

Procompetitive Losses from Trade*

Paolo Epifani[†] Gino Gancia[‡]
Bocconi University CREI and CEPR

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Abstract

We argue that the procompetitive effect of international trade may bring about significant welfare costs that have not been recognized. We formulate a stylized general equilibrium model with a continuum of imperfectly competitive industries to show that, under plausible conditions, a trade-induced increase in competition can actually amplify monopoly distortions. This happens because trade, while lowering the average level of market power, may increase its cross-sectoral dispersion. Using data on US industries, we document a dramatic increase in the dispersion of market power overtime. We also show evidence that trade might be responsible for it and provide some quantifications of the induced welfare cost. Our results suggest that, to avoid some unpleasant effects of globalization, trade integration should be accompanied by procompetitive reforms (i.e., deregulation) in the nontraded sectors.

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[†]CESPRI, Università Bocconi, via Sarfatti 25, 20136, Milano (Italy). E-mail: paolo.epifani@unibocconi.it

[‡]CREI, Universitat Pompeu Fabra and CEPR, Ramon Trias Fargas 25-27, 08005, Barcelona (Spain). E-mail: gino.gancia@upf.edu

“What is relevant for the general analysis is not the *sum* of individual degrees of monopoly but their *deviations*”

A.P. Lerner

1 INTRODUCTION

There is a general consensus that exposure to international trade reduces domestic firms' market power and that welfare gains are likely to materialize through this procompetitive effect (e.g., Helpman and Krugman, 1985, Roberts and Tybout, 1996). There is also a large literature emphasizing the beneficial effects of product market deregulation aimed at lowering entry barriers (e.g., Schiantarelli, 2005). Yet, what most studies on procompetitive gains from trade neglect is that the social cost of market power may not depend on its average level only, but rather on its dispersion across sectors. The aim of this paper is to study the link between trade and the dispersion of market power and its effect on welfare.

The insight that welfare is a negative function of the dispersion of market power is often overlooked because classical analysis of monopoly distortions is usually conducted in partial equilibrium. On the contrary, in this paper we build a general equilibrium model in which the degree of market power can vary across industries and show how its dispersion, independent of the average level, leads to misallocations. The reason is that the equilibrium allocation depends on relative prices and when relative prices reflect differences in market power the economy will deviate from the social optimum. Our goal is to relate the degree of monopoly power in a sector to the presence of foreign competition and study how various forms of economic integration can affect welfare by changing the dispersion of market power.

When trade lowers markups over marginal costs but increases their dispersion, for instance because trade affects some sectors and not others, we derive the somewhat paradoxical result that an increase in competition may actually amplify monopoly distortions. More generally, we discuss cases in which the average market power of firms matters too and show that conventional procompetitive gains from trade can be reduced or magnified depending on whether trade also increases or decreases the dispersion of market power. We also propose policy remedies for the misallocation of resources that international integration may induce. In particular, our model suggests that when trade makes open sectors more competitive than the rest of the economy, it is advisable to promote competition in those sectors that remain less exposed

to trade. That is, integration of international markets may call for deregulation in domestic markets.

Understanding the welfare effects of changes in the dispersion of market power due to foreign competition is important because there are many instances in which trade can affect the distribution of markups across industries. This might be the case because there are sectors, like services, that are naturally less exposed to international competition. A quick glance at the evidence is broadly consistent with this view: using economy-wide data for the US in 2003, we find that the average Price-Cost Margin (PCM), a commonly used measure of markups, equals a meagre 13% in manufacturing and a fat 33% in the business sector services, with a peak of 66% in the real estate activities. Among service industries, the average PCM is 48% in the electricity industry, 38% in the finance and insurance industry, 28% in the post and telecommunication industry and 24% in the transport and storage industry.¹ Interestingly, in the renting of machinery and equipment industry, selling nontraded services, the average PCM equals 41.5%, whereas in the machinery and equipment industry, producing traded manufacturing goods, the average PCM is 9.5%. Substantial asymmetries in market power may also arise among traded commodities, because of sectoral asymmetries in trade policy. Agriculture, for instance, is notoriously heavily protected and, not surprisingly, has an average PCM much higher than manufacturing (28% against 13% in the US). Even among freely traded manufacturing goods, transportation costs vary dramatically, implying that some sectors are more shielded than others from foreign competition.

