences *à* la Kimball) or on oligopolistic competition. In their setups, there is no endogenous entry/exit of firms, and globalization is modeled as an increase in the number of varieties. The firms are homogeneous in productivity and globalization unambiguously lowers the share of each firm in the market, therefore alleviating strategic interactions. Firms' concerns about losing market share diminish, which promotes greater price flexibility and steepens the slope of the Phillips curve. In my framework, it is not necessarily the case that firms' market share falls with globalization. The effect depends on each firm relative productivity. The more productive ones might gain market shares by penetrating the export market. In the end, the aggregate Phillips curve slope depends on the relative share of big versus small firms in the economy.

Second, this work is related to the recent literature that embeds endogenous varieties in a new-Keynesian DSGE setup.

A closely related series of papers deals with optimal monetary policy under endogenous entry : Bilbiie et al. (2012), **?**, and Bergin and Corsetti (2013) study models with endogenous firm entry and sluggish price adjustment to derive the optimal monetary policy.

Part of this literature also introduces strategic complementarities. In particular, Cecioni (2010), Etro and Colciago (2010), Faia (2012), Lewis and Poilly (2012), or Etro and Rossi (2014) rely on oligopolistic competition and endogenous firm entry assumptions in a closed economy framework. They find that short run markups vary countercyclically because, after a positive shock, the entry of new firms reduces their market share. Cecioni (2010) concludes that a cyclical increase in the number of operating firms lowers CPI-inflation in the short run.

My work differs from those papers along two dimensions : first, I study an open economy[10]; second, I suppose that firms are heterogeneous in productivity. As a result, I am able to account for a flattening of the Phillips curve while the aforementioned papers predict no change or a steepening.

Third, the paper also shares ingredients with the international trade literature on Pricing-To-Market and imperfect exchange rate pass-through.

This literature demonstrates that strategic interactions are sufficient to generate pricing-to-market and imperfect pass-through even in the absence of nominal rigidities (see. (Burstein and Gopinath,

[10] in order to assess the effects of globalization.

2013)). This result still holds in my model. In the long run, when prices are flexible, the model boils down to Atkeson and Burstein (2008) framework. My results are consistent with other models where the perceived price elasticity of demand declines with firm productivity. It is in line with Berman et al. (2012) who point out an heterogeneity in pricing to market driven by firm specific productivity.
However, my approach differs from international trade literature on imperfect pass-through as I consider a *sticky price environment*. I am focusing on how the combination of strategic interactions and nominal rigidities affects the inflation/real marginal cost nexus. As opposed to Atkeson and Burstein (2008)or Berman et al. (2012), I do not focus on the link between prices and nominal marginal costs, but I am looking at the relationship between inflation and real marginal cost (the Phillips curve slope).

In terms of modeling, this work is closely related to Ghironi and Melitz (2005) and Atkeson and Burstein (2008) insofar as I consider a dynamic two-country economy with an endogenous set of exporters driven by trade costs.[11]

I simplify Atkeson and Burstein (2008) framework by imposing symmetry across sectors. As sectors are identical, I can solve the model analytically in the vein of Ghironi and Melitz (2005): in steady state, there exists an endogenous cutoff productivity value that determines the set of exporters, their prices and the quantities sold, and eventually pins down the slope of the aggregate Phillips curve. Compared to Atkeson and Burstein (2008), I do not have the insights related to the heterogeneity across sectors but I gain the possibility to derive an analytical solution.

2. MODEL

Assume that the economy is composed of two countries, domestic (d) and foreign (f). In each country there exists a continuum of sectors on $[0, 1]$, indexed by k, producing differentiated goods. Within each sector, firms compete strategically in prices (*à* la Bertrand).[12]

The model is a general equilibrium that involves four types of agents in each country: households, intermediate goods producers, final good producers and a monetary authority. The representative household maximizes its intertemporal utility by choosing consumption, and assets holdings (risk free nominal bonds) and receives income from labor and dividends from firms. The monetary authority follows a standard Taylor rule. Since the behavior of the representative

[11]The key difference is that I am focusing on a sticky prices environment while they both deal with flexible prices.
[12]I derive in appendix G a version with quantity competition *à* la Cournot and I show that the results are qualitatively similar.

household and the monetary authority is pretty standard, I delay the full description to Appendix A. The firm behavior is the key novel ingredient in my model and it departs from the standard new-Keynesian framework through the existence of strategic interactions entailed by oligopolistic competition.

2.1. **Final goods producer.** A non-tradable final consumption good Y_t^c is composed of differentiated goods from a continuum of sectors k on $[0,1]$: $Y_t^c = \left[\int_0^1 Y_t^c(k)^{\frac{\sigma-1}{\sigma}} dk\right]^{\frac{\sigma}{\sigma-1}}$, where σ is the elasticity of substitution between goods from different sectors. The demand for sectoral good is $Y_t^c(k) = \left(\frac{P_t(k)}{P_t}\right)^{-\sigma} Y_t^c$, where P_t is the Dixit-Stiglitz price index defined as $P_t = \left[\int_0^1 P_t(k)^{1-\sigma} dk\right]^{\frac{1}{1-\sigma}}$ and $P_t(k)$ is the sectoral price.

In each sector k, a retailer firm combines foreign and domestic goods to produce $Y_t^c(k) = \left[\sum_{i\in\Omega_t^k} x_t(i)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}} = \left[\sum_{i\in\Omega_t^{k,d}} x_t^d(i)^{\frac{\theta-1}{\theta}} + \sum_{i\in\Omega_t^{k,f}} x_t^f(i)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}$. $\Omega_t^{k,d}$ and $\Omega_t^{k,f}$ are respectively the sets of domestic and foreign varieties consumed in sector k on domestic market at time t and satisfy $\Omega_t^{k,d} \bigcup \Omega_t^{k,f} = \Omega_t^k$ and $\Omega_t^{k,d} \bigcap \Omega_t^{k,f} = \emptyset$.

A *variety* i is equivalent to a *good* or a *firm* or a *production line* since each firm produces one differentiated good. N_t^k is the measure of Ω_t^k and represents the number of differentiated goods sold in each sector k. Similarly, $N_t^{k,d}$ is number of goods produced by domestic firms while $N_t^{k,f}$ is number goods produced by foreign firms (and consumed in sector k). By definition $N_t^k = N_t^{k,d} + N_t^{k,f}$.

The final goods producer in sector k chooses its optimal production plans to maximize its profit:

$$\max_{\{x_t(i)\}_{i\in\Omega_t^k}} P_t(k)Y_t^c(k) - \sum_{i\in\Omega_t^k} P_t^x(i)x_t(i)$$

$$\text{s.t. } Y_t^c(k) = \left[\sum_{i\in\Omega_t^k} x_t(i)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}$$

Optimality Conditions:

$$x_t(i) = \left(\frac{P_t^x(i)}{P_t(k)}\right)^{-\theta} Y_t^c(k) = \left(\frac{P_t^x(i)}{P_t(k)}\right)^{-\theta} \left(\frac{P_t(k)}{P_t}\right)^{-\sigma} Y_t^c$$

where $P_t(k) = \left[\sum_{i\in\Omega_t^k} P_t^x(i)^{1-\theta}\right]^{\frac{1}{1-\theta}} = \left[\sum_{i\in\Omega_t^{k,d}} P_t^d(i)^{1-\theta} + \sum_{j\in\Omega_t^{k,f}} P_t^f(j)^{1-\theta}\right]^{\frac{1}{1-\theta}}$ and $P_t^x(i)$ is the nominal price of good i, $P_t^x(i) \in \{P_t^d(i), P_t^f(i)\}$ depending on the country where the good has been produced.

2.2. Intermediate goods producers.

(1) **Heterogeneous productivity**

Each firm produces a different variety. Firms are heterogenous in productivity and are indexed by their productivity type, z, that does not vary over time. The production function has constant returns to scale and labor h_t is the only input: for all firms with productivity z, for all sectors k, $x_t(z) = A_t z h_t(z)$. A_t is the aggregate labor productivity (respectively A_t^* in country F), z is the specific firm relative productivity factor. The real marginal cost of production for a firm with productivity z in country D is $\frac{W_t}{P_t A_t z} = \frac{w_t}{A_t z} = s_t(z)$ and $\frac{w_t^*}{A_t^* z^*} = s_t^*(z^*)$ in country F.

(2) **Market structure: oligopolistic competition generates a time varying price-elasticity of demand.**

Firms compete in prices *à* la Bertrand, internalizing their impact on the sectoral price when choosing their optimal price ($\frac{\partial P_t(k)}{\partial P_t^x(z)} \neq 0$ in the firm's optimization program). Consequently the perceived elasticity of demand to its own price, $\Theta(z)$, is not constant, although the elasticity of substitution between goods in sector k is constant (θ).

$$\Theta(z) = -\frac{\partial x_t(z)}{\partial P_t^x(z)} \frac{P_t^x(z)}{x_t(z)} = \theta - (\theta - \sigma) \left(\frac{\partial P_t(k)}{\partial P_t^x(z)} \frac{P_t^x(z)}{P_t(k)} \right)$$

where $\frac{\partial P_t(k)}{\partial P_t^x(z)} \frac{P_t^x(z)}{P_t(k)} = \frac{P_t^x(z) x_t(z)}{P_t(k) Y_t^c(k)} = \left[\frac{P_t^x(z)}{P_t(k)} \right]^{1-\theta} = \xi_t(z)$, the market share of firm z in sector k.

(3) **Price Adjustment Cost**

Prices are sticky *à* la Rotemberg. $PAC_t(z) = \frac{\phi_p}{2} \left[\frac{P_t^x(z)}{P_{t-1}^x(z)} - 1 \right]^2 \frac{P_t^x(z)}{P_t} x_t(z)$ is the cost incurred by a firm z in any sector for adjusting its price at time t, expressed in units of final consumption. This cost can be interpreted as the amount of material that a firm must purchase in order to change a price. $\phi_p = 0$ yields to flexible prices.

(4) **Market Penetration Cost**

A domestic firm z can serve the domestic market as well as the foreign market if it is profitable to do so. Firms face a fixed penetration cost on the export market ($f_X u_f$), where u_f is the unit in which the cost f_X is paid. As a benchmark, I assume that this cost is paid in units of consumption (i.e. $u_f = 1$).[13] In addition to the fixed market penetration cost f_X,

[13] As a robustness check I allow for those costs to be paid in terms of effective labor units (i.e. $u_f = \frac{w}{A}$ units of consumption) as in Ghironi and Melitz (2005). As long as those costs are low enough, the two specifications predict the same impact of globalization on the Phillips curve. I choose the "consumption unit" as a benchmark in order to keep the model as simple as possible and to isolate the mechanisms trough which globalization affects the pricing behavior of firms. For clarity, I don't want the impact of globalization to be driven by a change in fixed costs induced by a move

an exporter also faces a melting-iceberg cost ($\tau \geq 1$). To sell one unit of good to the foreign country, an exporter must produce and ship τ units because $\tau - 1$ units melt on the way.

(5) **Profit Maximization**

Because of trade costs, markets are segmented and a domestic firm z can set different prices on domestic and foreign markets in order to maximize its total profit.

Maximization of the domestic component of profits by domestic firms

$$\max_{P^d_{t+j}(z)} \sum_{j=0}^{\infty} \mathbb{E}_t \left[Q_{t,t+j} \left(P^d_{t+j}(z) x_{t+j}(z) - \frac{W_{t+j}}{A_{t+j} z} x_{t+j}(z) - \frac{\phi_p}{2} \left(\frac{P^d_{t+j}(z)}{P^d_{t+j-1}(z)} - 1 \right)^2 P^d_{t+j}(z) x^d_{t+j}(z) \right) \right]$$

$$\text{s.t. } x^d_t(z) = \left(\frac{P^d_t(z)}{P_t(k)} \right)^{-\theta} Y^c_t(k)$$

where $Q_{t,t+j}$ is a stochastic discount factor, $Q_{t,t+j} = \beta^j \frac{U'(C_{t+j})}{U'(C_t)} \frac{P_t}{P_{t+j}}$.

