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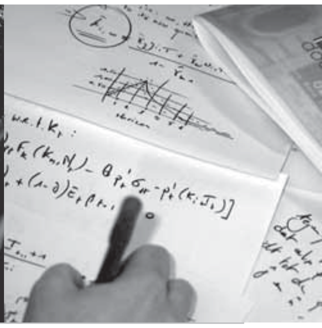

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THE DYNAMICS OF TRADE AND COMPETITION

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Editorial

On October 12-13, 2006 the National Bank of Belgium hosted a Conference on *"Price and Wage Rigidities in an Open Economy"*. Papers presented at this conference are made available to a broader audience in the NBB Working Paper Series (www.nbb.be).

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Abstract

We present, extend and estimate a model of international trade with firm heterogeneity in the tradition of Melitz (2003) and Melitz and Ottaviano (2005). The model is constructed to yield testable implications for the dynamics of international prices, productivity levels and markups as functions of openness to trade at a sectoral level. The theory lends itself naturally to a difference in differences estimation, with international differences in trade openness at the sector level reflecting international differences in the competitive structure of markets. Predictions are derived for the effects of both domestic and foreign openness on each economy. Using disaggregated data for EU manufacturing over the period 1989-1999 we find evidence that trade openness exerts a competitive effect, with prices and markups falling and productivity rising. Consistent with theory however, these effects diminish and may even revert in the longer term as less competitive economies become attractive havens from which to export from. We provide evidence that this entry into less open economies induces pro-competitive effects overseas in response to domestic trade liberalization.

JEL-code : E31, F12, F15, L16.

Keywords: Competition, Globalization, Markups, Openness, Prices, Productivity, Trade.

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1 Introduction

Increased openness is widely believed to induce competitive effects. In response to greater foreign competition and increased imports, profit margins should fall as markups decline, and average productivity should increase as marginal firms exit the industry. The introduction of heterogeneous firms into models of international trade has provided detailed predictions of the distributional dynamics induced by greater openness and the patterns of entry, exit and relocation that occur in its wake. However, a direct link from these models to empirical estimation remains elusive. This paper aims at filling this gap.

More specifically we develop a version of Melitz and Ottaviano (2005) adapted to be directly amenable to empirical analysis. In particular our empirical measure of openness is derived from our theoretical model as are the reduced form expressions which we estimate. Our theoretical specification naturally suggests a difference in differences estimation strategy in which international differences in sector-level inflation rates, productivity growth and markups are all ascribed to international differences in openness to trade. Thus, we are able to investigate the validity of the theoretical claim that it is relative openness that affects the relative extent of competition.

To test our model we use a cross section of manufacturing industries in seven European Union countries during the 1990s. We observe prices, productivity, markups, the number of domestically producing firms and imports. We uncover support for significant pro-competitive effects of trade openness, as measured by import penetration in domestic markets. In response to increased imports, productivity rises, margins fall, and prices grow at a (temporarily) lower rate. In a manner consistent with the theory these effects diminish and, in a non trivial number of cases, actually reverse themselves in the long run. We verify that it is relative trade openness that matters for market structure. Foreign and domestic openness to trade affect prices, productivity and margins with opposite - and often equal - signs, at all horizons, again in a manner consistent with our theory. Additional implications of our model, namely the importance of market size and the number of firms, all receive support from the data as well.

Ours is by no means the first attempt at quantifying the competitive effects of trade. A first extensive strand of the literature uses cross country panel studies to examine the effects of aggregate trade openness on economic (or productivity) growth. This line of work underscores the importance of theoretically sound aggregate measures of trade openness, and in particular the critical need to deal with the endogeneity of changes in trade openness.[1] This motivates our attempt to derive relevant measures of openness from our theoretical model. We build on this literature in two further ways. We use disaggregated sectoral data, and we test theoretical predictions that both domestic and foreign openness may affect domestic market structure.

A second branch of the literature attempts to assuage endogeneity concerns by studying one-off liberalization events, typically in the developing world. These events often occur as part of more general reforms and are liable to have differential effects across firms, whose cross section helps identification.[2] The disaggregated approach in some of these studies inspires the present work although we focus not on "natural experiments" but more gradual and continual processes of opening to trade. By using a cross section of developed European economies we also make a nod to Trefler's (2004) plea that "what is needed is at least some research focusing on industrialized countries" (p.2).

Closest to our work are several recent papers using US data to inform the effects of openness on firm-level performance. Bernard, Redding and Schott (2005) examine firms' output response at the plant level to increases in imports with a particular focus on within sector reallocations. Bernard, Eaton, Jensen, and Kortum (2003) fit a model of heterogeneous firms and empirically characterise the behaviour of U.S. exporters, and in particular their observed high productivity.[3] Closely related to our work is Bernard, Jensen and Schott (2006), who use U.S. data to investigate the response of firm-level productivity to falling trade costs at the sector level. The richness of their data enables them to identify characteristics of exiting firms or new exporters. The firm level focus of these studies provides substantial insight into the cross sectional dynamics of increased trade. By contrast our use of sectoral data provides insights in different dimensions.

[1] See, *inter alia*, Ades and Glaeser (1999), Frankel and Romer (1999), Alesina, Spolaore and Warcziag (2005), Alcalà and Ciccone (2003), Rodrik and Rodriguez (2001) or Irwin and Tervio (2002).

[2] See, among many others, Corbo, de Melo and Tybout (1991) or Pavcnik (2002) on Chile; Ferreira and Rossi (2003) on Brazil; Harrison (1994) on Ivory Coast; or Krishna and Mitra (1998) on India. Topalova (2004) invokes the exogeneity of the 1991 Indian trade reform as part of a package sponsored by the IMF. Aghion, Burgess, Redding and Zilibotti (2005) use the same episode but focus on differential responses at the sector level according to the prevailing institutions. Clerides, Lach and Tybout (1998) use carefully timed data to account for the self selection of productive firms in export markets.

[3] This list is far from exhaustive. For instance, in recent work, Breinlich (2005) shows that mergers and acquisitions are an empirically important channel through which trade openness brings about improved firm performance. Kramarz (2003) estimates the impact on French wages, through reductions in worker bargaining power, of increased imports.

Firstly we focus on the impact across a number of European countries of differential increases in international trade, and provide an alternative means of identifying the impact of trade on non-US economies. Secondly our focus on European importers, and our model's implications on relative openness, leads naturally to a difference in differences approach to estimation. In other words, identification is not of how France responds to increased imports, for instance, but rather of how France has been effected differently than Germany through differential changes in openness. Finally, our model has strong predictions on the short and long run impact of trade liberalization. We exploit the dynamic nature of our panel to investigate these effects.

Thanks to our difference in differences approach, the aggregate component of sector inflation rates can be accounted for directly in the estimation. This is important for it helps focus the empirics upon the question of interest, namely the putative micro-economic pro-competitive effects of trade openness, and away from alternative macro-economic mechanisms. Romer (1993) has argued trade openness affects the conduct of monetary policy, as depreciation costs erode the benefits of surprise inflations to an extent that increases with openness. More recently Rogoff (2003) argues that the inflation bias under discretionary monetary policy decreases with the extent of competition, which in turn improves with openness. Both explanations can explain the negative long run correlation between inflation and trade over recent decades. Both effects are directly purged from our data thanks to their disaggregated dimension, so that, under our assumptions, our sectoral estimates of the pro-competitive effects of trade are immune to alternative macroeconomic explanations. Separating out this effect also throws light on the direct impact that increased openness has had in lowering prices and contributing to the decline in inflation during the 1990s.

The plan of the paper is as follows. In Section 2 we outline a theoretical model which clarifies how changes in trade costs affect prices, productivity and markups. Falls in transport costs or tariffs lead to lower prices and margins due to heightened competition from imports. Because inefficient firms exit, trade also leads to lower average costs and higher productivity. Section 3 develops from this theoretical framework the equations we actually estimate. We reformulate the model in terms of directly observable import shares rather than transport costs. We pay particular attention to separating the short and long run dynamics of how openness impacts on the variables of interest. In Section 4 we tackle a number of econometric issues before proceeding in Section 5 to a discussion of our disaggregated dataset, which covers ten manufacturing sectors across seven European nations over the period 1989-1999. Section 6 presents our econometric results, and Section 7 considers various robustness checks. A final Section concludes.

2 Theory

In this section, we develop a two country general equilibrium model built around the work of Melitz and Ottaviano (2005). The theory offers a structural model in which prices, productivity and, in particular, markups of imperfectly competitive firms depend on the number of firms supplying a market. Trade liberalization affects the number of firms and so affects firm level performance. The model distinguishes between the short and long run impact of trade liberalization. In the short run, trade has pro-competitive effects: falling transport costs lead to an increase in imports, greater competition and a fall in prices and markups, which in turn raises average productivity as only the strongest firms continue to produce. In the longer term however, the greater degree of competition persuades firms to relocate their production overseas into more protected economies. As a result the pro-competitive effects of trade liberalization are reversed. This model provides structure to the short and long run dynamics of the model, draws an important distinction between domestic and overseas openness and allows for rich patterns in the manner through which trade affects market structure.

The main innovation in our paper is to take this theoretical structure and use it to estimate the competitive impact of greater trade openness amongst EU nations. In doing so we extend the model in two dimensions. Firstly, our theory points to a critical role for a trade cost variable, reflecting either transportation costs or tariffs. Reliable data for trade costs are scarce so we use our model to substitute out for trade costs using the more readily observable import share.[4] Our second extension is to allow for cross country heterogeneity in the cross sectional distribution of productivity. This serves both to enrich the structure of our estimated model but also opens the door for our difference in differences estimation strategy.

[4] See Harrigan (1999) for a discussion of measurement issues for transport costs, or Bernard, Jensen and Schott (2006) for an example of U.S based sector data on transport costs.

2.1 The Model

2.1.1 Demand

A representative agent has preferences over a continuum of sectors, indexed by i. Utility from consumption in each sector is derived from a continuum of varieties indexed by $u \in (0, 1]$ such that

$$C^u = \alpha \int_u q_u^i \ du - \frac{1}{2}\gamma \int_u \left(q_u^i\right)^2 \ du - \frac{1}{2}\eta \left(\int_u q_u^i \ du\right)^2$$

with $\alpha, \gamma, \eta > 0$. Varieties are perfect substitutes for $\gamma = 0$, in which case the agent only cares about sectoral consumption $Q^i = \int_u q_u^i \ du$. Identical assumptions hold in the foreign country, whose variables we denote by an asterisk. We denote the mass of consumers in the home country by L. In what follows we omit sector-specific superscripts unless the context is ambiguous.

Inverted demand for each variety is given by

$$p_u = \alpha - \gamma q_u - \eta Q^i \tag{1}$$

for $q_u > 0$. This defines $Q^i = (\alpha - \bar{p}) \ N \ / \ (\gamma + \eta N)$ where N is the number of firms competing in the sector (including both domestic producers and foreign exporters), and $\bar{p} = \frac{1}{N} \int_u p_u \ du$ is the aggregate sectoral price index. Demand for variety u remains positive so long as

$$p_u \leq \frac{1}{\gamma + \eta N} \left(\alpha\gamma + \eta N \ \bar{p}\right) \tag{2}$$

Using (1) and (2) and summing over all consumers gives total demand in the home country for variety u in sector i as

$$Q_u^i = Lq_u^i = \frac{\alpha L}{\gamma + \eta N} - \frac{L}{\gamma} p_u^i + \frac{1}{\gamma} \frac{\eta N L}{\gamma + \eta N} \ \bar{p}^i \tag{3}$$

Demand for each variety is linear in prices, but unlike the classic monopolistically competitive setup introduced in Dixit and Stiglitz (1977), the price elasticity of demand depends on N, the number of firms in the sector, a feature introduced in Ottaviano, Tabuchi and Thisse (2002). Variations in the number of competing firms is the key mechanism through which trade liberalization effects corporate performance.

2.1.2 Supply

Labor is the only factor of production and c denotes the firm's unit labor cost. Labor is perfectly mobile domestically between firms in the same sector, but not across countries. International wage differences are therefore possible in each sector.[5] As a result, unit costs vary across firms in a sector purely for technological reasons, i.e. differences in sectoral productivity. In contrast, sectoral unit costs vary across countries due to differences in wages and technology. Domestic firms can sell to the domestic market, or export but then they incur an ad-valorem cost $\tau^* > 1$, reflecting transportation costs or tariffs determined in the foreign economy. Production for domestic markets has unit cost c and for exports $\tau^* c$. Transportation costs for foreign goods entering the domestic economy are symmetrically denoted by τ. Entry and exit decisions entail a fixed cost f_E which firms have to pay to establish production in whichever economy. In the short run firms cannot change their location but can decide whether to produce or not and if they decide to produce whether they should also export. In the long run firms can change their location by paying f_E.