Optimality conditions : The optimal relative price is a markup over the real marginal cost.

$$\frac{P^d_t(z)}{P_t} = p^d_t(z) = \mu^d_t(z) \frac{w_t}{A_t z} = \mu^d_t(z) s_t(z) \tag{1}$$

where:

$$\mu^d_t(z) = \frac{\Theta^d_t(z)}{(\Theta^d_t(z) - 1) \left[1 - \frac{\phi_p}{2} (\Pi^d_t(z) - 1)^2 \right] + \phi_p \Pi^d_t(z) (\Pi^d_t(z) - 1) - \Gamma_t(z)}$$

$$\Theta^d_t(z) = \left| \frac{\partial x^d_t(z)}{\partial P^d_t(z)} \frac{P^d_t(z)}{x^d_t(z)} \right| = \theta - (\theta - \sigma) p^d_t(z)^{1-\theta} = \theta - (\theta - \sigma) \xi^d_t(z)$$

$$\Gamma^d_t(z) = \phi_p \mathbb{E} \left[Q_{t,t+1} \Pi^d_{t+1}(z)^2 (\Pi^d_{t+1}(z) - 1) \frac{x^d_{t+1}(z)}{x^d_t(z)} \right]$$

$$\Pi^d_t(z) = \frac{P^d_t(z)}{P^d_{t-1}(z)}$$

Under flexible prices, the markup becomes $\mu^{d,desired}_t(z) = \frac{\Theta^d_t(z)}{\Theta^d_t(z) - 1}$. Unlike monopolistic competition, the desired markup is not constant over time but depends on the firm's price elasticity of demand ($\Theta^d_t(z)$) that is negatively related to its market share : $\Theta^d_t(z) = \theta - (\theta - \sigma) \xi^d_t(z)$.[14]

in $\frac{w}{A}$ because this effect is of second order compared to the direct channels : the extensive margin (change in the set of exporters) and the intensive margin (changes in their price).

[14] The elasticity of substitution across goods within a sector (θ) is greater than the elasticity of substitution between sectoral goods (σ).

The standard monopolistic case is nested into my model for specific parameters restrictions. *(1)* If $\theta = \sigma$, i.e. the elasticity of substitution within a sector is equal to the elasticity of substitution between sectors, then the model collapses to the monopolistic case since the price elasticity of demand becomes $\Theta(z) = \theta - (\theta - \theta)\xi(z) = \theta = \sigma$ and $\mu_t^{d,desired}(z) = \frac{\theta}{\theta-1}$. Indeed, since there is an infinity of sectors, if the elasticity of substitution within a sector is equal to the one between sectors, the strategic interactions -that were taking place within a sector- vanish. *(2)* If the market share $\xi_t^d(z)$ tends to zero (the number of domestic or foreign firms goes to infinity), the market structure also becomes monopolistic with $\Theta(z) = \theta$. *(3)* If there is only one firm per sector, then $P_t^x(z) = P_t$ and thus $\Theta(z) = \theta - (\theta - \sigma)1 = \sigma$.

Maximization of the exports component of profits by domestic firms

See details of the program in Appendix C.

Optimality conditions : $\frac{P_t^{d*}(z)}{P_t^*} = p_t^{d*}(z) = rer_t^{-1}\mu_t^{d*}(z)\tau\frac{w_t}{A_t z}$ where rer_t is the real exchange rate, $rer_t = \frac{e_t P_t^*}{P_t}$ with e_t the nominal exchange rate.[15]

2.2.1. *Firms' dividends.* For a firm z in country D, the dividend (expressed in units of domestic consumption) is the sum of the profit from sales on the domestic market and the profit from sales on the foreign market, $d_t(z) = d_t^d(z) + d_t^{d*}(z)$, where:

$$d_t^d(z) = \left[1 - \frac{1}{\mu_t^d(z)} - \frac{\phi_p}{2}[\Pi_t^d(z) - 1]^2\right] x_t^d(z)\frac{P_t^d(z)}{P_t}$$

$$d_t^{d*}(z) = \begin{cases} 0 & \text{if the firm does not export.} \\ rer_t\left[1 - \frac{1}{\mu_t^{d*}(z)} - \frac{\phi_p}{2}[\Pi_t^{d*}(z) - 1]^2\right] x_t^{d*}(z)\frac{P_t^{d*}(z)}{P_t^*} - f_X u_f & \text{otherwise.} \end{cases}$$

2.2.2. *Cutoff values and firms average.* Suppose that firms are distributed within each sector following the same discrete bounded distribution on $S = \{z_{min}, z_2, z_3, ..z_{max}\}$. Suppose also that the number of values characterizing the distribution support is large enough so that the sum of the frequency distribution bins can be approximated by an integral (in the spirit of the Riemann sum). The ***average price*** set by domestic firms serving the domestic market is :
$\widetilde{P_t^d} = \left[\sum_{z\in S} P_t^d(z)^{1-\theta}\mathbb{P}(Z = z)\right]^{\frac{1}{1-\theta}} = \left[\int_{z_{min}}^{z_{max}} P_t^d(z)^{1-\theta} g(z)dz\right]^{\frac{1}{1-\theta}}$.

[15]The nominal exchange rate should be read as "1 unit of F currency = e_t units of D currency".

And the ***average profit*** can be written as:

$$\tilde{d}_t^d = \sum_{z \in S} \left[1 - \frac{1}{\mu_t^d(z)} - \frac{\phi_p}{2}[\Pi_t^d(z) - 1]^2\right] p_t^d(z)^{(1-\theta)} Y_t^c \mathbb{P}(Z = z)$$
$$= \int_{z_{min}}^{z_{max}} \left[1 - \frac{1}{\mu_t^d(z)} - \frac{\phi_p}{2}[\Pi_t^d(z) - 1]^2\right] p_t^d(z)^{(1-\theta)} Y_t^c g(z) dz.$$

The underlying continuous distribution $g(.)$ is a Pareto one with shape parameter k. The Pareto Probability Density Function is $g(z) = \frac{k z_{min}^k}{z^{k+1}} \frac{1}{1-\left(\frac{z_{min}}{z_{max}}\right)^k}$, $\forall z \in [z_{min}, z_{max}]$.

Its Cumulative Density Function is $G(z) = \mathbb{P}(Z \leq z) = \frac{1-\left(\frac{z_{min}}{z}\right)^k}{1-\left(\frac{z_{min}}{z_{max}}\right)^k}$.

- **Cutoff productivity value for a firm to export**

  Similarly to Ghironi and Melitz (2005), it is profitable for a firm z in country D to export if its productivity draw z is above the cutoff value $\overline{z_{X,t}} = \inf\left\{z, \text{ st. } d_t^{d*}(z) \geq 0\right\}$. The cutoff value, $\overline{z_{X,t}}$, for the export component of profit to be positive is defined by:

$$rer_t \left[1 - \frac{1}{\mu_t^{d*}(\overline{z_{X,t}})} - \frac{\phi_p}{2}[\Pi_t^{d*}(\overline{z_{X,t}}) - 1]^2\right] p_t^{d*}(\overline{z_{X,t}})^{(1-\theta)} Y_t^{c*} = f_X u_f \quad (2)$$

  and the probability for an active domestic firm to export at time t is $\mathbb{P}(Z \geq \overline{z_{X,t}}) = 1 - G(\overline{z_{X,t}})$.

- **Average values from exports**

  The ***average price*** set by domestic firms that are exporting is $\widetilde{P_t^{d*}} = \left[\int_{z_{min}}^{z_{max}} P_t^{d*}(z)^{1-\theta} \gamma_t^X(z) dz\right]^{\frac{1}{1-\theta}}$, where $\gamma_t^X(z)$ is the density function of productivity conditional on exporting, i.e. $\gamma_t^X(z) = \begin{cases} \frac{g(z)}{1-G(\overline{z_{X,t}})} & \text{if } z \geq \overline{z_{X,t}} \\ 0 & \text{otherwise.} \end{cases}$

  Hence:

$$\widetilde{P_t^{d*}} = \left[\frac{1}{1 - G(\overline{z_{X,t}})} \int_{\overline{z_{X,t}}}^{z_{max}} P_t^{d*}(z)^{1-\theta} g(z) dz\right]^{\frac{1}{1-\theta}}$$

  The ***average profit*** from exports is[16]

$$\tilde{d}_t^{d*}(z) = \int_{z_{min}}^{z_{max}} \left\{rer_t \left[1 - \frac{1}{\mu_t^{d*}(z)} - \frac{\phi_p}{2}[\Pi_t^{d*}(z) - 1]^2\right] p_t^{d*}(z)^{(1-\theta)} Y_t^{c*} - f_X u_f\right\} \gamma_t^X(z) dz$$

2.3. **Aggregate Equilibrium Conditions.**

2.3.1. *Aggregate accounting equation for households Budget Constraint:* Total expenditures (aggregate consumption and investment in new firms) is equal to the aggregate total income from labor and

[16] see details in Appendix C

dividends.

$$C_t = w_t L + N^d \tilde{d}_t$$

2.3.2. *Market clearing :*

- Bonds market : $b_t = \frac{B_t}{P_t} = 0$,
- Labor market: $L = \int_0^1 \left(N^d \int_{z_{min}}^{z_{max}} h_t^d(z) g(z) dz + N_t^{d*} \int_{z_{min}}^{z_{max}} \tau_t h_t^{d*}(z) \gamma_t^X(z) dz \right) dk$.
- Final consumption good market : the total amount of final good consumed (households consumption plus cost of adjusting prices and export market penetration costs) is equal to the total amount of final good produced, i.e. $Y_t^{c,absorbtion} = Y_t^{c,supply}$ with $Y_t^{c,absorbtion} = C_t + PAC_t + N_t^{d*} f_X$ and

$$Y_t^{c,supply} = \left[N^d \int_{z_{min}}^{z_{max}} x_t^d(z)^{\frac{\theta-1}{\theta}} g(z) dz + N_t^f \int_{z_{min}}^{z_{max}} x_t^f(z^*)^{\frac{\theta-1}{\theta}} \gamma_t^X(z^*) dz^* \right]^{\frac{\theta}{\theta-1}} \quad (3)$$

All those equilibrium conditions hold symmetrically for the foreign country.[17]

2.3.3. *Trade Balance.* Under financial autarky, trade should be balanced : $rer_t N_t^{d*} \widetilde{p^{d*}}^{(1-\theta)} Y_t^{c*} = N_t^f \widetilde{p^f}^{(1-\theta)} Y_t^c$.

3. Steady State:

Definition 1. *An competitive equilibrium is defined as a set of quantities* $\left\{ N_t^{d*}, C_t, Y_t^c, \overline{z_{X,t}}, \widetilde{d_t^d}, \widetilde{d_t^{d*}} \right\}$ *and prices* $\left\{ R_t, w_t, \widetilde{p_t^d}, \widetilde{p_t^{d*}}, \pi_t, \pi_t^d, \pi_t^{d*}, rer_t \right\}$ *for the domestic and symmetrically for the foreign country, such that :*

- *given the sequences of prices, the optimality conditions are satisfied for all the agents in the domestic and in the foreign country;*
- *labor market, bonds market and final consumption good market clear;*
- *trade is balanced, i.e.* $0 = rer_t N^{d*} \widetilde{p^{d*}}^{(1-\theta)} Y_t^{c*} - N^f \widetilde{p^f}^{(1-\theta)} Y_t^c$.