Denote c_D (c_D^*) as the unit cost of the marginal domestic (foreign) firm achieving zero sales, for which inequality (2) is binding. A firm with unit costs c charges a price $p(c)$ and so we have $p(c_D) = c_D$ and $p^*(c_D^*) = c_D^*$. The marginal exporting domestic firm has costs $c_X = c_D^*/\tau^*$, while its foreign counterpart has costs $c_X^* = c_D/\tau$. Due to trade costs, markets in different countries are distinct and firms have to choose how much to produce for domestic markets [$q_D(c)$ and $q_D^*(c)$] and how much for export [$q_X(c)$ and $q_X^*(c)$]. Profits from domestic sales are denoted Π_D and from exports by Π_X. Domestic profit maximization implies

$$\begin{aligned} [\, p_D(c) - c]\, \frac{L}{\gamma} &= q_D(c) \\ [\, p_X(c) - \tau^* c]\, \frac{L^*}{\gamma} &= q_X(c) \end{aligned}$$

To obtain closed form expressions for our key variables we follow Melitz (2003) and Melitz and Ottaviano (2005) and assume costs in each sector follow a Pareto distribution with cumulative distribution function $G(c) = (\frac{c}{c_M})^k$, $c \in [0, c_M]$. For $k = 1$ costs are distributed uniformly, and as k increases so does the relative proportion of high cost firms. To allow for cross-country productivity differences we extend the model so that

[5] In the empirical section, we assume perfect labor mobility across firms in the same sector, but take no stance regarding labor mobility between sectors.

the upper bound for costs differs across countries, i.e. $c_M \neq c_M^*$. If $c_M < (>)\ c_M^*$ then the domestic economy displays relatively low (high) cost and high (low) productivity. This helps introduce our estimation strategy based on international differences in the model's endogenous variables.[6]

Under these distributional assumptions and optimal pricing, a firm with costs c sells output to the domestic market at a price $p_D(c) = \frac{1}{2}(c_D + c)$, $c \in [0, c_D]$ and for imports the price is $p_X^*(c) = \frac{1}{2}(c_D + \tau c)$, $c \in [0, c_D/\tau]$. Given the distributional assumption for c, exporters also face a Pareto distribution for their costs with density $(c\tau^*/c_M)^k$. Therefore, the costs for domestic firms that produce for the domestic market, or that export (inclusive of trade costs) both follow a Pareto distribution. As a result the aggregate sectoral price index $\bar{p}$ and average cost $\bar{c}$ are given by

$$\begin{aligned}\bar{p} &= \int_0^{c_D} p(c)dG(c)/G(c_D) = \frac{2k+1}{2(k+1)}c_D \\ \bar{c} &= \int_0^{c_D} c dG(c)/G(c_D) = \frac{k}{k+1}c_D\end{aligned}$$

With markups for domestic sales given by $\mu_u = p_u - c_u$, average sector markups are

$$\bar{\mu} = \frac{1}{2}\frac{1}{k+1}c_D$$

The same relations hold by symmetry in the foreign economy. Prices, markups, costs and productivity are all pinned down by the value of threshold costs c_D and c_D^*, whose determination in equilibrium we now consider.

2.2 Market Structure and Trade Liberalization

2.2.1 Demand, Varieties and Competition

In this section we outline the intuition for the dynamic effects of trade liberalization in the model. The essential mechanisms are inspired from Melitz and Ottaviano (2005), with the added ingredients of international heterogeneity in productivity, trading costs

[6] Ghironi and Melitz (2005) introduce cross-country heterogeneity by assuming a stochastic country-specific productivity term. While this introduces some features shared by our model it differs in that heterogeneity arises from ex post variation. In our model ex ante variation in costs across countries affects firms entry decisions and industry cut off costs.

and wages. We spend time on the intuition for differences between short and long term responses, as this will be an interesting aspect of our empirical work.

N denotes the number of firms active in the domestic market, and N^* the number supplying to overseas markets. The number of firms supplying a market is made up of both domestic producers and foreign exporters. For the marginal firm in the domestic economy $p(c_D) = c_D$ and inequality (2) binds so that

$$\begin{aligned} p(c_D) &= c_D = \frac{1}{\gamma + \eta N} \left(\alpha\gamma + \eta N \ \bar{p}\right) \\ p^*(c_D^*) &= c_D^* = \frac{1}{\gamma + \eta N^*} \left(\alpha\gamma + \eta N^* \ \bar{p}^*\right) \end{aligned}$$

Using the expression for average sectoral prices,

$$N = \frac{2\gamma(k+1)}{\eta} \frac{\alpha - c_D}{c_D} \tag{4}$$

$$N^* = \frac{2\gamma(k+1)}{\eta} \frac{\alpha - c_D^*}{c_D^*} \tag{5}$$

The demand curve therefore implies a negative relationship between the number of active firms supported by the market and the threshold costs of the marginal firm. This relationship is shown in Figure 1 by the downward sloping curve. High values for c_D lead to high prices, limited demand, and so a limited number of firms and varieties. Note that equations (4) and (5) simply summarize the demand side of the economy and do not depend directly on transportation costs. The negative relationship in equations (4) and (5) between number of firms and threshold costs is not affected by trade liberalization.

2.2.2 Short Run Implications of Trade Liberalization

In the short run, firm location is fixed and their decision is whether to produce or not and which markets to supply, bearing in mind that exports incur the transport costs τ or τ^*. High cost firms decide not to produce but do not relocate. The lowest cost firms produce for domestic markets as well as export and an intermediate group of firms produce only for the domestic market.

In the short run, the number of firms that consider their production choices in each economy, $\bar{N}_{SR}$ and $\bar{N}_{SR}^*$, is fixed parametrically. Given the distribution of costs and as only firms with $c < c_D$ ($c < c_D^*$ abroad) actually choose to produce, the number of firms active in each market is given by

$$N = \bar{N}_{SR}\left(\frac{c_D}{c_M}\right)^k + \bar{N}_{SR}^* \frac{1}{\tau^k}\left(\frac{c_D}{c_M^*}\right)^k \quad (6)$$

$$N^* = \bar{N}_{SR}^*\left(\frac{c_D^*}{c_M^*}\right)^k + \bar{N}_{SR} \frac{1}{(\tau^*)^k}\left(\frac{c_D^*}{c_M}\right)^k \quad (7)$$

Equations (6) and (7) reflect the supply side of the economy and firms production decisions. The higher the threshold level of costs, c_D, the larger the number of firms (both domestically located and exporters) that decide to produce. Equation (6) is shown in Figure 1 by the upward sloping relationship. In contrast to the demand relationship (4), changes in transport costs affect the production decisions of firms and shift the relationship between N and c_D. For a given level of c_D, a fall in transport costs τ means more foreign firms selling to the domestic market, an increase in imports and a rise in N. This effect is captured in Figure 1 where the supply schedule shifts right in response to a fall in transport costs. In equilibrium, N rises and c_D falls in response to a fall in trading costs.

The increase in foreign firms exporting to the domestic market leads to a rise in varieties and so raises the elasticity of demand. Given the structure of the market this results in a fall in markups and prices and, as a result, the higher cost domestic firms and foreign exporters cease production. The end result is a net increase in N (even though some domestically produced firms are displaced by foreign exports), lower prices, lower markups and a trade induced rise in average productivity. In the short run, trade liberalizations have the standard pro-competitive effects.

2.2.3 Long Run Implications of Trade Liberalization

In the long run firms can decide to relocate elsewhere and then incur the fixed cost f_E. Letting N_{LR} and N_{LR}^* denote the endogenous long run equilibrium number of firms located in each country then equations (6) and (7) rewrite straightforwardly as

$$N = N_{LR}\left(\frac{c_D}{c_M}\right)^k + N_{LR}^* \frac{1}{\tau^k}\left(\frac{c_D}{c_M^*}\right)^k \quad (8)$$

$$N^* = N_{LR}^*\left(\frac{c_D^*}{c_M^*}\right)^k + N_{LR} \frac{1}{(\tau^*)^k}\left(\frac{c_D^*}{c_M}\right)^k \quad (9)$$

However N_{LR} and N^*_{LR} are no longer fixed but now vary due to firm entry and exit. In the long run, the number of firms located in a country is determined by free entry and the zero profit condition

$$\begin{aligned} \int_0^{c_D} \Pi_D(c)\ dG(c) + \int_0^{c_X} \Pi_X(c)\ dG(c) &= f_E \\ \int_0^{c^*_D} \Pi^*_D(c)\ dG^*(c) + \int_0^{c^*_X} \Pi^*_X(c)\ dG^*(c) &= f_E \end{aligned}$$

Under our Pareto distributional assumption for costs these expressions simplify to

$$\begin{aligned} \phi\ c_M^k &= L\ c_D^{k+2} + L^*\ (\tau^*)^2\ c_X^{k+2} \\ \phi\ (c^*_M)^k &= L^*\ (c^*_D)^{k+2} + L\ \tau^2\ (c^*_X)^{k+2} \end{aligned}$$

where $\phi = 2\gamma(k+1)(k+2)f_E$. Using the fact that $c_X = c^*_D/\tau$ gives

$$c_D^{k+2} = \frac{\phi\ c_M^k}{\Upsilon L}\left[1 - \frac{1}{(\tau^*)^k}\left(\frac{c^*_M}{c_M}\right)^k\right] \tag{10}$$

$$(c^*_D)^{k+2} = \frac{\phi\ (c^*_M)^k}{\Upsilon L^*}\left[1 - \frac{1}{\tau^k}\left(\frac{c_M}{c^*_M}\right)^k\right] \tag{11}$$

where $\Upsilon = 1 - \tau^{-k}(\tau^*)^{-k}$. Equations (10) and (11) replace (6) and (7) in the long run, while equations (4) and (5), reflecting demand and preferences, remain unaltered. As in the long run entry and exit are endogenous, there is no longer a direct relationship between N and c_D. Instead the marginal level of costs is pinned down by the distribution of costs (c_M), the level of fixed costs (ϕ), market size (L) and trade costs (Υ). The supply side of the economy is no longer characterized by an upward sloping schedule but a horizontal line, as in Figure 2. The equilibrium number of firms located in an economy is determined by the intersection of this line with the downward sloping curve originating from consumer preferences.

We can use Figure 2 to consider the long run implications of trade liberalization. Consider first the case of a decrease in domestic trading costs, τ. This leads to an upward shift in marginal costs, as given by equation (10), and in equilibrium, to a fall in N.[7] As a result of the increase in c_D, from our earlier analysis, we also have an increase

[7] Equations (4), (5), (8) and (9) can be used to solve for N, N^*, N_{LR} and N^*_{LR}.

in prices and markups and a fall in productivity. Therefore the long run impact of falling trade costs is the exact opposite of their short run impact. In the short run, lower trade costs lead to more intense competition and lower margins. In the long run firms respond to this increase in competition by shifting to more protected markets overseas. The fall in trade costs makes it more viable to serve the domestic market through exports from overseas, whilst simultaneously lessening the attraction of remaining in place and producing for the domestic market. The result is a decline in firms serving the domestic market, which through the demand relationship, leads to higher costs and prices.

Whilst our model generates an anti-competitive long run response to domestic trade liberalization, falls in overseas trade costs are pro-competitive. As shown in Figure 2 a fall in τ^* leads to a downward shift in the horizontal line given by equation (10), an increase in N, a fall in c_D and so a fall in prices and markups. A fall in overseas trade costs encourages firms to relocate from overseas. This increases the number of firms and the level of domestic competition. This theoretical discussion points to two key facts for our empirical analysis. Firstly, the need to model the dynamic response of competition to trade and to allow for differential effects at different horizons. Secondly the importance of distinguishing between changes in domestic and foreign openness.

3 Towards an Estimable Model

In this section we lay the foundations for our empirical analysis. We do so by deriving estimable equations in terms of observable variables using the theory from the previous section.

3.1 Openness and Import Share

The key parameters of trade liberalization in our model are τ and τ^*, but reliable estimates are notoriously difficult to obtain, especially at the sectoral level. We use our model to substitute out for τ in terms of directly observable indicators of trade openness. The key variable for our analysis will be domestic absorption which in our model can be shown to depend only on domestic transport costs and relative productivity. By definition, absorption is given by

$$\theta = \frac{\int_0^{c_X^*} p_X^*(c)\ q_X^*(c)\ dG^*(c)}{\int_0^{c_D} p_D(c)\ q_D(c)\ dG(c) + \int_0^{c_X^*} p_X^*(c)\ q_X^*(c)\ dG^*(c)}$$

Since $p_D(c) = \frac{1}{2}(c_D + c)$ and $p_X^*(c) = \frac{\tau}{2}(c_X^* + c)$, under the Pareto distributional assumption this gives

$$\theta = \frac{1}{1 + \left[\frac{1}{\tau^k}\left(\frac{c_M}{c_M^*}\right)^k\right]^{-1}}$$

Domestic openness falls with the transport costs applied to foreign imports, and increases with domestic costs. Symmetric effects hold for foreign openness as

$$\theta^* = \frac{1}{1 + \left[\frac{1}{(\tau^*)^k}\left(\frac{c_M^*}{c_M}\right)^k\right]^{-1}}$$

It is useful to rearrange both expressions to obtain

$$\frac{1}{\tau^k}\left(\frac{c_M}{c_M^*}\right)^k = \frac{\theta}{1-\theta} \text{ and } \frac{1}{(\tau^*)^k}\left(\frac{c_M^*}{c_M}\right)^k = \frac{\theta^*}{1-\theta^*}$$

We use these expressions to replace unobservable trade costs with observed import shares.