3.1. **Optimality and Equilibrium Conditions in steady State:** I suppose that the two countries are symmetric (thus the real exchange rate is 1). Inflation is zero in steady state. Entry costs are paid in units of consumption. Importantly, I assume in the rest of the paper that sectors are symmetric (i.e the distribution of firms within each sector is the same). Thus, for notational simplicity, I can drop the index k because in equilibrium, $\forall k$, $P_t(k) = P_t$ and $Y_t^c(k) = Y_t^c$. I summarize all the equilibrium

[17] If fixed costs are paid in units of production, then $N_t^{d*} f_X$ disappears in the final consumption goods equilibrium condition and the labor market clearing condition becomes $L = N^d \int_{z_{min}}^{z_{max}} (h_t^d(z) + h_{H,t}(z)) g(z) dz + N_t^{d*} \int_{z_{min}}^{z_{max}} (\tau_t h_t^{d*}(z) + h_{X,t}(z)) \gamma_t^X(z) dz$ where $h_{X,t}(z) = \frac{f_X}{A_t}$ since the fixed costs are expressed in units of effective labor.

conditions in steady state in Table 1. The superscript indicates the origin of the firm (d or f) and the destination market that the firm is serving (nothing for country D or '$*$' for country F).[18]

3.2. **Solving for the steady state:**

Lemma 1. *In steady state equilibrium, the optimal relative pricing rule defined as*

$$p^x(z) = \frac{P^x(z)}{P} = \frac{\theta - (\theta - \sigma)p^x(z)^{1-\theta}}{\theta - 1 - (\theta - \sigma)p^x(z)^{1-\theta}} s_e^r$$

is a monotone increasing convex function in the real effective marginal cost[19] s_e^r.

Proof. see Appendix E. □

This Lemma is a necessary step because, contrary to a standard monopolistic setup with no strategic interactions, the optimal relative price is a non linear function in the real marginal cost: $p = \frac{\theta-(\theta-\sigma)p^{1-\theta}}{\theta-(\theta-\sigma)p^{1-\theta}-1}s$. Therefore I want to make sure that for a given marginal cost, the firm can choose one and only one optimal relative price.

In order to highlight the key difference with the standard case, I go back to the textbook case, where firms take price as given and there is no love-for variety effect in the Consumer Price Index. Then I add step by step each additional assumption in Table **??**.

[18]see in Appendix B a summary of the notations.

[19]For non-exporters, the effective marginal cost is simply $s_e^r = s^r = \frac{w}{Az}$. For exporters, their effective marginal cost on the foreign market is scaled-up by the iceberg cost : $s_e^r = s^r\tau = \frac{w}{Az}\tau$.

TABLE 1. **Steady State Equilibrium.**

	Country D	Country F
Pricing for domestic sales $\forall z$	$\frac{p^d(z)}{\mu^d(z)} = \frac{w}{Az} = s(z)$	$\frac{w^*}{A^*z^*} = s^*(z^*) = \frac{p^{f*}(z^*)}{\mu^{f*}(z*)}$
Pricing for exports $\forall z$	$\frac{p^{d*}(z)}{\mu^{d*}(z)} = \tau s(z)$	$\frac{p^f(z^*)}{\mu^f(z*)} = \tau s^*(z^*)$
Desired Markup $\forall z$	$\mu^d(z) = \frac{\Theta^d(z)}{\Theta^d_{ss}(z)-1}$	$\mu^{f*}(z^*) = \frac{\Theta^{f*}(z^*)}{\Theta^{f*}(z^*)-1}$
	$\mu^{d*}(z) = \frac{\Theta^{d*}(z)}{\Theta^{d*}(z)-1}$	$\mu^f(z^*) = \frac{\Theta^f(z^*)}{\Theta^f(z^*)-1}$
Price-elasticity of demand $\forall z$	$\Theta^d(z) = \theta - (\theta-\sigma)p^d(z)^{1-\theta}$	$\Theta^{f*}(z^*) = \theta - (\theta-\sigma)p^{f*}(z^*)^{1-\theta}$
	$\Theta^{d*}(z) = \theta - (\theta-\sigma)p^{d*}(z)^{1-\theta}$	$\Theta^f(z^*) = \theta - (\theta-\sigma)p^f(z^*)^{1-\theta}$
Cutoff z for exports	$f_X u_f = Y^{c*} p^{d*}(\overline{z_X})^{1-\theta} \frac{1}{\Theta^{d*}(\overline{z_X})}$	$f^*_X u_{f*} = Y^c p^f(\overline{z^*_X})^{1-\theta} \frac{1}{\Theta^f(\overline{z^*_X})}$
Domestic comp. of Profit	$\tilde{d}^d = \int_{z_{min}}^{z_{max}} \{Y^c p^d(z)^{1-\theta}\left[\frac{1}{\Theta^d(z)}\right]\} g(z)dz$	$\tilde{d}^{f*} = \int_{z_{min}}^{z_{max}} \{Y^{c*} p^{f*}(z^*)^{1-\theta}\left[\frac{1}{\Theta^{f*}(z^*)}\right]\} g(z^*)dz^*$
Export comp. of Profit	$\tilde{d}^{d*} = \int_{\overline{z_X}}^{z_{max}} \{Y^{c*} p^{d*}(z)^{1-\theta}\left[\frac{1}{\Theta^{d*}(z)}\right] - f_X\}\gamma^X(z)dz$	$\tilde{d}^f = \int_{\overline{z^*_X}}^{z_{max}} \{Y^c p^f(z^*)^{1-\theta}\left[\frac{1}{\Theta^f(z^*)}\right] - f^*_X\}\gamma^H(z^*)dz^*$
Dividend	$\tilde{d} = \tilde{d}^d + \mathbb{P}(Z \geq \overline{z_X})\tilde{d}^{d*}$	$\tilde{d}^* = \tilde{d}^{f*} + \mathbb{P}(Z \geq \overline{z^*_X})\tilde{d}^f$
Aggregate output	$Y^c = C + N^{d*} f_X$	$Y^{c*} = C^* + N^f f^*_X$
Aggregate expenditures	$Y^c = wL + N^d\tilde{d}$	$Y^{c*} = w^*L^* + N^{f*}\tilde{d}^*$
Demand in country D $\forall z$	$x^d(z) = p^d(z)^{-\theta} Y^c$	$x^f(z*) = p^f(z^*)^{-\theta} Y^c$
Demand in country F $\forall z$	$x^{d*}(z) = p^{d*}(z)^{-\theta} Y^{c*}$	$x^{f*}(z^*) = p^{f*}(z^*)^{-\theta} Y^{c*}$
Consumer Price Index	$1 = N^d \widetilde{p^d}^{1-\theta} + N^f \widetilde{p^f}^{1-\theta}$	$1 = N^{f*} \widetilde{p^{f*}}^{1-\theta} + N^{d*} \widetilde{p^{d*}}^{1-\theta}$
Labor Market Clearing	$L = N^d \widetilde{h^d} + N^{d*} \widetilde{h^{d*}}$	$L^* = N^{f*} \widetilde{h^{f*}} + N^f \widetilde{h^f}$
Bonds	$b = 0$	$b^* = 0$
Balance of Payments	$0 = rer N^{d*} \widetilde{p^{d*}}^{(1-\theta)} Y^{c*} - N^f \widetilde{p^f}^{(1-\theta)} Y^c$	

TABLE 2. **Optimal pricing rules**

	(1)	(2)	(3)
Competition	Monopolistic	Monopolistic	Oligopolistic
⇒ Optimal nominal price rule :	$P^x(i) = \frac{\theta}{\theta-1} s^n$	$P^x(i) = \frac{\theta}{\theta-1} s^N$	$P^x(i) = \frac{\Theta(\xi(i))}{\Theta(\xi(i))-1} s^n$
Love for varieties effect in CPI	No	Yes	Yes
⇒ Consumption Price index :	$\forall i : P^x(i) = P$	$NP^x(i)^{1-\theta} = P^{1-\theta}$	$NP^x(i)^{1-\theta} = P^{1-\theta}$
Dividing both side of the optimal nominal pricing rule by the aggregate price level :			
Optimal relative price rule	$1 = \frac{\theta}{\theta-1} s^r$	$p^x(i) = \frac{P^x(i)}{P} = \frac{\theta}{\theta-1} s^r$	$p^x(i) = \frac{P^x(i)}{P} = \frac{\Theta(\xi(i))}{\Theta(\xi(i))-1} s^r$

Note : s^n is the nominal marginal cost. In this table, I assume that all firms produce differentiated goods i but have the same productivity of labor (A) and hence the same marginal cost $s^n = \frac{W}{A}$. The real marginal cost s^r is defined as $\frac{s^n}{P}$.

As long as there is no strategic interaction (columns (1) and (2)), the optimal relative price set by a firm is a linear function of its real marginal cost. Thus, the real marginal cost of a firm pins down uniquely its relative price.

Once strategic interactions are introduced, the optimal price rule is implicitly defined by a non linear equation : $p^x(i) = \frac{\Theta(\xi(i))}{\Theta(\xi(i))-1} s^r$ where $\xi(i) = \left(\frac{P^x(i)}{P(k)}\right)^{1-\theta}$ and $P(k)$ is the sectoral price in sector k.

By symmetry across sectors, $\forall k : P(k) = P$ in equilibrium. Thus the previous pricing rule can be simplified as:

$$p^x(i) = \frac{\theta - (\theta - \sigma) p^x(i)^{1-\theta}}{\theta - 1 - (\theta - \sigma) p^x(i)^{1-\theta}} s^r$$

. In equilibrium, the optimal relative price is implicitly defined by the non linear equation in s^r. This suggests that potentially, there might be more than one optimal relative price that corresponds to a given real marginal cost. If this were the case, multiple equilibria issues would arise. This is the reason why I check that the solution is unique. As a result, I get the optimal relative price as a monotonic increasing convex function to the real marginal cost.

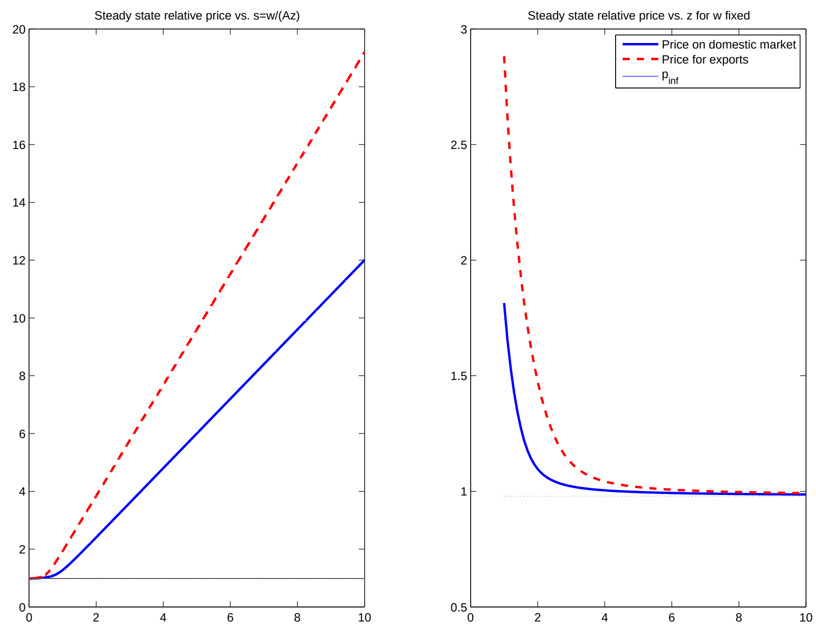

FIGURE 1. Optimal relative price

Corollary 1. *In equilibrium, the optimal relative price p is a decreasing convex function in productivity z.*

Proof. :
The corollary follows directly from the previous Lemma since $s = \frac{w}{Az}\tau$ with $\frac{dp}{ds}(s) \geq 0$. Thus $\frac{dp}{dw}(w) = \frac{dp}{ds}\frac{ds}{dw}(w) \leq 0$.
Figure 1 illustrates the bijection between s and p and between z and p. □

With that tool in hands, it is possible to simplify the system that characterizes the steady state equilibrium in Table 1 to a system composed of two equations with two unknowns $\{w, Y^c\}$.

$$\frac{1}{N^d} = \widetilde{p^d}^{1-\theta} + \mathbb{P}(Z \geq \overline{z_X})\widetilde{p^{d*}}^{1-\theta} \tag{4}$$

$$C(w, Y^c) = wL + N^d\tilde{d}(w, Y^c) \tag{5}$$

Recall that in a symmetric equilibrium, $p^{d*} = p^f$ and $N^{d*} = N^f$. Thus, for any pair $\{w, Y^c\}$, all the remaining endogenous variables can be recovered:

(1) Get the cutoff price for export using equation (2)
(2) Find the associated cutoff productivity value using the Corollary 1
(3) Get N^{d*} from $N^{d*} = N^d\mathbb{P}(Z \geq \overline{z_X})$

(4) Having the cutoff productivity value, I can compute average prices and average profits for serving the domestic market and the export market as described in section 2.2.2. Thus I get $\tilde{d} = \tilde{d}^d + \mathbb{P}(Z \geq \overline{z_X})\tilde{d}^{d*}$ with
   - $\tilde{d}^d = \int_{zmin}^{\infty} \{Y^c p^d(z)^{1-\theta} \left[\frac{1}{\Theta^d(z)}\right]\} g(z) dz$
   - $\tilde{d}^{d*} = \int_{\overline{z_X}}^{\infty} \{Y^{c*} p^{d*}(z)^{1-\theta} \left[\frac{1}{\Theta^{d*}(z)}\right] - f_X u_f\} \gamma^X(z) dz$

(5) C comes from $Y^c = C + N^{d*} f_X$.