3.2 Prices

3.2.1 Short Run

From our expressions for average sectoral prices we have $\left(\frac{\bar{p}}{\bar{p}^*}\right) = \left(\frac{c_D}{c_D^*}\right)$. In the short run, equations (6) and (7) yield

$$\begin{aligned}\left(\frac{\bar{p}}{\bar{p}^*}\right)^k &= \left(\frac{c_D}{c_D^*}\right)^k \\ &= \left(\frac{c_M}{c_M^*}\right)^k \frac{(\bar{N}_{SR}^*/N^*)}{(\bar{N}_{SR}/N)} \frac{1 + \frac{\bar{N}_{SR}}{\bar{N}_{SR}^*}\frac{\theta^*}{1-\theta^*}}{1 + \frac{\bar{N}_{SR}^*}{\bar{N}_{SR}}\frac{\theta}{1-\theta}} \qquad (12)\end{aligned}$$

From equation (12) we see that in the short run relative prices fall with domestic openness (θ) but rise with foreign openness (θ^*).[8] A rise in θ corresponds to a fall in τ and our openness channel traces through the effects described in Figure 1. Therefore in the short run, conditional on $\bar{N}_{SR}/N$ and $\bar{N}^*_{SR}/N^*$, increases in openness lead to falls in relative domestic prices. In the short run $\bar{N}_{SR}$ and $\bar{N}^*_{SR}$ are fixed, but N and N^* vary as trade liberalization leads to increased imports and fewer domestic firms producing. Our data contain information on prices and openness but not on N, the total number of firms supplying to the domestic market. Instead we have data on D, the number of domestic firms producing for the home market. In terms of our model $D = N_{SR}\left(\frac{c_D}{c_M}\right)^k$ and equations (4), (5), (6) and (7) can be combined to show that $D = \Psi(\tau, \tau^*)\ N$ where $\Psi_\tau > 0$.[9] In other words, falls in τ lead to a negative relationship between D and N. Equation (12) therefore suggests that, conditional on the level of openness, relative prices fall with an increase in the number of domestically producing firms (D) and rise with an increase in the number of foreign producing firms (D^*).

3.2.2 Long Run

From (10) and (11) long run relative prices imply

$$\left(\frac{\bar{p}}{\bar{p}^*}\right)^{k+2} = \left(\frac{c_D}{c_D^*}\right)^{k+2} = \frac{L^*}{L}\left(\frac{c_M}{c_M^*}\right)^k \frac{1-\frac{\theta^*}{1-\theta^*}}{1-\frac{\theta}{1-\theta}} \tag{13}$$

The effect of openness is no longer conditional on the number of firms. An increase in domestic openness θ now leads to a *rise* in relative prices, while an increase in overseas openness θ^* engenders a fall. In addition, large markets, as indexed by L, support a larger number of firms and have lower prices.

3.2.3 Combining Short and Long Run

We seek to evaluate simultaneously a short run relationship between relative prices, the number of domestically producing firms and openness and a long run relationship

[8] Equation (12) is derived using only the upward sloping supply schedule in Figure 1. We could further use equations (4) and (5) to solve for non-linear expressions for N and N^*.

[9] In particular, we have $\Psi = (\frac{c_M}{c_{M^*}})\frac{\tau^{*k}}{1-\tau^k\tau^{*k}}\frac{\bar{N}^*_{SR}}{\bar{N}_{SR}}\frac{1+\frac{\bar{N}_{SR}}{\bar{N}^*_{SR}}\frac{\theta^*}{1-\theta^*}}{1+\frac{\bar{N}^*_{SR}}{\bar{N}_{SR}}\frac{\theta}{1-\theta}} - \frac{\tau^{*k}\tau^k}{1-\tau^k\tau^{*k}}$.

To see why $\Psi_\tau > 0$ consider the following. Figure 1 shows that decreases in τ lead to an increase in N and a fall in c_D. With $D = N_{SR}\left(\frac{c_D}{c_M}\right)^k$ and N_{SR} and c_M fixed in the short run, D must be increasing in τ.

between relative prices, market size and openness, where the effect of openness is allowed to change sign. Our model suggests the following log-linear expression

$$\begin{aligned}\Delta \ln \left(\frac{\bar{p}_{it}}{\bar{p}^*_{it}}\right) &= \beta_0 + \beta_1 \,\Delta \ln \theta_{it} + \beta_2 \,\Delta \ln \theta^*_{it} + \beta_3 \,\Delta \ln D_{it} + \beta_4 \,\ln D^*_{it} \\ &+\gamma \,\{\ln \left(\frac{\bar{p}_{it-1}}{\bar{p}^*_{it-1}}\right) + \delta_0 + \delta_1 \,\ln L_{t-1} + \delta_2 \,\ln L^*_{t-1} \\ &+\delta_3 \,\ln \theta_{it-1} + \delta_4 \,\ln \theta^*_{it-1}\} + \varepsilon_{ijt} \qquad (14)\end{aligned}$$

where i denotes sector, a star denotes the foreign country and t is time. The difference terms capture short run relationships, whilst the error correction term in brackets captures the long run relationship in levels. The error correction model will improve the efficiency of our estimates so long as relative prices and relative openness are all integrated of order one, which we verify later. If $\beta_1 < 0$ then domestic openness has pro-competitive effects on domestic relative prices in the short run. In the long run, relative prices rise in response to openness if $\delta_3 < 0$. As the effects of changes in foreign openness on the domestic market have the opposite effect we expect $\beta_2 > 0$ and $\delta_4 > 0$. This framework also enables us to assess whether relative openness is what effectively matters in the data by testing the restrictions $\beta_1 + \beta_2 = 0$ and $\delta_3 + \delta_4 = 0$.

Our theory also has precise implications on the importance of firm dynamics and on relative market size, both at home and abroad. In the short run, the number of domestic firms affects prices negatively ($\beta_3 < 0$), while its foreign counterpart acts to increase domestic inflation ($\beta_4 > 0$). Equation (12) suggests coefficients should however not be equal. Market size should affect the long run dynamics of relative prices: the size of the domestic economy affects growth in relative prices negatively if $\delta_1 > 0$, and a large foreign market should have the opposite effect ($\delta_2 < 0$) with the model requiring $\delta_1 + \delta_2 = 0$.

Equation (14) exactly captures our difference in differences approach. Prices (and all independent variables) are expressed in first differences - which accounts among others for the use of indices to measure some of our variables - and we identify differential effects across the same sector in different countries. As both equations (12) and (13) include terms in $\frac{c_M}{c^*_M}$ we also need to include intercepts for each country pair to control for cross country variations in technology.[10]

[10] We also experimented with an intercept that varies per sector and per year, reasoning that the technological frontier may be sector-specific and time varying. All our results carry through, even more strongly in most cases.

3.3 Mark Ups

In our model, relative international markups depend directly on $\frac{c_D}{c_D^*}$, just as prices do. The theory therefore implies the following analogous equation to (14)

$$\begin{aligned}\Delta \ln \left(\frac{\bar{\mu}_{it}}{\bar{\mu}_{it}^*}\right) &= \beta_0 + \beta_1 \, \Delta \ln \theta_{it} + \beta_2 \, \Delta \ln \theta_{it}^* + \beta_3 \, \Delta \ln D_{it} + \beta_4 \, \Delta \ln D_{it}^* \\ &\quad + \gamma \, \{\ln \left(\frac{\bar{\mu}_{it-1}}{\bar{\mu}_{it-1}^*}\right) + \delta_0 + \delta_1 \, \ln L_{t-1} + \delta_2 \, \ln L_{t-1}^* \\ &\quad + \delta_3 \, \ln \theta_{it-1} + \delta_4 \, \ln \theta_{it-1}^* \} + \epsilon_{ijt} \qquad (15)\end{aligned}$$

3.4 Productivity

Our model is written in terms of unit costs, c, but under relatively mild assumptions we can derive implications for labor productivity, which enables a more direct comparison with other studies. Let z denote average sectoral labor productivity. We approximate $\bar{c} = w/z$, where w denotes nominal wages at the sector level. In so doing we are implicitly assuming away differences in capital costs. With mainstream theories of international trade based around variations in factor intensity this is a non-trivial assumption, opening the door for the possibility that any role we find for openness in influencing productivity may just reflect an omitted variable bias due to capital costs. However, while differences in factor intensity will undoubtedly produce more trade between countries it should not necessarily produce a positive relationship between productivity and openness. Our results would require that factor intensity varies in the *same* sector across countries in a manner that correlates highly with openness.[11] In addition, while factor intensity issues may affect interpretation of our productivity results it does not necessarily do the same for prices, and even less for margins or market structure. Further, given that our firms represent a cross section of European manufacturing we might also expect variations in capital intensity to be limited. This is confirmed in Section 7 where amongst

[11] The Heckscher-Ohlin view of international trade implies capital-rich countries (such as the EU) specialize in capital intensive sectors. As specialization occurs, labor intensive industries contract as imports take over. The decline in labor intensive industries will also lower wages and help lower prices in these sectors. Therefore we could see systematically rising import shares and falling prices in a number of sectors with shrinking domestic production. But this will only happen if stark enough international differences in factor intensity exist across countries to motivate international specialization in production. In addition, this would only explain a negative correlation between prices and import shares in the receiving economy. In the exporting economy, prices and import shares will be positively correlated.

our robustness tests we present results including measures of capital intensity in our estimation.

Assuming unit labor costs depend only on wages we have

$$\frac{z}{z^*} \equiv \frac{w}{w^*}\frac{\bar{c}^*}{\bar{c}} = \frac{w}{w^*}\frac{c_D^*}{c_D}$$

Perfect labor mobility between firms in a same sector implies $\frac{z_M}{z_M^*} = \frac{w}{w^*}\frac{c_M^*}{c_M}$, where z_M and z_M^* denote productivity in the least competitive firm for each sector. Using equation (12), we can derive an expression for relative labor productivity in the short run as

$$\left(\frac{z}{z^*}\right)^k = \left(\frac{z_M}{z_M^*}\right)^k \frac{(\bar{N}_{SR}/N)}{(\bar{N}_{SR}^*/N^*)} \frac{1+\frac{\bar{N}_{SR}^*}{\bar{N}_{SR}}\frac{\theta}{1-\theta}}{1+\frac{\bar{N}_{SR}}{\bar{N}_{SR}^*}\frac{\theta^*}{1-\theta^*}}$$

where international relative wages are subsumed in $\frac{z_M}{z_M^*}$, a measure of each country's relative distance from the productivity frontier. A rise in domestic openness boosts domestic productivity through a truncation effect on less productive domestic producers. This effect of openness is conditional upon $\bar{N}_{SR}/N$ which as before we approximate with D, the number of domestically producing firms, which we observe. As in Figure 1, increases in the number of domestic firms leads to a fall in c_D and a rise in productivity. Ceteris paribus, foreign openness and the number of foreign firms have the opposite impact.

Using Equation (13) in the definition for relative productivity implies that in the long run

$$\left(\frac{z}{z^*}\right)^{k+2} = \left(\frac{w}{w^*}\right)^2 \frac{L}{L^*}\left(\frac{z_M}{z_M^*}\right)^k \frac{1-\frac{\theta}{1-\theta}}{1-\frac{\theta^*}{1-\theta^*}}$$

Productivity is highest in the larger economy (L) but responds negatively to increases in domestic openness due to relocation effects. The size of the foreign market, and foreign openness have the opposite effects. Taking into account both short and long run effects,

$$\begin{aligned}\Delta \ln\left(\frac{z_{it}}{z_{it}^*}\right) &= \beta_0 + \beta_1\ \Delta\ln\theta_{it} + \beta_2\ \Delta\ln\theta_{it}^* + \beta_3\ \Delta\ln D_{it} + \beta_4\ \Delta\ln D_{it}^* \\ &\quad +\gamma\ \{\ln\left(\frac{z_{it-1}}{z_{it-1}^*}\right) + \delta_0 + \delta_1\ \ln L_{t-1} + \delta_2\ \ln L_{t-1}^* + \delta_3\ \ln\theta_{it-1} \\ &\quad +\delta_4\ \ln\theta_{it-1}^* + \delta_5\ \ln w_{it-1} + \delta_6\ \ln w_{it-1}^*\} + \eta_{ijt} \qquad (16)\end{aligned}$$

The short term effects of domestic openness on domestic productivity are positive ($\beta_1 > 0$), but revert in the long run ($\delta_3 > 0$). The exact opposite is true of foreign openness ($\beta_2 < 0$, $\delta_4 < 0$). The number of domestic firms increases relative domestic productivity in the short run ($\beta_3 > 0$), the number of foreign firms does the exact opposite ($\beta_4 < 0$). Market size matters in the long run. Domestic and foreign coefficients should be equal as regards openness and market size in the long run, but not for the number of firms in the short run. In addition, relative wages enter only in the long run.

4 Econometric Issues

4.1 Stationarity

In order to effectively discriminate between the short and long run implications of trade openness our approach requires that our key variables be non-stationary in a unit root sense. In Table 3 we provide the results of a battery of panel unit root tests used to investigate the hypothesis of non-stationarity in international relative prices, relative openness and relative productivity. All these variables are measured at the sector level, and for all possible pairs of countries in our data, but only over ten years. Given the limited time dimension of our panel we implement the procedure described in Im, Pesaran and Shin (2003), which allows for individual unit root processes, and augment it with the possibility that residuals be correlated across sectors of a same country, as proposed in Pesaran (2003). In addition, we also present the results of the tests proposed by Hadri (2000) and Levin, Lin and Chu (2002). In almost all cases we fail to reject the presence of a unit root in relative prices, productivity and openness, whether the process is assumed to be common across individuals or not, and whether we allow for the inclusion of deterministic trends or not. These results support the error correction formulation in our estimated equations. In what follows, we estimate our equations with and without the error correction terms.

4.2 Lagged Dependent Variables

We have used our error correction formulation to disentangle the short and long run response of variables to openness. Our model is however silent on how long the short run lasts and how long the dynamics to the long run take to complete. To alleviate this problem we introduce lagged dependent variables into our estimation. Reassuringly our main results are robust to the inclusion or otherwise of lagged dependent variables. In dealing with dynamics in this way we create the well known problem of estimating within-group equations with a lagged dependent variable. In our sensitivity analysis, we verify that our conclusions withstand the induced bias by using the proper GMM estimators introduced by Arellano and Bond (1991).

4.3 Nominal Prices

Our model is one of *real* relative prices at the sector level. However, prices in general are influenced by aggregate nominal developments, which are distinct from the pro-competitive effects of openness we are seeking to evaluate. Empirically however, aggregate influences on prices may well correlate significantly with openness, as exemplified by the mechanism stressed in Romer (1993). It is important to purge these effects from the estimates we obtain here. Our disaggregated approach makes this readily possible, under the hypothesis that aggregate monetary shocks affect all sectors homogeneously. To fix ideas, we augment the expression (14) with measures of aggregate price indices P for each country, as follows

$$\begin{aligned} \Delta \ln \left(\frac{\bar{p}_{it}}{\bar{p}^*_{it}} \right) &= \beta_0 + \beta_1 \, \Delta \ln \theta_{it} + \beta_2 \, \Delta \ln \theta^*_{it} + \beta_3 \, \Delta \ln D_{it} + \beta_4 \, \Delta \ln D^*_{it} \\ &+ \beta_5 \, \Delta \ln \left(\frac{P_t}{P^*_t} \right) + \gamma \, \{ \ln \left(\frac{\bar{p}_{it-1}}{\bar{p}^*_{it-1}} \right) + \delta_0 + \delta_1 \, \ln L_{t-1} + \delta_2 \, \ln L^*_{t-1} \\ &+ \delta_3 \, \ln \theta_{it-1} + \delta_4 \, \ln \theta^*_{it-1} + \delta_5 \, \ln \left(\frac{P_{t-1}}{P^*_{t-1}} \right) \} + \xi_{ijt} \end{aligned} \qquad (17)$$

Adding aggregate prices in this manner implicitly assumes that monetary influences have relatively homogeneous effects across sectors or, more precisely, that if some heterogeneity exists it is uncorrelated with openness. Peersman and Smets (2005) find that it is durability or the existence of financial constraints that are most important in explaining the differential effects of monetary policy across sectors, rather than openness.

4.4 Endogeneity

The key variable in our model is τ, reflecting trade costs. In our empirical strategy we substitute import shares for τ. However, import penetration θ is an endogenous variable reflecting the influence of potentially many factors. For instance, consumers in high price economies will respond by buying imports, which leads to a *positive* bias for our estimates of the effect of openness on prices. Issues may also arise for the relation between productivity and openness. Firms in low productivity sectors may lobby for protectionism, which leads to a *positive* bias in the estimate of openness on productivity. We have to use instrumental variables. We first instrument import shares with a measure of the "bulkiness" of the goods imported.[12] While cross-sectional variation in imports is affected by their weight, it is unclear how bulkiness could affect sector productivity or competitiveness. Second, we build on the large literature explaining trade flows with so called "gravity" variables. We instrument import penetration in sector i and into country j with a weighted average of output shares of sector i in all other countries in our sample, where weights are given by geographic distance. In particular, we compute

$$Gravity_{ijt} = \frac{y_{ijt}/Y_{jt}}{\sum_{k\neq j} \varpi_{jk}\ y_{ikt}/Y_{kt}}$$

where ϖ_{jk} denotes the (inverse of) the geographic distance between countries j and k. The intuition is straightforward: country j will tend to import goods i from country k if (i) the share of sector i is relatively smaller in country j, (ii) country k is relatively close.[13] In other words, low values of $Gravity_{ijt}$ lead to a higher import share.

Our third instrument uses sectoral information on transport costs. The trade data we use reports both bilateral import and export flows, whose ratio gives an indication of transport costs, as the former include "Costs, Insurance and Freight", whereas the latter are typically registered "Free On Board".[14] We also include some measure of pan-European changes in trade policy, such as a binary variable capturing the advent of the Single Market in 1992 and the re-entry of the Lira in the European Monetary System in

[12] The measure is the ratio of the imports weight (in tons) to their value. This approach follows Hummels (2001).

[13] The set of countries k includes: Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Mexico, the Netherlands, Norway, South Korea, Spain, Sweden, the United Kingdom and the US.

[14] These data are too noisy to be used as direct proxies for τ or τ^*. For instance, Harrigan (1999) recommends averaging observed values for each sector across countries to minimize measurement error.

1996. Taken together, these three instruments explain approximately 40 percent of the variation in import shares.

5 Data

Our database covers the period 1989 to 1999 for 7 European Union countries and 10 manufacturing sectors. We use for our price data domestic manufacturing production prices, as measured by factory gate prices in national currency. The source for this data is Eurostat, the Statistical Office of the European Commission. Price indices are available for most European Union countries between 1980 and 2001, and disaggregated at the two-digit NACE (revision 1) level.[15] We normalize all indices to equal 100 in 1995. Eurostat also collects data on total and bilateral exports and imports for manufacturing industries (in thousand Ecus), together with their corresponding weight (in tons), available at the four-digit NACE (revision 1) level. The data run between 1988 and 2001 for twelve EU countries. To achieve consistency with our price data we aggregate this trade data to the two-digit level.

To construct estimates of markups we use the Bank for the Accounts of Companies Harmonized (BACH) database, which contains harmonized annual account statistics of non-financial enterprises in eleven European countries, Japan and the US.[16] Data are available annually between 1980 and 2002 are broken down by major sector and firm size. We focus on seven EU countries: Belgium, Denmark, France, Germany, Italy, the Netherlands and Spain. To compute markups in sector i, country j and year t, one would ideally need data on prices and marginal costs. Marginal costs are hard to observe. We follow a considerable literature in Industrial Organization and measure (average) markups using information on variable costs only.[17] We compute

$$\mu_{ijt} = \left[\frac{turnover_{ijt}}{total\ variable\ costs_{ijt}}\right] = \left[\frac{unit\ price_{ijt}}{unit\ variable\ cost_{ijt}}\right]$$

where total variable costs are computed as the sum of the costs of materials, consumables and staff costs. We exclude fixed costs to avoid any biases in estimating markups. As

[15] NACE (revision 1) is the General Industrial Classification of Economic Activities within the European Union.

[16] The data are available at http://europa.eu.int/comm/economy_finance/indicators/bachdatabase_en.htm.

[17] See, *inter alia,* Conyon and Machin (1991a,b).

trade costs fall, an increase in the number of foreign firms will lead to falling market share for domestic producers and a rise in average total costs, as fixed costs are spread across a smaller level of production. This will generate a negative bias between measured markups and openness. In order to ensure consistency between our two- and three- digit NACE price indices and the BACH cost data we aggregate up the price data, as described in the Appendix.[18]

The value of exports and imports, together with their tonnage, are also aggregated across NACE industries into their BACH equivalent. To compute openness (as the share of imports into effective consumption) we use the BACH database. We construct output through the definition that value added equals the value of turnover, plus or minus the changes in stocks of finished products, work in progress and goods and services purchased for resale, plus capitalized production and other operating income. Our measure of openness is then the ratio of imports relative to the sum of imports and sectoral output net of exports.

Labor productivity is calculated as the ratio between real value-added and total employment, as provided by the OECD. We use value-added and employment data from Eurostat in the few cases where BACH sectors are not reported in the OECD data. The number of firms is directly taken from the BACH database. The value of GDP is from the OECD *Economic Outlook* as are the consumer prices we use as our measure of aggregate prices. In total we observe five sectors in Belgium, Denmark and the Netherlands, eight in Germany, seven in Spain and four in France and in Italy. Sectoral output values (at the ISIC revision 3 level) used to calculate our gravity instrument, are taken from the OECD STAN database (in millions of units of national currency). Bilateral distances (in kilometers) are calculated based on the "great circle distance" formula due to Fitzpatrick and Modlin (1986).

We present summary statistics in Tables 1 and 2. Our measure of sectoral inflation is highest in Spain and Italy, and lowest in France, where a few sectors saw their relative prices fall. Denmark is the least open of our European economies on the basis of the import share of production, while the Netherlands and Spain are particularly open. The most open of our sectors is Textiles, followed by Machinery. Productivity is highest in France and lowest in Spain, and highest in Chemicals and lowest in Textiles. Our markup data suggest margins are lowest on average in Belgium, and highest in Denmark,

[18] We weight each NACE sub-sector by its share in GDP.

the country that is least open in our sample. Markups range between 0.7 and 73.6 percent. They are highest on average in Non-Metallic Minerals. Table 3 suggests import penetration increased most in Belgium, while it actually fell in Italy, indeed across most of the sectors we observe. In terms of sectors, openness increased most in Office Machinery, followed by Chemicals, and least in Rubber Products and Furniture. Figure 3 illustrates the cross-section of interest, where we plot the behavior of import penetration over time for our nine sectors. Two things are apparent from the Figure. First, some sectors opened up more than others. Second, within each sector, some countries opened up more than others. Both dimensions achieve identification, in that we conjecture that cross-country differences in the extent of openness at the level of a given sector ought to have differential effects on productivity, margins and prices.

6 Empirical Results

We focus first on the short run results, estimated on first differences only. Under non-stationarity, these are consistent but not efficient. We then include error correction terms, and investigate the validity of the reversal implied by theory.

6.1 Short Run

Tables 4, 5 and 6 present our results on the effects of openness on prices, productivity and markups, respectively. The theoretical counterparts to our estimations are equations (17), (15) and (16), without an error correction term. We have implemented the difference in differences approach on all available country pairs in our sample. All three tables first present results under Ordinary Least Squares, and then instrument openness. We also investigate the importance of lagged dependent variables and constrain some of the coefficients of interest to be equal across countries, as implied by theory.

Table 4 focuses on the price effects of openness in the short run. We first investigate the relation between relative prices and import penetration, conditional on the number D of firms effectively based in each economy. The signs are as predicted, and almost always significant. Columns (2), (3) and (4) include relative openness, relative aggregate prices and lagged dependent variables, respectively. First, domestic and foreign openness have opposite signs that are significant and consistent with theory. In other words, domestic openness affects domestic prices negatively, whereas foreign openness affects them positively. The result stands when controls for aggregate price dynamics and sluggish price adjustments are included, and indeed strengthen both in terms of significance and magnitude. Interestingly, tests of coefficient equality in columns (1) to (3) suggest that perfect symmetry in the effects of domestic and foreign openness cannot be rejected at standard confidence levels. By contrast the impact of number of firms is not symmetric, as implied by theory.[19] Column (4) constrains the coefficients on import penetration to be the same internationally, and includes relative openness, the relative number of firms and relative aggregate prices. This tends to sharpen the results. The last three columns of the Table introduce the instruments for openness, with or without lagged dependent variables, and with or without controls for aggregate prices. All conclusions stand.

Table 5 focuses on productivity, based on equation (16). OLS results are strong. Domestic openness increases domestic productivity, foreign openness acts to diminish it. What is more, it is impossible to reject equality between the two coefficients (in absolute value), as predicted by the theory. By the same token the number of domestic firms also acts (conditionally) to increase productivity, and vice versa as regards the foreign market structure. Coefficient equality is however strongly rejected, as per our model. Columns (4) and (5) present our Instrumental Variables results, which confirm all these conclusions.[20]

Table 6 introduces markups as a dependent variable, as per equation (15). Once again, OLS results are strong: domestic openness acts to reduce profit margins, the opposite is true of foreign openness, both coefficients are not significantly different. By the same token, the number of domestic firms has a pro-competitive effects on margins,

[19] The former can be rejected at the 39% confidence level, whereas the latter at the 13% level only.

[20] It is possible that significant effects of openness on productivity might arise from the availability of cheap foreign intermediate goods, whose import could act to increase θ_{it}. There are several reasons why this cannot account for our findings. The first is that we also find an effect of openness on markups, which cannot be explained through increases in intermediate inputs. In addition, imported intermediate goods cannot possibly account for the effects of foreign openness on domestic productivity, nor the reversal we find at long horizons. Finally, it may be that intermediate goods are obtained cheaply because of movements in the nominal exchange rate rather than for differences in production efficiency. That would, for instance, happen if imports were priced in the exporter's currency, and it would imply that movements in the nominal exchange rate affect relative productivity, and therefore relative prices. In our sensitivity analysis we verify that the inclusion of nominal exchange rates in equation (15) affects none of our results.

the number of foreign firms has the opposite impact, but the coefficients are significantly different. The results strengthen under IV estimations.

6.2 Long Run

Tables 7, 8 and 9 report the results corresponding to equations (17), (16) and (15), respectively, where we now include error correction terms. The inclusion of error correction terms enables us to estimate the long run impact of trade liberalization and in particular whether the model's implication of a reversal is supported in the data.