Proposition 1. *The reduced steady state system composed of equations (4) and (5) has a unique solution.*

Proof. Sketch of the proof.
Equation (4) defines w as an increasing function of Y^c whose slope is very small. Equation (5) also defines w as an increasing function of Y^c, whose slope is always larger than the slope of the curve implicitly defined by (4).
Thus, I show that those two lines might cross at most once. In other words: if there is a solution, then the solution has to be unique.
See details of the proof in Appendix F. □

4. THE NEW-KEYNESIAN PHILLIPS CURVE

The goal of this section is to compare the dynamics of short-run inflation around the pre-globalization steady state and the post-globalization state. A decline in the sensitivity of inflation to marginal cost has been observed in the data[20] and I show that a drop in the iceberg trade costs, τ, can generate the same feature in my model. Since I consider heterogeneous firms with strategic interactions, two changes appear with respect to the standard new-Keynesian Phillips curve framework.

First, at the firm level, the slope of the Phillips curve depends on the firm productivity - that pins down its market share. More productive firms have a larger market share and exhibit a flatter Phillips curve. They are less prone to transmit marginal cost fluctuations into inflation compared to smaller firms. Intuitively, larger firms are the ones who are the more concerned about losing market share as the markup elasticity is increasing in the market share. Therefore, the real rigidities are increasing with firm size, and the pass-through of marginal cost into inflation declines.

Second, the Phillips curve exhibits a new term on the right-hand side that captures cyclical adjustments in the desired markup due to fluctuations in firms' market power.

Results regarding the firm level Phillips curve are derived in Section 4.1. The impact of globalization on the aggregate Phillips curve is discussed in Section 4.2.

[20] see for instance Matheson and Stavrev (2013)

4.1. **Dynamics around the Steady State for an individual firm** z**.** Loglinearizing the actual markup $\mu_t^d(z)$ from equation (1) around the steady state gives the augmented Phillips curve in (6). Hat denotes the logdeviation of a variable from the steady state. The only stochastic disturbance is an aggregate productivity shock.

$$\widehat{\Pi_t^d}(z) = -\frac{\Theta_{ss}^d(z) - 1}{\phi_p}\left[\hat{\mu}_t^d(z) - \hat{\mu}_t^{d,desired}(z)\right] + \beta \mathbb{E}_t \widehat{\Pi_{t+1}^d}(z) \tag{6}$$

For notational simplicity, as gross inflation is one in steady state, I rewrite the log-deviation of inflation as $\widehat{\Pi_t^d}(z) = \Pi_t^d(z) - 1 = \pi_t^d(z)$. Then,

$$\pi_t^d(z) = \frac{\Theta_{ss}^d(z) - 1}{\phi_p}\left[\hat{mc}_t^d(z) + \hat{\mu}_t^{d,desired}(z)\right] + \beta \mathbb{E}_t \pi_{t+1}^d(z) \tag{7}$$

where $\hat{mc}_t^d = \hat{W}_t - \hat{A}_t - \hat{P}_t^d(z) = \hat{w}_t - \hat{A}_t - \hat{p}_t^d(z)$ and symbol "hat" denotes log-deviations from the steady state. $\hat{\mu}_t^{d,desired}(z)$ is the log-deviation from the steady state of the desired markup.[21] Contrary to the monopolistic competition case, the desired markup is not constant and fluctuates with the price elasticity of demand : $\mu_t^{d,desired}(z) = \frac{\Theta_t^d(z)}{\Theta_t^d(z)-1}$ and $\hat{\mu}_t^{d,desired}(z) = -\frac{1}{\Theta_{ss}^d(z)-1}\hat{\Theta}_t^d(z)$. Thus:

$$\pi_t^d(z) = \frac{\Theta_{ss}^d(z) - 1}{\phi_p}\hat{mc}_t^d(z) - \frac{1}{\phi_p}\hat{\Theta}_t^d(z) + \beta \mathbb{E}_t \pi_{t+1}^d(z) \tag{8}$$

Proposition 2. (Cyclical fluctuations in the price elasticity of demand matter for inflation dynamics)
In a sticky price environment à la Rotemberg, under oligopolistic competition, individual firm inflation depends ***positively*** *on changes in the real marginal cost and on inflation expectations and* ***negatively*** *on the cyclical fluctuations in the perceived price-elasticity of demand,* $\hat{\Theta}_t^d$*. A decline in* $\hat{\Theta}_t^d$ *should be interpreted as a strengthening of firm's market power, which pushes up inflation. Conversely, an increase in* $\hat{\Theta}_t^d$ *is associated with a decline in real rigidities and reduces inflation.*

Proof. See equation (8). □

Intuitively, the distance between the actual perceived price elasticity of demand and the one prevailing without strategic interactions, $|\Theta(z)_t - \theta|$, can be interpreted as a proxy for a firm market power. It is a measure of the strategic interactions or real rigidities. A decline in $\Theta(z)_t$ increases the distance to monopolistic competition. The larger the distance, the higher the market power of the firm z and the higher its desired markup. Conversely, an increase in the perceived price elasticity of demand indicates that the firm gets closer to the monopolistic competition case : strategic

[21] The markup prevailing under a flexible price environment.

interactions are vanishing.

The price elasticity of demand is negatively related to the firm market share ($\zeta_t^d(z)$).

$$\hat{\Theta}_t^d(z) = -\frac{(\theta-\sigma)\zeta_{ss}^d(z)}{\Theta_{ss}^d(z)}\hat{\zeta}_t^d(z) = -\frac{(\theta-\Theta_{ss}^d(z))}{\Theta_{ss}^d(z)}\hat{\zeta}_t^d(z)$$

Thus

$$\pi_t^d(z) = \frac{\Theta_{ss}^d(z)-1}{\phi_p}\hat{mc}_t^d(z) + \frac{1}{\phi_p}\frac{(\theta-\Theta_{ss}^d(z))}{\Theta_{ss}^d(z)}\hat{\zeta}_t^d(z) + \beta\mathbb{E}_t\pi_{t+1}^d(z) \tag{9}$$

Corollary 2. (Cyclical fluctuations in the market share matter for inflation dynamics)
In a sticky price environment, under oligopolistic competition, individual firm short run inflation is increasing in its market share.

Proof. See equation (9). □

A market share decline is equivalent to a strengthening in competitive pressures[22] faced by a firm. The decline in market share results in a decline in the desired markup and consequently a fall in inflation. Conversely, an increase in the market share means that the desired markup increases, which pushes up inflation.

The previous proposition (2) and the associated corollary (2) describe the determinants of inflation at the firm level. Importantly, the weight of each factor (marginal cost and market share) is firm specific.

Proposition 3. (The steady state Price Elasticity of Demand perceived by a firm pins down the Phillips curve slope)
Under oligopolistic competition with sticky prices à la Rotemberg, the lower a firm steady state price elasticity of demand (or equivalently the higher its market power), the less reactive its inflation to marginal cost fluctuations and the more responsive to market share fluctuations.

Proof. See equation (9). □

The Phillips curve slope refers precisely to the coefficient pondering the real marginal cost term.

$$\pi_t^d(z) = \overbrace{\frac{\Theta_{ss}^d(z)-1}{\phi_p}}^{\text{high for small firms}}\hat{mc}_t^d(z) + \overbrace{\frac{1}{\phi_p}\frac{(\theta-\Theta_{ss}^d(z))}{\Theta_{ss}^d(z)}}^{\text{high for large firms}}\hat{\zeta}_t^d(z) + \beta\mathbb{E}_t\pi_{t+1}^d(z)$$

[22]that might come from an increase in competitors prices or a decrease in the number of competitors.

Large firms face a low steady state price elasticity of demand. They are relatively unreactive to marginal cost shocks and more responsive to market share movements -standing for the pro-competitive pressures. For small firms (with low productivity), their price elasticity of demand is already very close to the monopolistic competition case.[23] The strategic interactions channel is very weak. Consequently, the slope of their Phillips curve is steeper because they cannot absorb marginal costs shocks into their desired markup and have to transmit those shocks proportionally into price adjustments.

Noting that the steady state market share of a firm is a monotonic increasing function in its productivity draw, the previous proposition can be re-stated as follows:

Corollary 3. (Large firms exhibit a flatter Phillips curve)
High-productivity firms are large and exhibit a flatter Phillips curve compared to less productive (small) firms.

Proof. : The sensitivity of inflation to marginal cost is increasing in the steady state price elasticity of demand, and the latter is decreasing in firm's productivity. □

In the end, the sensitivity of inflation to real marginal cost is lower for large firms. The aggregate Phillips curve slope will depend on the relative proportion of big versus small firms in the economy.

4.2. **The aggregate Phillips curve.** The previous section gives the intuition that globalization might affect the aggregate Phillips curve by rendering big firms bigger (for those who enter the export market) and therefore increasing the average degree of market power. If the share of exporters (high-productivity firm) increases, then a flattening of the Phillips curve should be expected as those firms essentially respond less to marginal cost fluctuations.

4.2.1. *Production Price Index Inflation.* As I am interested in the impact of globalization on domestic firms' behavior, I focus on domestic inflation measured as the percent change in the Production Price Index (here the PPI is equivalent to the GDP deflator). It corresponds to the weighted sum of prices of all goods produced by domestic firms either for domestic consumption or for export). I define the Production Price Index as the Laspeyres price index, and I take the steady state values for the base quarter.

[23] $|\theta - \Theta(z)| \longrightarrow 0$

PPI is defined as $PPI_t = \frac{N^d PPI_t^d \widetilde{x_{ss}^d} + N_{ss}^{d*} PPI_t^{d*} e_t \widetilde{x_{ss}^{d*}}}{N^d PPI_{ss}^d \widetilde{x_{ss}^d} + N_{ss}^{d*} PPI_{ss}^{d*} \widetilde{x_{ss}^{d*}}}$.

Consequently: $\widehat{PPI_t} = \omega_{ss}\widehat{PPI_t^d} + (1-\omega_{ss}^*)(\widehat{PPI_t^{d*}} + \hat{e}_t)$

And thus: $\widehat{\Pi_t^{ppi}} = \left[\omega_{ss}\widehat{\Pi_t^{ppi,d}} + (1-\omega_{ss}^*)(\widehat{\Pi_t^{ppi,d*}} + \Delta\hat{e}_t)\right]$

where $\omega_{ss} = N^d \widetilde{\xi_{ss}^d}$ and by symmetry between countries $1-\omega_{ss}^* = 1-\omega_{ss} = N_{ss}^{d*}\widetilde{\xi_{ss}^{d*}}$. See more detailed calculations in Appendix D.