Estimates of equation (17) are shown in Table 7.[21] The short run results that relative openness (and the relative number of firms) have pro-competitive effects on prices continues to obtain albeit at somewhat weaker significance levels. The Table is interesting for two reasons. First, there is a reversal of the effects of relative openness on prices. In the long run, domestic openness exerts an upward pressure on relative prices, whereas it is now foreign openness that acts negatively on relative prices. This is a direct vindication of the theory, which is statistically significant in our specifications. Second, market size (measured here by real GDP) enters the estimation with the coefficients predicted by theory: a relatively large economy tends to have relatively low prices. What is more, the coefficients are not remotely significantly different. These conclusions all stand (and indeed strengthen) when we instrument.

Table 8 summarizes the results that pertain to equation (16). Once again, the short run pro-competitive effect of relative openness (and the relative number of firms) on relative productivity stand, significantly so in almost all cases. As with the relative price equation, the data show evidence of a reversal at longer horizon. Relative productivity apparently falls in the long run in the wake of trade liberalization, i.e. falls in relative openness. Relative market size also enters with signs that are consistent with theory and significant.

Finally, markups are examined in Table 9. Once more, pro-competitive effects on margins continue to obtain in the short run even once error correction terms are included,

[21] To conserve space we no longer quote p-values for testing the coefficient restrictions on domestic and foreign variables. These are available upon request but, as in Tables 4, 5 and 6, the restrictions are accepted.

and once again, there is (some) evidence of a reversal at long horizons. In the long run, domestic relative openness acts to increase margins, at least on the basis of our point estimates. In one out of four cases, the effect is still significant.[22]

7 Robustness

In this Section we review a number of alternative specifications and controls we implemented to ensure the stability of our results. First, we verify that including changes in nominal exchange rates does not alter our conclusions, as it would under some specific kinds of pricing to market or if intermediate inputs were captured in our import share measure. Second, we attempt to account directly for the possibility that some of our results could be accounted for by a simple Heckscher-Ohlin argument. If this mechanism were at work we should find that openness matters only through its interaction with factor endowments. To test this we augment our specifications with an interaction term between aggregate capital accumulation and sectoral capital shares. If openness remains significant, it suggests we are identifying a different effect than Hecksher-Ohlin. Finally, we implement the GMM estimator proposed by Arellano and Bond (1991) to account for the fact that we run a fixed effect estimation with lagged dependent variables. The results of these exercises are shown in Appendix B, C and D respectively. In all cases our results remain intact.

Two further extensions are worth mentioning. Firstly we estimate the impact of openness focusing just on deviations from a benchmark economy, rather than all possible bilateral pairs as previously. Although this lessens substantially the number of observations it helps reduce measurement error problems and offers a sharper treatment effect for our difference in differences approach. Measurement error, specific to a given economy j, would plague all bilateral pairs that involve country j and potentially contaminate our results. In addition, we choose as our benchmark a country (Italy) where trade did not increase as much as in the rest of our sample across all sectors. Assuming this lack of openness reflects macroeconomic factors that are external to each sector's price dynamics (for instance exchange rate policies), the Italian benchmark may provide

[22] Long run estimates are only valid if the explanatory variables are cointegrated. Applying the seven tests suggested by Pedroni (1999) provides strong support for cointegration, although the variance and Phillips-Perron ρ test provide some evidence to the contrary.

us with a classic treatment sample. As shown in Appendix E our results remain little changed although the significance of the reversal effect diminishes.

We consider whether the impact of increased imports depends on their origin, in particular whether EU imports exert a more significant competitive impact than non-EU imports. During the period covered by our sample, the EU Single Market was established and EU imports could constitute closer substitutes for domestic production than non-EU imports. In all cases we were able to accept at standard significance levels the hypothesis that EU and non-EU imports have the same short and long run effects in our price, productivity and markup equations. Although EU imports may have increased more rapidly than non-EU imports the estimated elasticities do not differ by import origin.

Our focus throughout has been on the microeconomic channels through which increased competition impacts on manufacturing industry. We can also use our results to gauge the direct impact that greater trade openness has had on inflation during the 1990s. To assess the contribution of greater openness we consider once again the case of Italy - the country with the smallest average increase in openness. We use our estimates to evaluate what would have happened to changes in Italian manufacturing prices if Italy had experienced an increase in openness equal to our sample's average. The annual impact of this change would have lowered Italian manufacturing inflation by 0.1 percent. Had Italy experienced the largest increase in openness recorded in our sample it would have reduced price increases by 0.33 percent per annum. Given that the sectors in our sample only account for around 9 percent of GDP these estimates suggest that increased openness has only had a minor role in the reduction of European inflation.

8 Conclusion

We present a theory where openness has pro-competitive effects. We set up the model in a way that is directly amenable to empirical testing, and in particular to a difference in differences estimation. We show how it is relative openness (and relative firm dynamics) that affect relative prices, relative productivity and relative profit margins across the same sector in different countries. This focus on relative openness means that our estimated effects are distinct from alternative explanations based on traditional trade theory or the aggregate impact of openness on inflation, and emphasize the pro-competitive effects of trade in a model with heterogeneous firms. We find strongly supportive evidence of the pro-competitive effects of relative openness in the short run: domestic import penetration tends to lower price inflation, accelerate productivity and reduce profit margins. We interpret this evidence as the empirical counterpart to the increased competition induced by foreign firms entering the domestic market as a result of diminished trade costs.

A number of additional predictions of the theory are supported by the data. We find strong effects of foreign import penetration on relative prices, productivity and margins, and significant roles for firm dynamics and market sizes. Interestingly, we uncover some evidence supporting the well known notion of tariff jumping, whereby firms are attracted to relocating in protected economies. This is often conjectured to result in anti-competitive effects of (relative) openness, as firms exit, margins and prices increase while productivity falls. Both this reversal effect and our estimated elasticities suggest that whilst increased trade has had a significant effect on European productivity the end impact on prices is relatively small. The direct effect of competition on prices cannot offer much explanation for the fall in European inflation, which must therefore be due to macroeconomic phenomena rather than the microeconomic mechanism that is our focus.

Appendix A

BACH sector groupings used in the paper and correspondence with NACE (revision 1) industries

BACH	NACE	Sector
211	13.0	Metal ores
	27.1	Basic iron & steel
	27.2	Tubes
	27.3	Other first processing of basic iron & steel
	27.4	Basic precious & non-ferrous metals
212	14.0	Mining & quarrying
	26.0	Other non-metallic mineral products
213	24.0	Chemicals & chemical products
221	27.5	Casting of metals
	28.0	Fabricated metal products (except machinery & equipment)
	29.1	Machinery for the production & use of mechanical power
	29.2	Other general purpose machinery
	29.3	Agricultural & forestry machinery
	29.4	Machine-tools
	29.5	Other special purpose machinery
	29.6	Weapons & ammunition
	33.0	Medical, precision & optical instruments
222	30.0	Office machinery & computers
	31.0	Electrical machinery & apparatus
	32.0	Radio, television & communication equipment
	29.7	Domestic appliances
223	34.0	Motor-vehicles, trailers & semi-trailers
	35.0	Other transport equipment
231	15.0	Food products & beverages
	16.0	Tobacco products
232	17.0	Textiles
	18.0	Wearing apparel; dressing & dyeing of fur
	19.0	Tanning & dressing of leather; luggage, handbags
233	20.0	Wood & products of wood & cork, excl. furniture
	21.0	Pulp, paper & paper products
	22.0	Publishing, printing & reproduction of recorded media
234	25.0	Rubber & plastic products
	36.0	Furniture

Appendix B

Nominal Exchange Rates

Short Run

Table B1: Prices (Short Run), all country pairs, sector-specific nominal exchange rates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	OLS	OLS	OLS	IV	IV	IV
$\Delta \ln \frac{\overline{p}_{it-1}}{\overline{p}^*_{it-1}}$	–	–	0.066 (1.963)	0.066 (1.978)	–	–	0.072 (2.070)
$\Delta \ln \theta_{it}$	−0.013 (−1.202)	−0.022 (−2.002)	−0.035 (−3.400)	–	–	–	–
$\Delta \ln \theta^*_{it}$	0.009 (0.989)	0.019 (1.995)	0.025 (2.701)	–	–	–	–
$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	–	–	–	−0.029 (−4.231)	−0.056 (−1.764)	−0.056 (−1.830)	−0.073 (−2.675)
$\Delta \ln D_{it}$	0.007 (0.637)	−0.008 (−0.720)	−0.016 (−1.474)	−0.014 (−1.329)	−0.014 (−1.037)	−0.016 (−1.223)	−0.023 (−1.914)
$\Delta \ln D^*_{it}$	0.000 (−0.107)	0.002 (1.413)	0.002 (1.584)	0.003 (1.839)	0.007 (2.716)	0.005 (1.893)	0.005 (2.431)
$\Delta \ln P_t$	–	0.449 (5.542)	0.518 (6.518)	0.521 (6.576)	–	0.428 (5.081)	0.489 (5.831)
$\Delta \ln P^*_t$	–	−0.424 (−5.029)	−0.584 (−6.865)	−0.577 (−6.825)	–	−0.406 (−4.725)	−0.534 (−5.885)
N	800	800	720	720	800	800	720

Notes: Country/industry fixed effects are included in all regressions. We cannot reject the hypothesis that the coefficients on domestic and foreign variables are equal. In (5) to (7) instruments for openness include weight-to-value, weighted distance, cif/fob and 1992 and 1996 dummies. Industry-specific bilateral nominal exchange rates are included in all regressions.

Long Run

Table B2: Prices (Long Run), all country pairs, sector-specific nominal exchange rates

	(1)	(2)	(3)	(4)
	OLS	OLS	IV	IV
$\Delta \ln \frac{\overline{p}_{it-1}}{\overline{p}^*_{it-1}}$	–	–	–	0.023 (0.642)
$\Delta \ln \theta_{it}$	−0.007 (−0.814)	–	–	–
$\Delta \ln \theta^*_{it}$	0.003 (0.406)	–	–	–
$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	–	−0.006 (−0.923)	0.013 (0.396)	−0.026 (−0.675)
$\Delta \ln D_{it}$	0.005 (0.557)	−0.001 (−0.105)	−0.004 (−0.320)	−0.009 (−0.725)
$\Delta \ln D^*_{it}$	−0.001 (−0.837)	0.001 (0.706)	0.001 (0.320)	0.004 (1.239)
$\Delta \ln P_t$	0.721 (5.386)	0.641 (6.592)	0.744 (6.892)	0.598 (3.916)
$\Delta \ln P^*_t$	−0.624 (−4.072)	−0.853 (−6.843)	−0.886 (−5.870)	−0.761 (−4.372)
$\ln \frac{\overline{p}_{it-1}}{\overline{p}^*_{it-1}}$	−0.484 (−17.465)	−0.451 (−18.419)	−0.397 (−13.025)	−0.382 (−9.322)
$\ln \theta_{it-1}$	0.011 (1.628)	–	–	–
$\ln \theta^*_{it-1}$	−0.003 (−0.410)	–	–	–
$\ln \frac{\theta_{it-1}}{\theta^*_{it-1}}$	–	0.012 (2.423)	0.056 (4.408)	0.052 (3.779)
$\ln L_{t-1}$	−0.101 (−2.952)	–	–	–
$\ln L^*_{t-1}$	0.054 (1.664)	–	–	–
$\ln \frac{L_{t-1}}{L^*_{t-1}}$	–	−0.069 (−6.687)	−0.070 (−6.223)	−0.070 (−5.063)
$\ln P_{t-1}$	0.310 (6.486)	0.301 (9.951)	0.289 (8.268)	0.244 (3.555)
$\ln P^*_{t-1}$	−0.283 (−5.469)	−0.352 (−10.100)	−0.354 (−8.364)	−0.314 (−4.284)
N	800	800	800	720

Notes: Country/industry fixed effects are included in all regressions. We cannot reject the hypothesis that the coefficients on domestic and foreign variables are equal. In (3) and (4) instruments for openness include weight-to-value, weighted distance, cif/fob and 1992 and 1996 dummies. L_t denotes (real) GDP. Industry-specific bilateral exchange rates are included in all regressions.

Appendix C

Factor Endowments

Short Run

Table C1: Prices (Short Run), all country pairs, controlling for factor endowments

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	OLS	OLS	OLS	IV	IV	IV
$\Delta \ln \frac{\overline{p}_{it-1}}{\overline{p}^*_{it-1}}$	–	–	0.061 (1.849)	0.061 (1.868)	–	–	0.070 (2.020)
$\Delta \ln \theta_{it}$	−0.021 (−1.949)	−0.021 (−1.995)	−0.034 (−3.442)	–	–	–	–
$\Delta \ln \theta^*_{it}$	0.021 (2.147)	0.015 (1.550)	0.021 (2.274)	–	–	–	–
$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	–	–	–	−0.027 (−3.995)	−0.055 (−1.703)	−0.057 (−1.836)	−0.074 (−2.674)
$\Delta \ln D_{it}$	−0.008 (−0.718)	−0.007 (−0.662)	−0.016 (−1.581)	−0.014 (−1.385)	−0.017 (−1.276)	−0.017 (−1.304)	−0.024 (−2.019)
$\Delta \ln D^*_{it}$	0.004 (2.476)	0.001 (0.729)	0.002 (1.032)	0.002 (1.346)	0.006 (2.553)	0.004 (1.553)	0.005 (2.162)
$\Delta \ln P_t$	–	0.500 (6.318)	0.534 (6.870)	0.539 (6.951)	–	0.478 (5.731)	0.499 (5.983)
$\Delta \ln P^*_t$	–	−0.584 (−6.989)	−0.686 (−8.225)	−0.677 (−8.167)	–	−0.545 (−6.296)	−0.621 (−6.767)
$\Delta \ln \alpha_{it}$	0.457 (3.885)	0.568 (4.975)	0.519 (4.860)	–	–	–	–
$\Delta \ln \alpha^*_{it}$	−0.558 (−3.948)	−0.728 (−5.195)	−0.509 (−3.856)	–	–	–	–
$\Delta \ln \frac{\alpha_{it}}{\alpha^*_{it}}$	–	–	–	0.513 (5.750)	0.476 (4.720)	0.599 (5.934)	0.470 (4.910)
N	800	800	720	720	800	800	720

Notes: Country/industry fixed effects are included in all regressions. We cannot reject the hypothesis that the coefficients on domestic and foreign variables are equal. In (5) to (7) instruments for openness include weight-to-value, weighted distance, cif/fob and 1992 and 1996 dummies. α_{it} denotes an interaction term between aggregate capital stock and sectoral capital shares.