I need to compute the PPI inflation for goods sold on the domestic market (PPI_t^d) and for goods sold on the foreign market (PPI_t^{d*}). Typically, the weights for the production price index in the United States are updated every five years. In the model, I account for the change in the market structure (N^{d*} and N^f) between the pre- and the post-globalization steady states since the transition lasts more than five years.But as far as the cyclical fluctuations around a steady state are concerned, the set of goods is kept constant, consistently with the empirical Production Price Index.

4.2.2. *Phillips curve for domestic firms on the domestic market.* The average production price set by domestic firms for serving the domestic market is defined as

$$PPI_t^d = \frac{\int_{z_{min}}^{z_{max}} P_t^d(z) x_{ss}^d(z) g(z) dz}{\int_{z_{min}}^{z_{max}} P_{ss}^d(z) x_{ss}^d(z) g(z) dz} \Rightarrow \widehat{P_t^d} = \int_{z_{min}}^{\infty} \frac{\xi_{ss}^d(z)}{\tilde{\xi}_{ss}^d} \widehat{PPI_t^d(z)} g(z) dz.$$

$$\Rightarrow \pi_t^{ppi,d} = \widehat{\Pi_t^{ppi,d}} = \int_{z_{min}}^{z_{max}} \frac{\xi_{ss}^d(z)}{\tilde{\xi}_{ss}^d} \widehat{\Pi_t^d(z)} g(z) dz. \tag{10}$$

where $\tilde{\xi}_{ss}^d = \int_{z_{min}}^{z_{max}} {p_{ss}^d}^{(1-\theta)}(z) g(z) dz = \int_{z_{min}}^{z_{max}} \frac{P_{ss}^d(z) x_{ss}^d(z)}{P_{ss} Y_{ss}^c} g(z) dz$. Now, by plugging the firm specific Phillips curve equations within the second term of equation (10), I get a link between average inflation $pi_t^{ppi,d}$ and firms' marginal cost.

$$\begin{aligned} \pi_t^{ppi,d} = & \int_{z_{min}}^{z_{max}} \frac{\xi_{ss}^d(z)}{\tilde{\xi}_{ss}^d} \frac{\Theta_{ss}^d(z)-1}{\phi_p} (\hat{W}_t - \hat{A}_t - \widehat{P_t^d}(z)) g(z) dz \\ & + \int_{z_{min}}^{z_{max}} \frac{\xi_{ss}^d(z)}{\tilde{\xi}_{ss}^d} \frac{1}{\phi_p} \frac{(\theta - \Theta_{ss}^d(z))}{\Theta_{ss}^d(z)} \hat{\xi}_t^d(z) g(z) dz + \beta \mathbb{E}_t \pi_{t+1}^d \end{aligned} \tag{11}$$

$\frac{\theta-\Theta_{ss}^d(z)}{\Theta_{ss}^d(z)}$ captures the relative distance to the monopolistic steady state price elasticity of demand, i.e. the one prevailing in the absence of strategic interactions. The larger this term, the more market power has the firm.

4.2.3. *Phillips curve for domestic firms on the export market.* The average price set by domestic firms for exporting (expressed in foreign currency unit) is $PPI_t^{d*} = \frac{\int_{\overline{z_{X,ss}}}^{z_{max}} P_t^{d*}(z) x_{ss}^{d*}(z) \gamma_{ss}^X(z) dz}{\int_{\overline{z_{X,ss}}}^{z_{max}} P_{ss}^{d*}(z) x_{ss}^{d*}(z) \gamma_{ss}^X(z) dz}$

$$\Rightarrow \pi_t^{ppi,d*} = \widehat{\Pi_t^{ppi,d*}} = \int_{\overline{z_{X,ss}}}^{z_{max}} \frac{\xi_{ss}^{d*}(z)}{\tilde{\xi}_{ss}^{d}} \widehat{\Pi_t^{d*}(z)} \gamma_{ss}^X(z) dz. \tag{12}$$

Plugging firm specific Phillips curve into the previous equation, I get:

$$\begin{aligned}\pi_t^{ppi,d*} =& \beta \mathbb{E}_t \pi_{t+1}^{ppi,d*} \\ &+ \underbrace{\int_{\overline{z_{X,ss}}}^{z_{max}} \frac{\xi_{ss}^{d*}(z)}{\tilde{\xi}_{ss}^{d*}} \frac{\Theta_{ss}^{d*}(z) - 1}{\phi_p} \hat{mc}_t^{d*}(z) \gamma_{ss}^X(z) dz}_{\text{Marginal Cost effect}} + \underbrace{\int_{\overline{z_{X,ss}}}^{z_{max}} \frac{\xi_{ss}^{d*}(z)}{\tilde{\xi}_{ss}^{d*}} \frac{1}{\phi_p} \frac{(\theta - \Theta_{ss}^{d*}(z))}{\Theta_{ss}^{d*}(z)} \hat{\xi}_t^{d*}(z) \gamma_{ss}^X(z) dz}_{\text{Short run competitive pressures}}\end{aligned} \tag{13}$$

where $\hat{mc}_t^{d*}(z) = \hat{W}_t - \hat{e}_t - \hat{A}_t - \hat{P}_t^{d*}(z) = \hat{w}_t - \hat{A}_t - \hat{p}_t^{d*}(z) - \hat{rer}_t$.

4.2.4. *Aggregate Phillips curve.*

$$\pi_t^{ppi} = \beta \mathbb{E}_t \pi_{t+1}^{ppi} + \Gamma(\overline{z_{X,ss}}) \hat{mc}_t + \text{MP}_t + \text{Exch. Rate}_t \tag{14}$$

where

$$\Gamma(\overline{z_{X,ss}}) = \omega_{ss} \int_{z_{min}}^{z_{max}} \frac{\xi_{ss}^d(z)}{\widetilde{\xi_{ss}^d}} \frac{\Theta_{ss}^d(z) - 1}{\phi_p} g(z) dz + (1 - \omega_{ss}) \int_{\overline{z_{X,ss}}}^{z_{max}} \frac{\xi_{ss}^{d*}(z)}{\widetilde{\xi_{ss}^{d*}}} \frac{\Theta_{ss}^{d*}(z) - 1}{\phi_p} \gamma_{ss}^X(z) dz$$

$$\text{MP}_t = \begin{cases} \omega_{ss} \int_{z_{min}}^{z_{max}} \frac{\xi_{ss}^d(z)}{\phi_p \widetilde{\xi_{ss}^d}} \left(\frac{\theta - \Theta_{ss}^d(z)}{\Theta_{ss}^d(z)} + \frac{\Theta_{ss}^d(z) - 1}{\theta - 1} \right) \hat{\xi}_t^d(z) g(z) dz \\ + (1 - \omega_{ss}) \int_{\overline{z_{X,ss}}}^{z_{max}} \frac{\xi_{ss}^{d*}(z)}{\phi_p \widetilde{\xi_{ss}^{d*}}} \left(\frac{\theta - \Theta_{ss}^{d*}(z)}{\phi_p \Theta_{ss}^{d*}(z)} + \frac{\Theta_{ss}^{d*}(z) - 1}{\theta - 1} \right) \hat{\xi}_t^{d*}(z) \gamma_{ss}^X(z) dz \end{cases}$$

$$\text{Exch. Rate}_t = (1 - \omega_{ss}) \left(\Delta \hat{e}_t + \int_{\overline{z_{X,ss}}}^{z_{max}} \frac{\xi_{ss}^{d*}(z)}{\widetilde{\xi_{ss}^{d*}}} \frac{\Theta_{ss}^{d*}(z) - 1}{\phi_p} \hat{rer}_t \gamma_{ss}^X(z) dz \right).$$

5. Results

Definition 2. *Globalization is defined as a permanent fall in the per unit trade cost τ.*

Proposition 4. (The share of exporters increases with globalization)
The probability for an active firm to export is decreasing in the trade cost τ.

Proof. :
$\frac{d\mathbb{P}(z\geq\overline{z_{X,ss}})}{d\tau} = -k\frac{z_{min}^k}{\overline{z_{X,ss}}^{k+1}}\frac{d\overline{z_{X,ss}}}{d\tau}$
and $\frac{d\overline{z_{X,ss}}}{d\tau} = \underbrace{\frac{\partial\overline{z_{X,ss}}}{\partial w}\frac{dw}{d\tau}}_{\leq 0} + \underbrace{\frac{\partial\overline{z_{X,ss}}}{\partial Y^c}}_{\leq 0}\underbrace{\frac{dY^c}{d\tau}}_{\leq 0} + \underbrace{\frac{\partial\overline{z_{X,ss}}}{\partial\tau}}_{\geq 0}$

The third term on the right-hand side is of first order magnitude compared to the changes going trough the induced effect due do the increase in w: $\left|\frac{\partial\overline{z_{X,ss}}}{\partial w}\frac{dw}{d\tau}\right| \ll \frac{\partial\overline{z_{X,ss}}}{\partial\tau}$.
Thus $\frac{d\mathbb{P}(z\geq\overline{z_{X,ss}})}{d\tau} \geq 0$. □

Proposition 5. (Openness to trade increases with globalization)
The openness to trade in steady state ($1-\omega_{ss}$) is decreasing in the trade cost (τ).

Proof. :

$$\frac{d\omega_{ss}}{d\tau} = N^d\frac{d\tilde{\xi}_{ss}^d}{d\tau}$$

And $\frac{d\tilde{\xi}_{ss}^d}{d\tau} \geq 0$ because $\frac{d\tilde{p}_{ss}^d}{d\tau} \leq 0$
This comes from $\frac{d\tilde{p}_{ss}^d}{d\tau} = \frac{d\tilde{p}_{ss}^d}{dY^c}\frac{dY^c}{d\tau} + \frac{d\tilde{p}_{ss}^d}{dw}\frac{dw}{d\tau}$ with $\frac{d\tilde{p}_{ss}^d}{dY^c} = 0$ and $\frac{d\tilde{p}_{ss}^d}{dw} \geq 0$
and : $\frac{dw}{d\tau} \leq 0$.
More details are given in Appendix F.

Thus $\frac{d\omega_{ss}}{d\tau} \geq 0$ and the openness to trade $(1-\omega_{ss})$ is decreasing in the trade cost: $\frac{d(1-\omega_{ss})}{d\tau} \leq 0$

□

Proposition 6. (Exporters have on average more market power than non exporters)
If fixed export penetration costs are large enough, then exporters are on average more productive than the domestic firms, despite their productivity being scaled down by iceberg trade costs. Thus, the market shares of exporters in steady state are on average larger than the average market share of the whole population of firms.

Proof. :
The average market share of domestic firms on the domestic market is defined as $\widetilde{\xi_{ss}^d} = \int_{z_{min}}^{z_{max}} p_{ss}^{d\ (1-\theta)}(z)g(z)dz$ and the average market share on the export market as $\widetilde{\xi_{ss}^{d*}} = \int_{\overline{z_{X,ss}}}^{z_{max}} p_{ss}^{d*\,(1-\theta)}(z)\gamma_{ss}^X(z)dz$.
For a cutoff productivity $\overline{z_{X,ss}}$ sufficiently high, the higher average productivity of exporters offsets the effect of the iceberg trade cost (that penalizes their effective marginal cost) on prices. In the end, the average price of traded goods is lower than non traded goods because they are produced by much more productive firms. Thus the average market share of exporters is higher than the

market share of the whole set of domestic firms.
In the parameterization, I choose values such that that $\mathbb{P}(z \geq \overline{z_{X,ss}}) \leq 20\%$, which ensures that this proposition is satisfied. □

This result is really key in understanding the impact of globalization on the Philips curve slope. It is fundamentally different from setups where globalization is modeled as an increase in the number of varieties produced by firms that are homogeneous in productivity. In this case, openness to international trade uniformly squeezes out firms' market share. Then globalization necessarily leads to a decline in the average firms' market power, which is equivalent to relaxing the degree of real rigidities. In the end the Phillips curve steepens.
On the contrary, once globalization is modeled as a fall in trade costs with an endogenous selection of exporters, then globalization might increase the "average market share" in the economy as the relative proportion of big firms increases. This aggregate strengthening of firms' market power is the force driving the flattening of the Phillips curve.