Long Run

Table C2: Prices (Long Run), all country pairs, controlling for factor endowments

	(1)	(2)	(3)	(4)
	OLS	OLS	IV	IV
$\Delta \ln \frac{\overline{p}_{it-1}}{\overline{p}^*_{it-1}}$	–	–	–	0.058 (1.582)
$\Delta \ln \theta_{it}$	−0.012 (−1.365)	–	–	–
$\Delta \ln \theta^*_{it}$	−0.001 (−0.075)	–	–	–
$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	–	−0.005 (−0.861)	0.019 (0.576)	−0.038 (−0.984)
$\Delta \ln D_{it}$	−0.008 (−0.812)	−0.005 (−0.571)	−0.004 (−0.316)	−0.014 (−1.184)
$\Delta \ln D^*_{it}$	0.000 (−0.208)	0.000 (0.123)	0.000 (−0.191)	0.003 (1.272)
$\Delta \ln P_t$	0.678 (6.678)	0.679 (6.946)	0.754 (7.057)	0.626 (3.924)
$\Delta \ln P^*_t$	−0.958 (−7.569)	−0.949 (−7.626)	−0.982 (−6.374)	−0.771 (−4.334)
$\Delta \ln \alpha_{it}$	0.355 (3.319)	–	–	–
$\Delta \ln \alpha^*_{it}$	−0.420 (−3.105)	–	–	–
$\Delta \ln \frac{\alpha_{it}}{\alpha^*_{it}}$	–	0.377 (4.315)	0.313 (3.287)	0.292 (2.616)
$\ln \frac{\overline{p}_{it-1}}{\overline{p}^*_{it-1}}$	−0.413 (−17.192)	−0.412 (−17.206)	−0.375 (−13.201)	−0.359 (−9.527)
$\ln \theta_{it-1}$	0.014 (2.036)	–	–	–
$\ln \theta^*_{it-1}$	−0.011 (−1.893)	–	–	–
$\ln \frac{\theta_{it-1}}{\theta^*_{it-1}}$	–	0.012 (2.515)	0.044 (3.523)	0.038 (2.774)
$\ln L_{t-1}$	−0.046 (−3.528)	–	–	–
$\ln L^*_{t-1}$	0.048 (3.864)	–	–	–
$\ln \frac{L_{t-1}}{L^*_{t-1}}$	–	−0.047 (−4.400)	−0.049 (−4.343)	−0.050 (−3.313)
$\ln P_{t-1}$	0.311 (10.154)	0.310 (10.286)	0.302 (8.781)	0.266 (3.539)
$\ln P^*_{t-1}$	−0.367 (−10.205)	−0.367 (−10.536)	−0.370 (−8.849)	−0.320 (−4.123)
$\ln \frac{P_{t-1}}{P^*_{t-1}}$	–	–	–	–
$\ln \alpha_{it-1}$	−0.009 (−0.236)	–	–	–
$\ln \alpha^*_{it-1}$	−0.019 (−0.621)	–	–	–
$\ln \frac{\alpha_{it-1}}{\alpha^*_{it-1}}$	–	0.006 (0.247)	0.006 (0.197)	0.003 (0.093)
N	800	800	800	720

Notes: Country/industry fixed effects are included in all regressions. We cannot reject the hypothesis that the coefficients on domestic and foreign variables are equal except for the coefficients on domestic and foreign CPIs. In (3) and (4) instruments for openness include weight-to-value, weighted distance, cif/fob and 1992 and 1996 dummies. L_t denotes (real) GDP. α_{it} denotes an interaction term between aggregate capital stock and sectoral capital shares.

Appendix D

Arellano-Bond

Short Run

Table D1: Prices, Short Run Arellano-Bond estimations, all country pairs

	(1)	(2)	(3)
$\Delta \ln \frac{\overline{p}_{it-1}}{\overline{p}^*_{it-1}}$	0.382 (13.472)	0.370 (12.920)	0.353 (12.768)
$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	−0.076 (−8.122)	−0.078 (−7.934)	−0.069 (−7.630)
$\Delta \ln D_{it}$	−0.040 (−4.035)	−0.034 (−3.364)	−0.035 (−3.636)
$\Delta \ln D^*_{it}$	0.006 (4.412)	0.009 (5.648)	0.006 (4.133)
$\Delta \ln P_t$	0.469 (8.629)	0.464 (8.526)	0.492 (9.429)
$\Delta \ln P^*_t$	−0.622 (−11.808)	−0.552 (−9.925)	−0.717 (−13.347)
$\Delta \ln \frac{\alpha_{it}}{\alpha^*_{it}}$	–	–	0.502 (5.423)
N	720	720	720

Notes: Country/industry fixed effects are included in all regressions. Instruments for openness include weight-to-value, weighted distance, cif/fob and 1992 and 1996 dummies. The number of lagged dependent variables (one) is chosen in order to reject autocorrelation of order 2. In (2), industry-specific bilateral nominal exchange rates are included. In (3), α_{it} denotes an interaction term between aggregate capital stock and sectoral capital shares.

Table D2: Productivity and Markups, Short Run Arellano-Bond estimations, all country pairs

Productivity		Markups	
$\Delta \ln \frac{z_{it-1}}{z^*_{it-1}}$	0.371 (8.711)	$\Delta \ln \frac{\overline{\mu}_{it-1}}{\overline{\mu^*}_{it-1}}$	0.196 (4.742)
$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	0.089 (2.559)	$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	−0.066 (−5.548)
$\Delta \ln D_{it}$	0.207 (5.745)	$\Delta \ln D_{it}$	−0.072 (−6.699)
$\Delta \ln D^*_{it}$	−0.033 (−6.256)	$\Delta \ln D^*_{it}$	0.008 (4.666)
N	720	N	720

Notes: Country/industry fixed effects are included in all regressions. Instruments for openness include weight-to-value, weighted distance, cif/fob and 1992 and 1996 dummies. The number of lagged dependent variables (one) is chosen in order to reject autocorrelation of order 2.

Long Run

Table D3: Prices, Long Run Arellano-Bond estimations, all country pairs

Prices	(1)	(2)	(3)
$\Delta \ln \frac{\overline{p}_{it-1}}{\overline{p}^*_{it-1}}$	0.305 (11.722)	0.295 (11.280)	0.313 (12.308)
$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	−0.032 (−3.760)	−0.023 (−2.634)	−0.027 (−3.245)
$\Delta \ln D_{it}$	−0.008 (−0.966)	0.002 (0.267)	−0.012 (−1.359)
$\Delta \ln D^*_{it}$	0.004 (2.725)	0.004 (2.970)	0.002 (1.824)
$\Delta \ln P_t$	0.447 (4.811)	0.479 (5.108)	0.600 (6.394)
$\Delta \ln P^*_t$	−0.593 (−5.172)	−0.527 (−4.481)	−0.753 (−6.566)
$\Delta \ln \frac{\alpha_{it}}{\alpha^*_{it}}$	–	–	0.563 (6.133)
$\ln \frac{\overline{p}_{it-1}}{\overline{p}^*_{it-1}}$	−0.285 (−16.528)	−0.309 (−16.411)	−0.294 (−17.398)
$\ln \frac{\theta_{it-1}}{\theta^*_{it-1}}$	0.009 (2.328)	0.008 (2.141)	0.006 (1.566)
$\ln \frac{L_{t-1}}{L^*_{t-1}}$	−0.049 (−5.709)	−0.053 (−5.726)	−0.017 (−1.738)
$\ln P_{t-1}$	0.152 (4.599)	0.164 (4.887)	0.254 (7.021)
$\ln P^*_{t-1}$	−0.177 (−4.655)	−0.181 (−4.643)	−0.273 (−6.789)
$\ln \frac{\alpha_{it-1}}{\alpha^*_{it-1}}$	–	–	−0.013 (−0.712)
N	720	720	720

Notes: Country/industry fixed effects are included in all regressions. Instruments for openness include weight-to-value, weighted distance, cif/fob and 1992 and 1996 dummies. The number of lagged dependent variables (one) is chosen in order to reject autocorrelation of order 2. L_t denotes (real) GDP. In (2), industry-specific bilateral nominal exchange rates are included. In (3), α_{it} denotes an interaction term between aggregate capital stock and sectoral capital shares.

Table D4: Productivity and Markups, Long Run Arellano-Bond estimations, all country pairs

Productivity	(1)	Markups	(2)
$\Delta \ln \frac{z_{it-1}}{z^*_{it-1}}$	0.265 (8.279)	$\Delta \ln \frac{\overline{\mu}_{it-1}}{\overline{\mu}^*_{it-1}}$	0.263 (7.298)
$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	−0.003 (−0.093)	$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	−0.067 (−6.648)
$\Delta \ln D_{it}$	0.072 (2.020)	$\Delta \ln D_{it}$	−0.080 (−8.205)
$\Delta \ln D^*_{it}$	−0.025 (−5.274)	$\Delta \ln D^*_{it}$	0.006 (3.892)
$\ln \frac{z_{it-1}}{z^*_{it-1}}$	−0.240 (−11.359)	$\ln \frac{\overline{\mu}_{it-1}}{\overline{\mu}^*_{it-1}}$	−0.460 (−15.705)
$\ln \frac{\theta_{it-1}}{\theta^*_{it-1}}$	−0.017 (−1.094)	$\ln \frac{\theta_{it-1}}{\theta^*_{it-1}}$	−0.011 (−2.738)
$\ln \frac{L_{t-1}}{L^*_{t-1}}$	0.091 (3.190)	$\ln \frac{L_{t-1}}{L^*_{t-1}}$	−0.003 (−0.614)
$\ln \frac{w_{t-1}}{w^*_{t-1}}$	0.016 (0.894)	–	–
N	720		720

Notes: Country/industry fixed effects are included in all regressions. Instruments for openness include weight-to-value, weighted distance, cif/fob and 1992 and 1996 dummies. The number of lagged dependent variables (one) is chosen in order to reject autocorrelation of order 2. L_t denotes (real) GDP.

Appendix E

Long Run

Table E1: Prices (Long Run), benchmark is Italy

	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	IV	IV	GMM
$\Delta \ln \frac{\overline{p}_{it-1}}{\overline{p}^*_{it-1}}$	–	–	–	0.141 (1.164)	0.301 (5.005)
$\Delta \ln \theta_{it}$	−0.029 (−1.750)	–	–	–	–
$\Delta \ln \theta^*_{it}$	0.019 (1.087)	–	–	–	–
$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	–	−0.024 (−1.959)	−0.162 (−2.710)	−0.184 (−2.562)	−0.041 (−2.398)
$\Delta \ln D_{it}$	−0.024 (−1.718)	−0.022 (−1.648)	−0.044 (−2.012)	−0.043 (−1.903)	−0.021 (−1.596)
$\Delta \ln D^*_{it}$	0.004 (1.118)	0.005 (1.548)	0.015 (2.641)	0.014 (2.351)	0.008 (2.390)
$\Delta \ln P_t$	0.645 (3.563)	0.664 (3.797)	0.605 (2.188)	0.407 (1.215)	0.732 (4.519)
$\Delta \ln P^*_t$	−1.230 (−5.183)	−1.178 (−5.184)	−0.705 (−1.859)	−0.965 (−2.424)	−0.819 (−3.184)
$\ln \frac{\overline{p}_{it-1}}{\overline{p}^*_{it-1}}$	−0.475 (−9.431)	−0.480 (−9.891)	−0.440 (−5.778)	−0.535 (−5.537)	−0.359 (−8.523)
$\ln \theta_{it-1}$	0.010 (0.812)	–	–	–	–
$\ln \theta^*_{it-1}$	−0.012 (−0.928)	–	–	–	–
$\ln \frac{\theta_{it-1}}{\theta^*_{it-1}}$	–	0.013 (1.335)	0.089 (2.267)	0.056 (1.279)	0.001 (0.102)
$\ln L_{t-1}$	−0.052 (−2.349)	–	–	–	–
$\ln L^*_{t-1}$	0.034 (1.547)	–	–	–	–
$\ln \frac{L_{t-1}}{L^*_{t-1}}$	–	−0.043 (−2.447)	−0.094 (−2.983)	−0.066 (−1.886)	−0.020 (−1.036)
$\ln P_{t-1}$	0.424 (5.717)	0.436 (6.169)	0.406 (3.170)	0.521 (2.935)	0.368 (4.625)
$\ln P^*_{t-1}$	−0.535 (−6.288)	−0.540 (−6.514)	−0.521 (−3.418)	−0.688 (−3.269)	−0.383 (−3.956)
N	260	260	260	234	234

Notes: Country/industry fixed effects are included in all regressions. We cannot reject the hypothesis that the coefficients on domestic and foreign variables are equal except for the coefficients on domestic and foreign CPIs. In (3) to (5) instruments for openness include weight-to-value, weighted distance, cif/fob and 1992 and 1996 dummies. L_t denotes (real) GDP.