Proposition 7. (The aggregate Phillips curve flattens in response to globalization)
The slope of the aggregate Phillips curve defined in equation (14) as $\Gamma(\overline{z_{X,ss}})$ *decreases in response to globalization for a parameterization of the model that replicates standard features of international trade.*

Proof. see Numerical Example. □

6. Numerical Example

6.1. **Calibration.** I consider quarterly frequency and set $\beta = 0.99$, which yields a 4% real interest rate. The risk aversion coefficient γ is 1 to have a log utility from consumption. The distribution of firm relative productivity is a Pareto with parameter $z_{min} = 0.01$ and $z_{max} = 5$. The shape parameter k is set following Ghironi and Melitz (2005): $k = 3.4$. Note that z_{max} is such that, for a non bounded Pareto distribution, $\mathbb{P}(z \geq z_{max}) \leq 10^{-9}$. This means that the results I get with the truncated Pareto distribution are very closed to those I would have with a non truncated distribution (as in (Ghironi and Melitz, 2005)). But the advantage of the bounded distribution is that the productivity averages are always finite, whereas in the non-bounded case, some parameters restrictions are needed to ensure convergence.

As far as the elasticity of substitution is concerned, I set $\theta = 10$ and $\sigma = 1.01$ as in Atkeson and Burstein (2008), which implies that the intra-sectoral elasticity of substitution is higher than the inter-sectoral, consistently with Broda and Weinstein (2006) findings.[24]

[24] Anderson and van Wincoop (2004) find that the inter-sectoral elasticity of substitution lies between 5 and 10.

The number of firms per sector and the fixed export costs are chosen in order to match a openness to trade equal to 98% pre-globalization and around 80% post-globalization. In the benchmark case, $N^d = 25$ and $f_X = 0.001$.

I model globalization as a structural shock captured through a fall in iceberg costs τ. The per-unit trade cost may reflect different type of barriers to trade. Table 3 presents the range of values for τ in the literature.

TABLE 3. **Per unit iceberg costs in the literature**

	value range	target
Atkeson and Burstein [2008]	[1.34; 1.58]	exports to GDP ratio = 16.5%, exporting firms= 25%
Ghironi and Melitz [2005]	[1.1; 1.3]	target 21% of exporters
Obstfeld and Rogoff [1995]	1.25	ad hoc
Anderson and van Wincoop [2004]	1.65	
Alessandria and Choi [2012]	1.738 in 1987	export intensity 9.9%
	1.529 in 2007	export intensity 15.5%

I consider a large fall in the iceberg trade costs from 3 to 1. This range corresponds to a share of domestic goods in the domestic consumption basket equal to 0.98 pre-globalization (for $\tau = 3$); 0.81 post-globalization (for $\tau = 1.4$) and 0.57 in the extreme case where $\tau = 1$.

Regarding nominal rigidities, standard results in the literature estimate a duration of prices equal to three quarters, corresponding to a probability of being unable to re-optimize a price in the Calvo setup $\alpha = 0.66$. I choose the price adjustment cost in order for the Phillips curve slope in the Rotemberg setup (with price adjustment cost ϕ_p) to match the Phillips curve slope arising in models *à* la Calvo. So I impose ϕ_p to be such that

$$\underbrace{\frac{\theta - 1}{\phi_p}}_{\text{Rotemberg PC slope}} = \underbrace{\frac{(1-\alpha)(1-\alpha\beta)}{\alpha}}_{\text{Calvo PC slope}}$$

Consequently I derive $\phi_p = 28$. As I am interested in the change of the Phillips curve slope before and after globalization, this parameter doesn't influence my conclusions. It scales up or down the slope of the Phillips curve, but the relative change caused by globalization is unaffected.

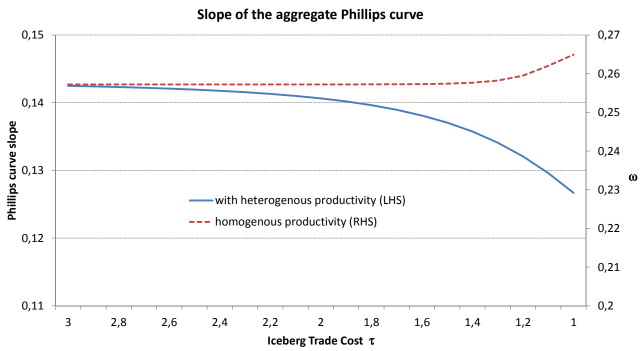

FIGURE 2. Phillips curve slope

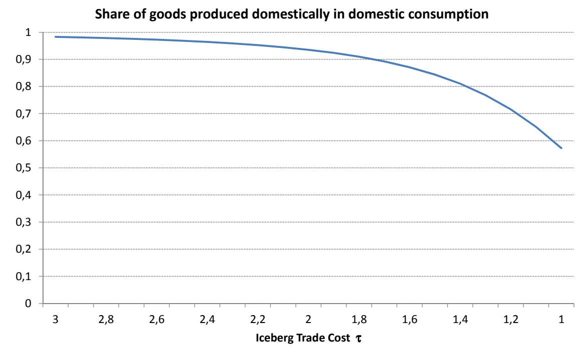

FIGURE 3. Home Bias

6.2. **Numerical results.** Figure 2 shows the changes in the aggregate Phillips curve slope under two specifications. The solid blue line represents the slope of the Phillips curve when firms are *heterogeneous* in productivity and thus the high-productivity firms self-selection mechanism is at play. The red dashed line stands for the slope of the Phillips curve is an economy that exhibits the same average productivity (constructed as $z_{average} = \left(\int_{z_{min}}^{z_{max}} z^{\theta-1} g(z)dz\right)^{\frac{1}{\theta-1}} + \mathbb{P}(z \geq \overline{z_X}) \left(\int_{\overline{z_X}}^{z_{max}} z^{\theta-1}\gamma_X(z)dz\right)^{\frac{1}{\theta-1}}$), but in which all firms are *homogeneous* in productivity. For sake of comparison, I impose the same number of firms in the homogeneous productivity economy as in the heterogeneous economy, for each value of τ. Hence the pro-competitive channel, due to the enlargement in the set of competitors, is at work in the homogeneous productivity economy, but the composition effect (due to self-selection of high-productivity firms) is shut down.

Two results are brought to light.

First, for a same average productivity, the economy with homogeneous firms exhibits a much higher Phillips curve slope than the economy with heterogeneous productivity firms. This result highlights the crucial non-linearities in the model. Large firms play a very important role in driving the response of inflation to marginal cost shocks.

Second, the slope of the Phillips curve responds in opposite direction to globalization in the two economies. In the heterogeneous productivity case, the Phillips curve flattens because the composition effect (self-selection of big firms) offsets the pro-competitive effect due to more competitors.

Shutting down the composition channel causes a steepening of the Phillips curve.

As a quantitative exercise, I suppose that the iceberg trade cost falls from 3 to 1. Figure 3 gives the corresponding home bias (ω), going from 0.98 to 0.57 in the extreme case where $\tau = 1$ (i.e. there is no more unit iceberg cost). The model predicts that the slope of the aggregate Phillips curve would increase by 3% if only the pro-competitive channel were active. Once the composition channel (coming from the self-selection mechanism) is added, then the slope of the Phillips curve drops by 11%.

Conclusion. I have developed a general equilibrium setup that can rationalize the flattening of the Phillips curve in response to a fall in trade costs.

Two forces are simultaneously playing in opposite directions in response to globalization. On the one hand, the increase in the number of goods competing on the domestic market reduces firms' market power. This decline in real rigidities renders price adjustments more responsive to marginal cost fluctuations. Thus, the pro-competitive force favors a steepening of the Phillips curve.

On the other hand, the distribution of firms changes because the share of big producers in the economy increases due to the self-selection of high-productivity firms. The post-globalization economy comprises relatively more large firms. As large firms have more market power than the average population, the overall degree of real rigidities in the economy increases. This composition effect reduces the responsiveness of inflation to marginal cost shocks.

At the aggregate level, the Phillips curve does flatten if the composition effect dominates the pro-competitive effect. I show that it is indeed the case: for a parameterization of the model that replicates standard features of international trade, the sensitivity of domestic production price inflation to domestic marginal cost decreases by 11%.

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Appendix A. Closing the General Equilibrium

A.1. **Households.** The problem of the representative household in country D is

$$\max_{\{C_t,B_t\}_{t=0}^{\infty}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t U(C_t)$$
$$\text{s.t.} : P_t C_t + B_t \leq R_{t-1} B_{t-1} + W_t L + N^d \tilde{d}_t P_t$$

where C_t is the consumption of final good at time t, β is a subjective discount factor, L is the inelastic supply of hours of work and the utility function is $U(C_t) = \left[\frac{C_t^{1-\gamma}}{1-\gamma}\right]$. W_t is the nominal wage determined competitively on the labor market and P_t is the consumption price. Households can invest in domestic risk free bonds. B_t is the quantity of domestic risk-free bonds purchased at $t-1$ and $R_t = 1 + r_t^n$ is the nominal return on those bonds from $t-1$ to t. Under financial autarky, domestic bonds are only traded among domestic households.
Households own the firms that pay dividends ($N^d \tilde{d}_t P_t$). $\tilde{d}_t$ is the average firms' dividends and N^d is the number of firms located in country D.

Optimality Conditions:
I denote $\Pi_t = \frac{P_t}{P_{t-1}}$ the gross CPI inflation rate in country D.

$$U'(C_t) = R_t \beta \mathbb{E}_t \left[\frac{U'(C_{t+1})}{\Pi_{t+1}}\right]$$

A.2. **Monetary Policy.** The monetary authority in each country follows a Taylor rule to set the nominal interest rate R_t:

$$log(R_t) = log(R) + \gamma_\pi(log(\Pi_t) - log(\Pi))) + \gamma_y(log(Y_t)) - log(Y))$$

where $Y_t = GDP_t^v = N^d \tilde{p}_t^d \tilde{x}_t^d + N_t^{d*} \tilde{p}_t^{d*} rer_t \tilde{x}_t^{d*} = w_t L + N^d \tilde{d}_t$

Appendix B. Notations

The notations read as follows:

Notation	**refers to**
d	a firm from country D serving market D
$d*$	a firm from country D serving market F
$f*$	a firm from country F serving market F
f	a firm from country F serving market D
N^d ; N^{f*}	the number of firms located respectively on the market D and F
$\frac{N^{d*}}{N^d}$; $\frac{N^f}{N^{f*}}$	the share of exporters in country D and F

APPENDIX C. EXPORT COMPONENT OF PROFIT FOR INTERMEDIATE GOODS PRODUCER

Maximization of the exports component of profits

$$\max_{P^{d*}_{t+j}(z)} \sum_{j=0}^{\infty} \mathbb{E}_t \Bigg[(1-\delta)^j Q_{t,t+j} \Bigg(P^{d*}_{t+j}(z) x^{d*}_{t+j}(z) - \tau_t \frac{W_{t+j}/e_t}{A_{t+j} z^*(z)} x^{d*}_{t+j}(z) - \frac{\phi_p}{2} \left(\frac{P^{d*}_{t+j}(z)}{P^{d*}_{t+j-1}(z)} - 1 \right)^2 P^{d*}_{t+j}(z) x^{d*}_{t+j}(z) - \frac{f_{X,t+j} P^*_{t+j}}{rer_{t+j}} u_f \Bigg) \Bigg]$$

s.t.