Table E2: Productivity (Long Run), benchmark is Italy

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	OLS	IV	IV	IV	IV	GMM
$\Delta \ln \frac{z_{it-1}}{z^*_{it-1}}$	–	–	–	0.013 (0.103)	−0.011 (−0.077)	−0.121 (−0.687)	0.317 (5.658)
$\Delta \ln \theta_{it}$	0.067 (0.962)	–	–	–	–	–	–
$\Delta \ln \theta^*_{it}$	−0.197 (−2.758)	–	–	–	–	–	–
$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	–	0.146 (2.742)	0.883 (3.889)	0.999 (3.408)	1.134 (3.516)	0.931 (2.541)	0.137 (2.017)
$\Delta \ln D_{it}$	0.197 (3.111)	0.201 (3.290)	0.355 (3.448)	0.381 (3.197)	0.304 (2.318)	0.785 (1.625)	0.097 (1.483)
$\Delta \ln D^*_{it}$	−0.070 (−5.510)	−0.066 (−5.555)	−0.101 (−4.887)	−0.109 (−4.364)	−0.126 (−4.231)	−0.066 (−0.901)	−0.060 (−4.712)
$\ln \frac{z_{it-1}}{z^*_{it-1}}$	−0.335 (−5.122)	−0.330 (−5.032)	−0.328 (−2.969)	−0.405 (−2.812)	−0.366 (−2.304)	−0.300 (−1.776)	−0.307 (−6.436)
$\ln \theta_{it-1}$	−0.001 (−0.009)	–	–	–	–	–	–
$\ln \theta^*_{it-1}$	−0.053 (−0.963)	–	–	–	–	–	–
$\ln \frac{\theta_{it-1}}{\theta^*_{it-1}}$	–	0.018 (0.398)	−0.185 (−1.037)	−0.247 (−1.124)	−0.139 (−0.680)	−0.274 (−1.156)	0.039 (1.123)
$\ln L_{t-1}$	0.357 (3.609)	–	–	–	–	–	–
$\ln L^*_{t-1}$	−0.117 (−1.116)	–	–	–	–	–	–
$\ln \frac{L_{t-1}}{L^*_{t-1}}$	–	0.221 (2.602)	0.502 (2.708)	0.699 (2.906)	0.496 (2.001)	0.572 (2.436)	0.135 (1.977)
$\ln w_{t-1}$	−0.087 (−1.224)	–	–	–	–	–	–
$\ln w^*_{t-1}$	0.122 (1.526)	–	–	–	–	–	–
$\ln \frac{w_{t-1}}{w^*_{t-1}}$	–	−0.099 (−1.581)	−0.335 (−1.876)	−0.429 (−2.138)	−0.110 (−0.436)	−0.266 (−1.146)	−0.032 (−0.662)
N	260	260	260	234	234	234	234

Notes: Country/industry fixed effects are included in all regressions. We cannot reject the hypothesis that the coefficients on domestic and foreign variables are equal except for the coefficients on domestic and foreign number of firms. In (3) to (7) instruments for openness include weight-to-value, weighted distance, cif/fob and 1992 and 1996 dummies. In (5) wages are instrumented by the average income tax rate for singles and married individuals and in (6) the number of firms is further instrumented by its own lags. L_t denotes (real) GDP.

Table E3: Markups (Long Run), benchmark is Italy

	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	IV	IV	GMM
$\Delta \ln \frac{\overline{\mu}_{it-1}}{\overline{\mu}^*_{it-1}}$	–	–	–	0.001 (0.013)	0.248 (4.013)
$\Delta \ln \theta_{it}$	−0.009 (−0.649)	–	–	–	–
$\Delta \ln \theta^*_{it}$	0.017 (1.155)	–	–	–	–
$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	–	−0.016 (−1.457)	−0.030 (−0.894)	−0.013 (−0.349)	−0.049 (−3.311)
$\Delta \ln D_{it}$	−0.027 (−2.119)	−0.026 (−2.156)	−0.028 (−2.133)	−0.026 (−1.893)	−0.035 (−2.921)
$\Delta \ln D^*_{it}$	0.006 (2.442)	0.006 (2.616)	0.007 (2.350)	0.006 (1.856)	0.003 (1.313)
$\ln \frac{\overline{\mu}_{it-1}}{\overline{\mu}^*_{it-1}}$	−0.501 (−8.492)	−0.520 (−9.036)	−0.525 (−8.901)	−0.553 (−6.949)	−0.413 (−8.517)
$\ln \theta_{it-1}$	0.014 (1.544)	–	–	–	–
$\ln \theta^*_{it-1}$	−0.008 (−0.791)	–	–	–	–
$\ln \frac{\theta_{it-1}}{\theta^*_{it-1}}$	–	0.013 (1.873)	0.018 (1.165)	0.020 (1.300)	0.002 (0.352)
$\ln L_{t-1}$	−0.029 (−2.071)	–	–	–	–
$\ln L^*_{t-1}$	−0.013 (−0.946)	–	–	–	–
$\ln \frac{L_{t-1}}{L^*_{t-1}}$	–	−0.007 (−0.829)	−0.013 (−0.809)	−0.010 (−0.588)	0.007 (1.156)
N	260	260	260	234	234

Notes: Country/industry fixed effects are included in all regressions. We cannot reject the hypothesis that the coefficients on domestic and foreign variables are equal except for the coefficients on domestic and foreign number of firms. In (3) to (5) instruments for openness include weight-to-value, weighted distance, cif/fob and 1992 and 1996 dummies. L_t denotes (real) GDP.

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Descriptive Statistics

Table 1: Summary Statistics

	Inflation (%)			Import Share (%)			Productivity (Ecus/worker)			Markups		
Country/Sector	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max
Belgium	0.4	-2.8	6.9	68.9	32.1	155.8	55,325	20,805	111,973	1.074	1.046	1.112
Germany	0.9	-2.6	5.8	60.4	32.2	129.4	42,066	20,942	58,731	1.308	1.139	1.666
Denmark	1.2	-10.0	16.5	8.2	2.3	24.1	46,139	28,890	99,810	1.358	1.089	1.736
Spain	2.2	-3.3	13.1	81.7	27.9	208.9	35,086	18,545	61,411	1.118	1.007	1.319
France	-0.7	-18.5	7.4	50.1	23.2	112.6	62,171	36,215	115,458	1.141	1.038	1.235
Italy	1.9	-7.3	15.2	40.5	21.5	63.3	45,583	24,335	76,245	1.094	1.035	1.127
Netherlands	0.8	-3.4	6.2	108.9	33.8	233.9	41,633	27,617	64,282	1.109	1.015	1.180
Metals	-2.1	-18.5	15.2	67.0	48.3	112.6	62,415	36,215	88,808	1.072	1.035	1.127
Non-Metallic Minerals	1.6	-10.0	16.5	35.4	3.2	90.1	45,693	34,245	60,448	1.329	1.154	1.531
Chemicals	0.9	-3.3	13.0	52.6	9.2	146.1	75,003	52,359	115,458	1.198	1.062	1.736
Machinery	2.7	1.3	5.6	110.7	89.7	125.8	29,830	28,113	32,821	1.080	1.025	1.107
Office Machinery	0.4	-1.6	3.6	77.5	34.1	218.8	42,622	29,620	58,731	1.121	1.064	1.214
Motor Vehicles and Transport	2.1	-0.6	5.1	58.8	14.7	131.6	39,989	28,192	58,553	1.109	1.007	1.257
Food, Tobacco	0.9	-4.4	6.1	30.8	2.3	49.9	43,069	25,995	64,282	1.191	1.046	1.666
Textiles	1.1	-2.7	5.0	123.2	42.0	233.9	27,991	18,545	41,810	1.114	1.052	1.252
Wood, Paper and Printing	1.7	-2.4	13.1	46.4	24.2	75.3	40,550	30,834	61,110	1.166	1.075	1.355
Rubber Products, Furniture	2.0	-0.7	8.7	70.8	5.1	156.6	38,542	25,547	62,469	1.198	1.037	1.398

Table 2: Summary Statistics

	Import Share (%)	
Country/Sector	1989	1999
Belgium	49.8	101.3
Germany	55.6	77.7
Denmark	8.2	9.2
Spain	64.6	94.8
France	41.3	67.5
Italy	47.1	38.7
Netherlands	98.6	133.9
Metals	65.9	82.5
Non-Metallic Minerals	28.6	48.0
Chemicals	42.8	72.3
Machinery	89.7	113.4
Office Machinery	58.1	102.8
Motor Vehicles and Transport	51.8	71.3
Food, Tobacco	29.0	34.2
Textiles	105.5	151.3
Wood, Paper and Printing	45.5	53.6
Rubber Products, Furniture	70.1	80.3

Table 3: Unit Root Tests

	Prices	Productivity	Openness
Im-Pesaran-Shin			
Intercept	−0.766 (0.222)	2.074 (0.981)	2.738 (0.997)
Intercept + Trend	−0.422 (0.336)	0.4378 (0.669)	−2.516 (0.006)
Im-Pesaran-Shin (CCE)			
Intercept	-1.132	-1.946	-1.993
Intercept + Trend	-3.234	-2.251	-1.815
Levin-Lin-Chu			
Intercept	3.189 (0.999)	−0.433 (0.332)	−1.611 (0.054)
Intercept + Trend	6.938 (1.000)	−1.433 (0.076)	0.756 (0.775)
Hadri			
Intercept	16.095 (0.000)	15.174 (0.000)	16.692 (0.000)
Intercept + Trend	14.737 (0.000)	14.206 (0.000)	19.535 (0.000)

Notes: Im-Pesaran-Shin reports values for the W-statistic corresponding to the null hypothesis that there is a unit root that is individual to each cross-section. p-values are reported in the Table. Im-Pesaran-Shin (CCE) allows for correlated residuals, and continues to report the statistic corresponding to the null hypothesis that there is a unit root that is individual to each cross-section. The critical values at the 5% confidence level are -2.16 without intercept, and -2.82 with one. Levin-Lin-Chu reports the Breitung t-statistic corresponding to the null hypothesis that there is a common unit root process, along with its p-value. The Hadri test reports the Z-statistic corresponding to the null hypothesis that there is no common unit root process, along with its p-value.

Short Run

Table 4: Prices (Short Run), all country pairs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	OLS	OLS	OLS	IV	IV	IV
$\Delta \ln \frac{\overline{p}_{it-1}}{\overline{p}^*_{it-1}}$	–	–	0.064 (1.905)	0.065 (1.920)	–	–	0.073 (2.065)
$\Delta \ln \theta_{it}$	−0.023 (−2.178)	−0.023 (−2.172)	−0.036 (−3.517)	–	–	–	–
$\Delta \ln \theta^*_{it}$	0.022 (2.207)	0.017 (1.796)	0.024 (2.620)	–	–	–	–
$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	–	–	–	−0.029 (−4.290)	−0.062 (−1.897)	−0.063 (−1.991)	−0.078 (−2.779)
$\Delta \ln D_{it}$	−0.009 (−0.747)	−0.010 (−0.892)	−0.018 (−1.691)	−0.016 (−1.530)	−0.018 (−1.301)	−0.019 (−1.427)	−0.026 (−2.150)
$\Delta \ln D^*_{it}$	0.004 (2.512)	0.002 (1.076)	0.002 (1.208)	0.002 (1.481)	0.006 (2.698)	0.004 (1.834)	0.005 (2.273)
$\Delta \ln P_t$	–	0.452 (5.584)	0.524 (6.589)	0.528 (6.655)	0.426 (5.000)	–	0.488 (5.714)
$\Delta \ln P^*_t$	–	−0.463 (−5.533)	−0.619 (−7.311)	−0.611 (−7.262)	−0.436 (−5.038)	–	−0.558 (−6.053)
N	800	800	720	720	800	800	720
$\Delta \ln \theta_{it} = (-1)\, \Delta \ln \theta^*_{it}$	0.91	0.69	0.39	–	–	–	–
$\Delta \ln D_{it} = (-1)\, \Delta \ln D^*_{it}$	0.71	0.47	0.13	0.20	0.38	0.25	0.07
$\Delta \ln P_t = (-1)\, \Delta \ln P^*_t$	–	0.89	0.21	0.27	–	0.89	0.37

Notes: Country/industry fixed effects are included in all regressions. We cannot reject the hypothesis that the coefficients on domestic and foreign variables are equal. In (5) to (7) instruments for openness include weight-to-value, weighted distance, cif/fob and 1992 and 1996 dummies.