$$x^{d*}_t(z) = \left(\frac{P^{d*}_t(z)}{P^*_t} \right)^{-\theta} Y^{c*}_t$$

$$Q_{t,t+j} = \beta^j \frac{U'(C_{t+j})}{U'(C_t)} \frac{P_t}{P_{t+j}}$$

rer_t is the real exchange rate and e_t the nominal exchange rate: $rer_t = \frac{P^*_t e_t}{P_t}$

Optimality conditions :

$$\frac{P^{d*}_t(z)}{P^*_t} = p^{d*}_t(z) = rer_t^{-1} \mu^{d*}_t(z) \tau_t \frac{w_t}{A_t z}$$

APPENDIX D. OPENNESS TO TRADE

$$\omega_{ss} = N^d_{ss} \frac{\widetilde{P^d}_{ss} \widetilde{x^d}_{ss}}{P_{ss} Y^c_{ss}} = N^d_{ss} \frac{\int_{z_{min}}^{z_{max}} x^d_{ss}(z) P^d_{ss}(z) g(z) dz}{Y^c_{ss} P_{ss}}$$

$$= N^d_{ss} \frac{\int_{z_{min}}^{z_{max}} x^d_{ss}(z) p^d_{ss}(z) g(z) dz}{Y^c_{ss}} = N^d_{ss} \frac{\int_{z_{min}}^{z_{max}} {p^d_{ss}}^{1-\theta}(z) Y^c_{ss} g(z) dz}{Y^c_{ss}}$$

$$= N^d_{ss} \frac{\widetilde{p^d_{ss}}^{1-\theta} Y^c_{ss}}{Y^c_{ss}} = N^d_{ss} \widetilde{p^d_{ss}}^{1-\theta}$$

and

$$1 - \omega^*_{ss} = 1 - \omega_{ss}$$

because by symmetry, in steady state: $N^f = N^{d*}$ and $p^f(z) = p^{d*}(z)$.

$$
\begin{aligned}
1-\omega_{ss} &= N^f_{ss}\frac{\widetilde{Pf}_{ss}\widetilde{xf}_{ss}}{P_{ss}Y^c_{ss}} = N^f_{ss}\frac{\int_{z_{X,ss}}^{z_{max}} x^f_{ss}(z)P^f_{ss}(z)\gamma^X_{ss}(z)dz}{Y^c_{ss}P_{ss}} \\
&= N^f_{ss}\frac{\int_{z_{X,ss}}^{z_{max}} x^f_{ss}(z)p^f_{ss}(z)\gamma^X_{ss}(z)dz}{Y^c_{ss}} = N^f_{ss}\frac{\int_{z_{X,ss}}^{z_{max}} {p^f_{ss}}^{1-\theta}(z)Y^c_{ss}\gamma^H_{ss}(z)dz}{Y^c_{ss}} \\
&= N^f_{ss}\frac{\widetilde{p^d_{ss}}^{1-\theta}Y^c_{ss}}{Y^c_{ss}} = N^d_{ss}\widetilde{p^d_{ss}}^{1-\theta}
\end{aligned}
$$

Appendix E. The optimal relative price is an increasing convex function in the real marginal cost

In the monopolistic case there is a linear relationship between the optimal relative price and the real marginal cost, $p = \mu s^r$. In the oligopolistic case, equation (**??**) relates the optimal relative price to firm's real marginal cost in a non linear way:

$$
\begin{aligned}
p &= \frac{\Theta(p)}{\Theta(p)-1}s^r = \frac{\theta-(\theta-\sigma)p^{1-\theta}}{(\theta-1)-(\theta-\sigma)p^{1-\theta}}s^r \\
&\Leftrightarrow \mathcal{H}(p,s^r) = (\theta-1)p^\theta - \theta s^r p^{\theta-1} - (\theta-\sigma)p + (\theta-\sigma)s^r = 0
\end{aligned}
$$

I want to check that for any given real marginal cost s^r, a firm can choose one and only one optimal relative price p.

To that end I study s^r as a function of p and show that it is a bijection: s^r is a monotonic increasing concave function in p on $[1,+\infty]$. Thus p is the inverse function and is strictly increasing and convex in s^r.

STEP 1: I show that $\frac{\partial s^r}{\partial p} \geq 0$

$$
\frac{\partial s^r}{\partial p} = \frac{\theta^2(p^{2\theta}-p^{\theta+1}+p^2)-\theta(p^{2\theta}-\sigma p(p^\theta-2p)+\sigma^2p^2)}{(\theta(p^\theta-p)+\sigma p)^2}
$$

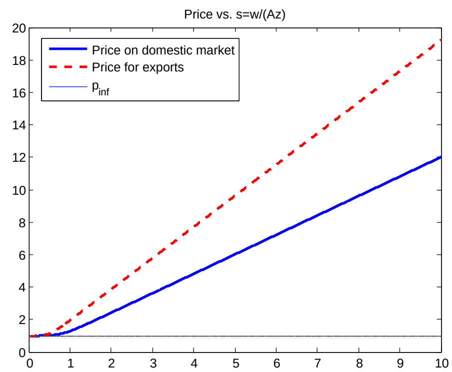
$$
\Rightarrow \forall p \geq 1, \frac{\partial s^r}{\partial p} \geq 0
$$

STEP 2: I show that $\frac{\partial^2 s^r}{\partial p^2} \leq 0$

$$
\frac{\partial^2 s^r}{\partial p^2} = -\frac{(\theta-1)\theta(\theta-\sigma)p^\theta(-2p^\theta+\theta(p^\theta+p)-\sigma p)}{(\theta(p^\theta-p)+\sigma p)^3}
$$

STEP 3:

If s^r is a monotonic increasing and concave function in p, then there exists a reciprocal function: $p(.)$ that is monotonically increasing and convex in s^r.



APPENDIX F. STEADY STATE UNIQUENESS

Suppose that countries are symmetric (then $Y^c = Y^{c*}$, $w = w*$ and $p^f = p^{d*}$), labor supply is inelastic (L is fixed) and entry costs are paid in units of consumption good.

STEP 1. Show that (4) defines w as a monotonic increasing function in Y^c

1.1. **Equation (4) can be rewritten as** $G(w, Y^c) = 0$ **with** $\frac{dG}{dw} \leq 0$ **and** $\frac{dG}{dY^c} \geq 0$**.**

$$G(w, Y^c) = \widetilde{p^d}^{1-\theta} + \mathbb{P}(Z \geq \overline{z_X})\widetilde{p^{d*}}^{1-\theta} - \frac{1}{N^d} = 0 \tag{15}$$

I want to compute $\frac{dG}{dY^c}(w, Y^c)$ and $\frac{dG}{dw}(w, Y^c)$.

Let's find first some useful intermediate derivatives. Define the cutoff price (for exporting).

$$\overline{p_X} = \left[\frac{Y^c}{\theta f_X u_f} + \frac{(\theta - \sigma)}{\theta}\right]^{\frac{1}{\theta-1}} \tag{16}$$

$$\boxed{\frac{d\overline{p_X}}{dY^c} \geq 0} \tag{17}$$

$$\overline{z_X} = \frac{\tau}{\overline{p_X}} \frac{w}{A} \frac{\theta - (\theta - \sigma)\overline{p_X}^{1-\theta}}{(\theta - 1) - (\theta - \sigma)\overline{p_X}^{1-\theta}} \tag{18}$$

$$\boxed{\begin{aligned}&\frac{d\overline{z_X}}{dw} \geq 0\\&\frac{d\overline{z_X}}{dY^c} = \frac{d\overline{z_X}}{d\overline{p_X}}\frac{d\overline{p_X}}{dY^c} \leq 0\end{aligned}} \tag{19}$$

Besides, $\mathbb{P}(Z \geq \overline{z_X}) = \left(\frac{z_{min}}{\overline{z_X}}\right)^k$.

Hence:

$$\boxed{\begin{aligned}\frac{d\mathbb{P}(Z \geq \overline{z_X})}{dw} &= \frac{d\mathbb{P}(Z \geq \overline{z_X})}{d\overline{z_X}}\frac{d\overline{z_X}}{dw} \leq 0\\ \frac{d\mathbb{P}(Z \geq \overline{z_X})}{dY^c} &= \frac{d\mathbb{P}(Z \geq \overline{z_X})}{d\overline{z_X}}\frac{d\overline{z_X}}{dY^c} \geq 0\end{aligned}} \tag{20}$$

Turning to the average price conditional on serving the domestic (resp. foreign) market:

$$\widetilde{p^d}^{1-\theta} = \int_{z_{min}}^{z_{max}} p^d(z,w)^{1-\theta} g(z)dz \tag{21}$$

$$\Rightarrow (1-\theta)\widetilde{p^d}^{-\theta}\frac{d\widetilde{p^d}}{dw} = \int_{z_{min}}^{z_{max}} (1-\theta)p^{d-\theta}(z,w)\frac{dp^d(z,w)}{dw}g(z)dz \tag{22}$$

$$\boxed{\frac{d\widetilde{p^d}}{dw} = \widetilde{p^d}^{\theta}\int_{z_{min}}^{z_{max}} p^{d-\theta}(z,w)\frac{dp^d(z,w)}{dw}g(z)dz \geq 0} \tag{23}$$

and for exporting:

$$\begin{aligned}\widetilde{p^{d*}}^{1-\theta} &= \int_{\overline{z_X}}^{z_{max}} p^{d*}(z,w)^{1-\theta}\gamma_t^X(z)dz\\ \Leftrightarrow \widetilde{p^{d*}}^{1-\theta} &= \int_{\overline{z_X}}^{z_{max}} p^{d*}(z,w)^{1-\theta}\frac{g(z)}{\mathbb{P}(Z \geq \overline{z_X})}dz\end{aligned} \tag{24}$$

$$\begin{aligned}\Rightarrow (1-\theta)\widetilde{p^{d*}}^{-\theta}\frac{d\widetilde{p^{d*}}}{dw} = &\int_{\overline{z_X}}^{z_{max}} (1-\theta)p^{d*-\theta}(z,w)\frac{dp^{d*}(z,w)}{dw}\frac{g(z)}{\mathbb{P}(Z \geq \overline{z_X})}dz\\ &+ \frac{d\overline{z_X}}{dw}\left[\frac{k}{z_{min}^k}\overline{z_X}^{k-1}\int_{\overline{z_X}}^{z_{max}} p^{d*1-\theta}(z,w)g(z) - \frac{p^{d*1-\theta}(\overline{z_X},w)g(\overline{z_X})}{\mathbb{P}(Z \geq \overline{z_X})}\right]\end{aligned} \tag{25}$$

$$\begin{aligned}\frac{d\widetilde{p^{d*}}}{dw} = \widetilde{p^{d*}}^{\theta}\Bigg(&\overbrace{\int_{\overline{z_X}}^{z_{max}} p^{d*-\theta}(z,w)\frac{dp(z,w)}{dw}\frac{g(z)}{\mathbb{P}(Z \geq \overline{z_X})}dz}^{\text{Pricing Function Adjustment (PFA)}}\\ &- \frac{1}{(\theta-1)}\underbrace{\frac{d\overline{z_X}}{dw}\frac{k}{\overline{z_X}}\left[\widetilde{p^{d*}}^{1-\theta} - p^{d*1-\theta}(\overline{z_X},w)\right]}_{\text{Set of Varieties Adjustment (SVA)}}\Bigg)\end{aligned} \tag{26}$$

Thus:

$$\frac{d\widetilde{p^{d*}}}{dw} = \widetilde{p^{d*}}^{\theta}\left(\underbrace{PFA}_{>0} - \frac{1}{(\theta-1)}\underbrace{\frac{d\overline{z_X}}{dw}\frac{k}{\overline{z_X}}\left[\widetilde{\xi^d} - \xi^d(\overline{z_X})\right]}_{>0}\right) \tag{27}$$

$$\boxed{\begin{aligned}&\frac{d\widetilde{p^{d*}}}{dw} \geq 0\\ \Leftrightarrow &\underbrace{\int_{\overline{z_X}}^{z_{max}} p^{d*-\theta}(z,w)\frac{dp^{d*}(z,w)}{dw}\frac{g(z)}{\mathbb{P}(Z\geq\overline{z_X})}dz}_{\text{Pricing Function Adjustment}} \geq \underbrace{\frac{1}{(\theta-1)}\frac{d\overline{z_X}}{dw}\frac{k}{\overline{z_X}}\left[\widetilde{\xi^{d*}} - \xi^{d*}(\overline{z_X})\right]}_{\text{Set of Varieties Adjustment}}\end{aligned}} \tag{28}$$