Table 5: Productivity (Short Run), all country pairs

	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	OLS	IV	IV
$\Delta \ln \frac{z_{it-1}}{z^*_{it-1}}$	–	-0.077 (-2.050)	-0.077 (-2.064)	–	-0.088 (-2.196)
$\Delta \ln \theta_{it}$	0.043 (1.220)	0.061 (1.567)	–	–	–
$\Delta \ln \theta^*_{it}$	-0.061 (-1.872)	-0.073 (-2.096)	–	–	–
$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	–	–	0.067 (2.586)	0.170 (1.586)	0.320 (2.915)
$\Delta \ln D_{it}$	0.147 (3.871)	0.173 (4.390)	0.176 (4.667)	0.179 (4.013)	0.231 (4.964)
$\Delta \ln D^*_{it}$	-0.033 (-5.892)	-0.034 (-5.898)	-0.033 (-6.057)	-0.039 (-4.956)	-0.046 (-5.764)
N	800	720	720	800	720
$\Delta \ln \theta_{it} = (-1)\, \Delta \ln \theta^*_{it}$	0.71	0.82	–	–	–
$\Delta \ln D_{it} = (-1)\, \Delta \ln D^*_{it}$	0.00	0.00	0.00	0.00	0.00

Notes: Country/industry fixed effects are included in all regressions. We cannot reject the hypothesis that the coefficients on domestic and foreign openness are equal but can can reject it for the coefficients on domestic and foreign number of firms. In (4) and (5) instruments for openness include weight-to-value, weighted distance, cif/fob and 1992 and 1996 dummies.

Table 6: Markups (Short Run), all country pairs

	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	OLS	IV	IV
$\Delta\ln\frac{\overline{\mu}_{it-1}}{\overline{\mu}^*_{it-1}}$	–	-0.223 (-5.947)	-0.223 (-5.952)	–	-0.224 (-4.466)
$\Delta\ln\theta_{it}$	-0.022 (-1.860)	-0.025 (-2.021)	–	–	–
$\Delta\ln\theta^*_{it}$	0.019 (1.695)	0.030 (2.656)	–	–	–
$\Delta\ln\frac{\theta_{it}}{\theta^*_{it}}$	–	–	-0.028 (-3.300)	-0.240 (-4.775)	-0.215 (-4.918)
$\Delta\ln D_{it}$	-0.042 (-3.269)	-0.051 (-4.004)	-0.052 (-4.270)	-0.094 (-4.477)	-0.091 (-4.948)
$\Delta\ln D^*_{it}$	0.005 (2.750)	0.006 (3.227)	0.006 (3.274)	0.017 (4.635)	0.016 (4.808)
N	800	720	720	800	720
$\Delta\ln\theta_{it}=(-1)\,\Delta\ln\theta^*_{it}$	0.82	0.79	–	–	–
$\Delta\ln D_{it}=(-1)\,\Delta\ln D^*_{it}$	0.00	0.00	0.00	0.00	0.00

Notes: Country/industry fixed effects are included in all regressions. We cannot reject the hypothesis that the coefficients on domestic and foreign openness are equal but can can reject it for the coefficients on domestic and foreign number of firms. In (4) and (5) instruments for openness include weight-to-value, weighted distance, cif/fob and 1992 and 1996 dummies.

Long Run

Table 7: Prices (Long Run), all country pairs

	(1)	(2)	(3)	(4)
	OLS	OLS	IV	IV
$\Delta \ln \frac{\overline{p}_{it-1}}{\overline{p}^*_{it-1}}$	–	–	–	0.034 (0.915)
$\Delta \ln \theta_{it}$	−0.011 (−1.186)	–	–	–
$\Delta \ln \theta^*_{it}$	0.000 (0.053)	–	–	–
$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	–	−0.005 (−0.828)	0.012 (0.345)	−0.046 (−1.122)
$\Delta \ln D_{it}$	−0.008 (−0.828)	−0.005 (−0.614)	−0.007 (−0.577)	−0.015 (−1.261)
$\Delta \ln D^*_{it}$	0.000 (0.324)	0.001 (0.562)	0.001 (0.277)	0.005 (1.590)
$\Delta \ln P_t$	0.662 (6.488)	0.648 (6.589)	0.740 (6.814)	0.544 (3.405)
$\Delta \ln P^*_t$	−0.926 (−7.305)	−0.916 (−7.286)	−0.930 (−5.962)	−0.727 (−3.941)
$\ln \frac{\overline{p}_{it-1}}{\overline{p}^*_{it-1}}$	−0.419 (−17.670)	−0.419 (−17.687)	−0.368 (−12.674)	−0.345 (−8.656)
$\ln \theta_{it-1}$	0.018 (2.676)	–	–	–
$\ln \theta^*_{it-1}$	−0.012 (−2.064)	–	–	–
$\ln \frac{\theta_{it-1}}{\theta^*_{it-1}}$	–	0.015 (3.041)	0.054 (4.448)	0.048 (3.295)
$\ln L_{t-1}$	−0.063 (−5.304)	–	–	–
$\ln L^*_{t-1}$	0.062 (5.274)	–	–	–
$\ln \frac{L_{t-1}}{L^*_{t-1}}$	–	−0.063 (−6.315)	−0.063 (−5.929)	−0.069 (−5.182)
$\ln P_{t-1}$	0.296 (9.692)	0.293 (9.729)	0.281 (8.090)	0.208 (2.902)
$\ln P^*_{t-1}$	−0.359 (−10.183)	−0.353 (−10.121)	−0.350 (−8.176)	−0.276 (−3.550)
N	800	800	800	720

Notes: Country/industry fixed effects are included in all regressions. We cannot reject the hypothesis that the coefficients on domestic and foreign variables are equal except for the coefficients on domestic and foreign CPIs. In (3) and (4) instruments for openness include weight-to-value, weighted distance, cif/fob and 1992 and 1996 dummies. L_t denotes (real) GDP.

Table 8: Productivity (Long Run), all country pairs, manufacturing wages

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	IV	IV	IV	IV
$\Delta \ln \frac{z_{it-1}}{z^*_{it-1}}$	–	–	–	−0.051 (−1.122)	−0.062 (−1.285)	−0.054 (−1.027)
$\Delta \ln \theta_{it}$	0.043 (1.239)	–	–	–	–	–
$\Delta \ln \theta^*_{it}$	−0.041 (−1.244)	–	–	–	–	–
$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	–	0.046 (1.878)	0.250 (2.590)	0.265 (2.688)	0.287 (2.715)	0.277 (2.565)
$\Delta \ln D_{it}$	0.126 (3.357)	0.110 (3.096)	0.193 (3.997)	0.182 (3.897)	0.160 (3.393)	0.331 (2.172)
$\Delta \ln D^*_{it}$	−0.031 (−5.701)	−0.032 (−6.147)	−0.045 (−5.863)	−0.045 (−5.901)	−0.047 (−5.658)	0.008 (0.336)
$\ln \frac{z_{it-1}}{z^*_{it-1}}$	−0.289 (−9.311)	−0.286 (−9.229)	−0.224 (−5.406)	−0.260 (−5.718)	−0.250 (−5.237)	−0.243 (−4.747)
$\ln \theta_{it-1}$	−0.026 (−1.045)	–	–	–	–	–
$\ln \theta^*_{it-1}$	0.000 (−0.012)	–	–	–	–	–
$\ln \frac{\theta_{it-1}}{\theta^*_{it-1}}$	–	−0.014 (−0.711)	−0.157 (−2.716)	−0.140 (−2.243)	−0.122 (−2.051)	−0.125 (−1.913)
$\ln L_{t-1}$	0.248 (5.172)	–	–	–	–	–
$\ln L^*_{t-1}$	−0.135 (−2.881)	–	–	–	–	–
$\ln \frac{L_{t-1}}{L^*_{t-1}}$	–	0.189 (4.943)	0.217 (4.859)	0.219 (4.248)	0.170 (2.841)	0.173 (2.820)
$\ln w_{t-1}$	−0.020 (−0.580)	–	–	–	–	–
$\ln w^*_{t-1}$	−0.028 (−0.767)	–	–	–	–	–
$\ln \frac{w_{t-1}}{w^*_{t-1}}$	–	−0.002 (−0.091)	−0.089 (−2.141)	−0.064 (−1.551)	0.011 (0.190)	−0.103 (−1.242)
N	800	800	800	720	720	720

Notes: Country/industry fixed effects are included in all regressions. We cannot reject the hypothesis that the coefficients on domestic and foreign variables are equal except for the coefficients on domestic and foreign number of firms. In (3) to (7) instruments for openness include weight-to-value, weighted distance, cif/fob and 1992 and 1996 dummies. In (5) wages are instrumented by the average income tax rate for singles and married individuals and in (6) the number of firms is further instrumented by its own lags. L_t denotes (real) GDP.

Table 9: Markups (Long Run), all country pairs

	(1)	(2)	(3)	(4)
	OLS	OLS	IV	IV
$\Delta \ln \frac{\mu_{it-1}}{\mu^*_{it-1}}$	–	–	–	0.034 (0.684)
$\Delta \ln \theta_{it}$	-0.014 (-1.354)	–	–	–
$\Delta \ln \theta^*_{it}$	0.010 (0.965)	–	–	–
$\Delta \ln \frac{\theta_{it}}{\theta^*_{it}}$	–	-0.013 (-1.769)	-0.146 (-3.870)	-0.136 (-4.175)
$\Delta \ln D_{it}$	-0.042 (-3.701)	-0.038 (-3.565)	-0.067 (-4.170)	-0.066 (-4.457)
$\Delta \ln D^*_{it}$	0.005 (2.769)	0.005 (3.211)	0.013 (4.435)	0.012 (4.555)
$\ln \frac{\mu_{it-1}}{\mu^*_{it-1}}$	-0.539 (-15.741)	-0.542 (-15.925)	-0.511 (-11.211)	-0.565 (-10.341)
$\ln \theta_{it-1}$	0.006 (0.933)	–	–	–
$\ln \theta^*_{it-1}$	-0.011 (-1.482)	–	–	–
$\ln \frac{\theta_{it-1}}{\theta^*_{it-1}}$	–	0.008 (1.480)	0.044 (2.467)	0.018 (1.123)
$\ln L_{t-1}$	-0.030 (-2.885)	–	–	–
$\ln L^*_{t-1}$	0.017 (1.804)	–	–	–
$\ln \frac{L_{t-1}}{L^*_{t-1}}$	–	-0.024 (-3.453)	-0.036 (-3.254)	-0.028 (-2.458)
N	800	800	800	720

Notes: Country/industry fixed effects are included in all regressions. We cannot reject the hypothesis that the coefficients on domestic and foreign variables are equal except for the coefficients on domestic and foreign number of firms. In (3) and (4) instruments for openness include weight-to-value, weighted distance, cif/fob and 1992 and 1996 dummies. L_t denotes (real) GDP.

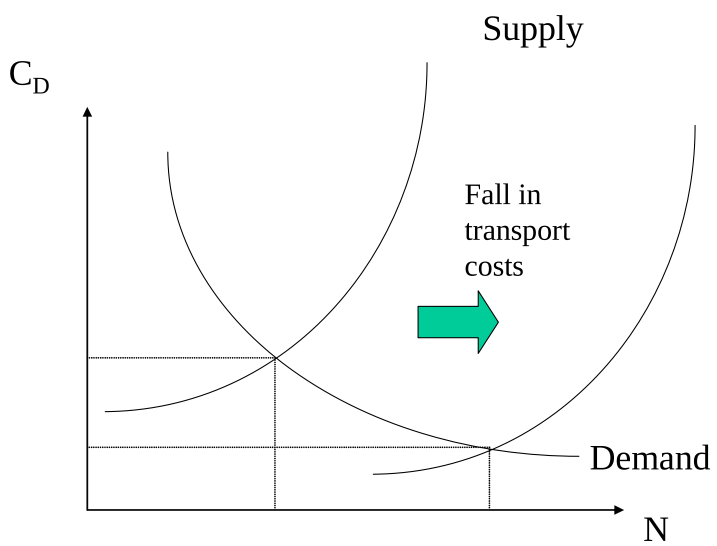

Figure 1: Short Run Effects of Liberalisation

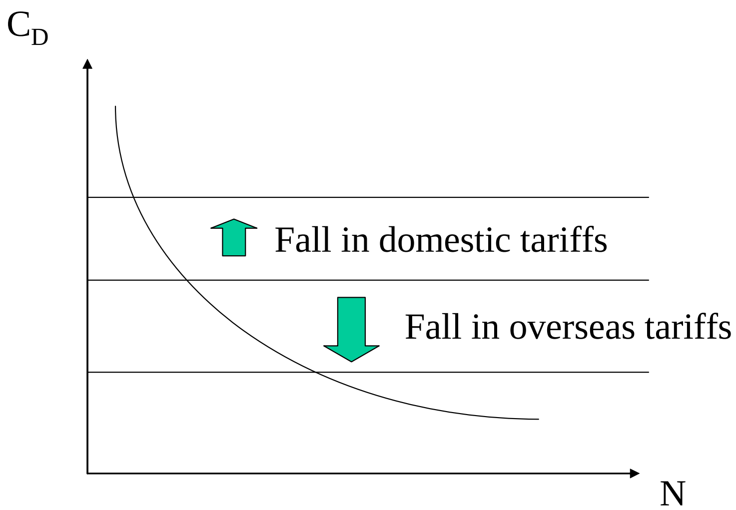

Figure 2: Long Run Effects of Liberalisation

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