$\boxed{\forall C : \frac{d\widetilde{p^d}}{dY^c} = 0}$ and $\boxed{\forall C : \frac{d\widetilde{p^{d*}}}{dY^c} \geq 0}$ because

$$\frac{d\widetilde{p^d}}{dY^c} = \widetilde{p^d}^{\theta}\left(\int_{z_{min}}^{z_{max}} p^{d-\theta}(z,w)\overbrace{\frac{dp^d(z,w)}{dY^c}}^{=0}\frac{g(z)}{\mathbb{P}(Z\geq\overline{z_H})}dz\right) = 0 \tag{29}$$

and

$$\frac{d\widetilde{p^{d*}}}{dY^c} = \widetilde{p^{d*}}^{\theta}\left(\int_{\overline{z_X}}^{z_{max}} p^{d*-\theta}(z,w)\overbrace{\frac{dp^{d*}(z,w)}{dY^c}}^{=0}\frac{g(z)}{\mathbb{P}(Z\geq\overline{z_X})}dz - \frac{1}{(\theta-1)}\underbrace{\frac{d\overline{z_X}}{dY^c}}_{\leq 0}\frac{k}{\overline{z_X}}\left[\widetilde{\xi^{d*}} - \xi^{d*}(\overline{z_X})\right]\right) \tag{30}$$

Going back to $G(w, Y^c)$:

$$G(w,Y^c) = \widetilde{p^d}^{1-\theta} + \mathbb{P}(Z\geq\overline{z_X})\widetilde{p^{d*}}^{1-\theta} - \frac{1}{N^d}$$

Then :

$$\begin{aligned}\frac{dG}{dY^c}(w,Y^c) =&(1-\theta)\widetilde{p^d}^{-\theta}\frac{d\widetilde{p^d}}{dY^c} + \frac{\mathbb{P}(Z\geq\overline{z_X})}{dY^c}\widetilde{p^{d*}}^{1-\theta}\\ &+ \mathbb{P}(Z\geq\overline{z_X})(1-\theta)\widetilde{p^{d*}}^{-\theta}\frac{\widetilde{p^{d*}}}{dY^c}\end{aligned}$$

Thus $\boxed{\frac{dG}{dY^c}(w,Y^c) \geq 0}$.

Besides,

$$\begin{aligned}\frac{dG}{dw}(w,Y^c) =&(1-\theta)\widetilde{p^d}^{-\theta}\frac{d\widetilde{p^d}}{dw} + \frac{\mathbb{P}(Z\geq\overline{z_X})}{dw}\widetilde{p^{d*}}^{1-\theta}\\ &+ \mathbb{P}(Z\geq\overline{z_X})(1-\theta)\widetilde{p^{d*}}^{-\theta}\frac{\widetilde{p^{d*}}}{dw}\end{aligned}$$

Thus $\boxed{\dfrac{dG}{dw}(w, Y^c) \leq 0}$

1.2. **Apply implicit function theorem**

By implicit function theorem: there exists an implicit function g such that $w = g(Y^c)$ and $\frac{\partial g}{\partial Y^c}(Y^c) = -\frac{\frac{\partial G}{\partial Y^c}(w, Y^c)}{\frac{\partial G}{\partial w}(w, Y^c)}$. Thus $\frac{\partial g}{\partial Y^c}(Y^c) \geq 0$.

STEP 2. Show that (5) defines w as a monotonic increasing function to Y^c

2.1. **Equation (5) can be rewritten as** $F(w, Y^c) = 0$ **with** $\frac{dF}{dw} \leq 0$ **and** $\frac{dF}{dY^c} \geq 0$**.**

$$F(w, Y^c) = C(w, Y^c) - wL - N^d \tilde{d}(w, Y^c)$$

$$F(w, Y^c) = Y^c - wL - N^d Y^c \left(\frac{1}{\theta \widetilde{p^d}^{\theta-1} - (\theta - \sigma)} + \mathbb{P}(Z \geq \overline{z_X}) \frac{1}{\theta \widetilde{p^f}^{\theta-1} - (\theta - \sigma)} \right)$$

$$F(w, Y^c) = Y^c \left(1 - N^d \left(\frac{1}{\theta \widetilde{p^d}^{\theta-1} - (\theta - \sigma)} + \mathbb{P}(Z \geq \overline{z_X}) \frac{1}{\theta \widetilde{p^f}^{\theta-1} - (\theta - \sigma)} \right) \right) - wL$$

$$\frac{dF(w, Y^c)}{dY^c} = 1 - N^d \left(\frac{-\theta(\theta - 1) \frac{d\widetilde{p^d}}{dY^c} \widetilde{p^d}^{\theta-2}}{(\theta \widetilde{p^d}^{\theta-1} - (\theta - \sigma))^2} + \mathbb{P}(Z \geq \overline{z_X}) \frac{-\theta(\theta - 1) \frac{d\widetilde{p^f}}{dY^c} \widetilde{p^f}^{\theta-2}}{(\theta \widetilde{p^f}^{\theta-1} - (\theta - \sigma))^2} \right.$$
$$\left. + \frac{d\mathbb{P}(Z \geq \overline{z_X})}{dY^c} \frac{1}{\theta \widetilde{p^f}^{\theta-1} - (\theta - \sigma)} \right)$$

The second term in brackets on the right-hand-side is small compared to the first order effect $\frac{dY^c}{dY^c} = 1$. Thus $\boxed{\dfrac{dF(w, Y^c)}{dY^c} \geq 0}$

$$\frac{dF(w, Y^c)}{dw} = -L - N^d \left(\frac{-\theta(\theta - 1) \frac{d\widetilde{p^d}}{dw} \widetilde{p^d}^{\theta-2}}{(\theta \widetilde{p^d}^{\theta-1} - (\theta - \sigma))^2} + \mathbb{P}(Z \geq \overline{z_X}) \frac{-\theta(\theta - 1) \frac{d\widetilde{p^f}}{dw} \widetilde{p^f}^{\theta-2}}{(\theta \widetilde{p^f}^{\theta-1} - (\theta - \sigma))^2} \right.$$
$$\left. + \frac{d\mathbb{P}(Z \geq \overline{z_X})}{dw} \frac{1}{\theta \widetilde{p^f}^{\theta-1} - (\theta - \sigma)} \right)$$

The second term in brackets on the right-hand-side is small (in absolute value) compared to the first order effect $\frac{dwL}{dw} = L$. Thus $\boxed{\dfrac{dF(w, Y^c)}{dw} \leq 0}$

2.2. Apply implicit function theorem

By implicit function theorem: there exists an implicit function f such that $w = f(Y^c)$ and $\frac{\partial f}{\partial Y^c}(Y^c) = -\frac{\frac{\partial F}{\partial Y^c}(w,Y^c)}{\frac{\partial F}{\partial w}(w,Y^c)}$. Thus $\frac{\partial f}{\partial Y^c}(Y^c) \geq 0$.

STEP 3. $\frac{dg}{dY^c}(Y^c) - \frac{df}{dY^c}(Y^c)$ is monotonic.

$$\frac{dg}{dY^c}(Y^c) - \frac{df}{dY^c}(Y^c) = -\frac{\frac{\partial G}{\partial Y^c}(w, Y^c)}{\frac{\partial G}{\partial w}(w, Y^c)} + \frac{\frac{\partial F}{\partial Y^c}(w, Y^c)}{\frac{\partial F}{\partial w}(w, Y^c)} \tag{31}$$

I know that $Y^c \geq w$ by (5).

I check numerically that, for the set of parameters considered in the paper, $\frac{\frac{\partial G}{\partial Y^c}(w,Y^c)}{\frac{\partial G}{\partial w}(w,Y^c)} \simeq 0$. Besides $\frac{\frac{\partial F}{\partial Y^c}(w,Y^c)}{\frac{\partial F}{\partial w}(w,Y^c)} \leq 0$.

Figure 4 illustrates graphically this idea.

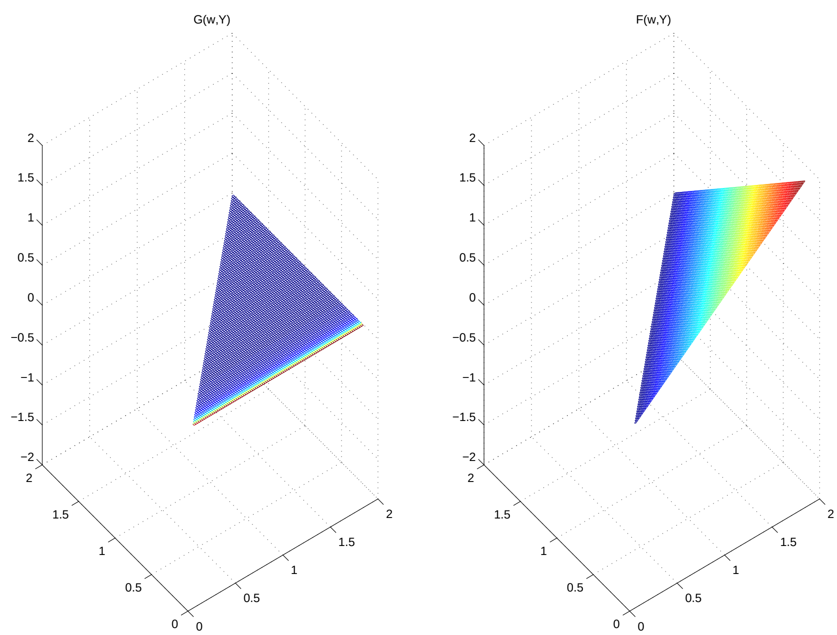


FIGURE 4. figure

Thus, $\frac{dg}{dY^c}(Y^c) - \frac{df}{dY^c}(Y^c)$ is monotonically decreasing in Y^c.

$\frac{dg}{dY^c}(Y^c) - \frac{df}{dY^c}(Y^c)$ crosses at most once the zero axis. Consequently there is at most one solution to the previous system: if a solution exists, it has to be unique.

APPENDIX G. COURNOT VERSUS BERTRAND COMPETITION

I focus on competition *à* la Bertrand, in which firms internationalize the effect of their *price* decision on the sectoral price, entailing a perceived elasticity of demand $\Theta^{\text{Bertrand}}(\xi) = \theta - (\theta - \sigma)\xi$. Alternatively I could have considered firms competing *à* la Cournot, i.e. in quantities, internalizing the effect of their choice on the aggregate sectoral supply. Under Cournot competition, the perceived price elasticity of demand becomes $\Theta^{\text{Cournot}}(\xi) = \left[\frac{1}{\theta} - (\frac{1}{\theta} - \frac{1}{\sigma})\xi\right]^{-1}$.

The perceived price demand elasticity is different under the two setups but the same important properties still hold:

(1) If $\xi \neq 0$ then the market share, that depends on the degree of competition, does affect the pricing behavior of firm.
(2) The perceived price elasticity of demand $\Theta^{\text{Cournot}}(\xi)$ falls as the firm market share ξ rises.
(3) If $\xi \longrightarrow 0$, then the model boils down to the monopolistic case and $\Theta^{\text{Bertrand}}(\xi) = \Theta^{\text{Cournot}} = \theta$. Pro-competitive effects are ruled-out.
(4) If $\sigma = \theta$, then the model boils down to the monopolistic case with $\Theta^{\text{Bertrand}}(\xi) = \Theta^{\text{Cournot}} = \theta = \sigma$.

Hence: the same qualitative results are confirmed with Cournot competition instead of Bertrand.