How trade has affected the dispersion of market power overtime is ultimately an empirical question to which Figure 1 provides a first answer. The graph shows the evolution of the standard deviation of PCMs across 450 US manufacturing industries (broken line) and the average trade openness of the same industries (solid line) over the period 1958-1996.² It is immediate to see that, starting from the mid 70s, the dispersion of PCMs shows a relentless increase. More importantly, the standard deviation of PCMs and the average openness chase each other closely. Figure 2 reinforces this impression by plotting the same two series after removing a liner trend. The co-movements between the two de-trended measures are evident, with a simple correlation of 0.4. A simple OLS regression of the standard deviation of PCMs

¹Data are from the OECD STAN database.

²Price-cost margins have been computed from the Bartelsman and Gray database, while openness of US industries is taken from the NBER Trade Database by Feenstra. See section 3 for more details about the data and the construction of the variables.

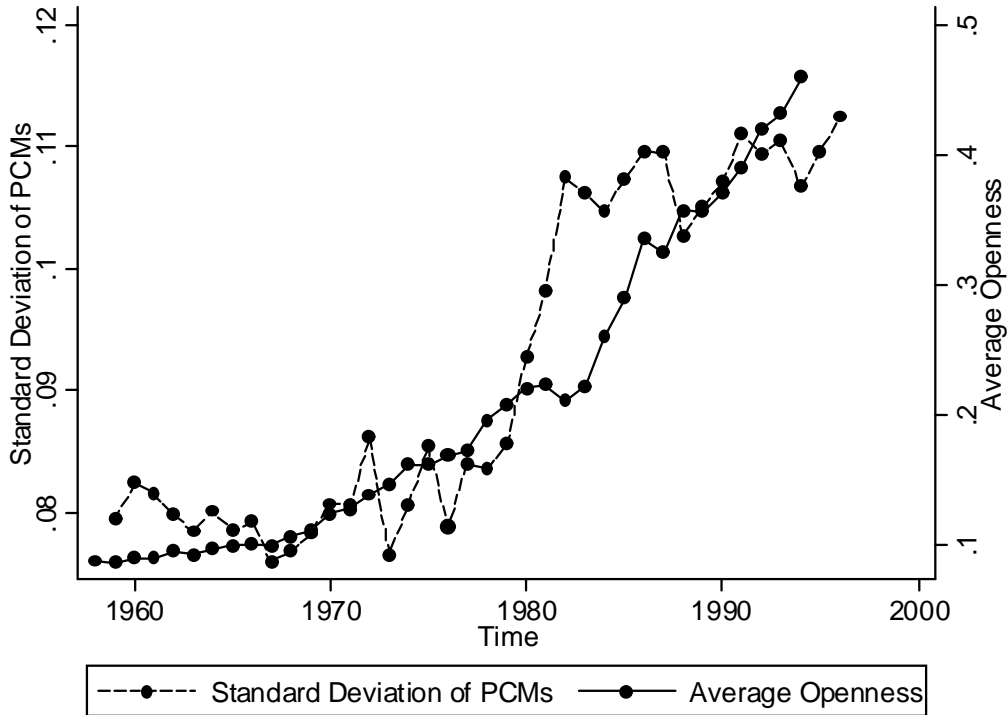


Figure 1: Openness and the Dispersion of PCMs

on the openness ratio yields a coefficient of 0.103 (0.007) with an R-squared of 0.81. The coefficient becomes 0.091 (0.019) after controlling for a time trend. Thus, a first look at the data suggests that the dispersion of price-cost margins has increased dramatically, starting in the mid-70s, and that trade may be partly responsible for this phenomenon. We take these novel stylized facts as a motivation for our analysis. Plausible quantifications of our model will suggest that the welfare costs of changes in the dispersion of market power may not be negligible, while the last section of the paper will confirm the positive relationship between trade and markup dispersion by looking at more detailed and systematic evidence.

This paper is related to the literature studying the welfare effects of trade in models with imperfect competition. The fact that, in the presence of distortions, trade might be welfare reducing is an application of second-best theory and it is not *per se* so surprising. A notable example seemingly related to ours is the paper by Brander and Krugman (1983), showing that a fall in trade costs can lower welfare when oligopolistic firms produce homogeneous

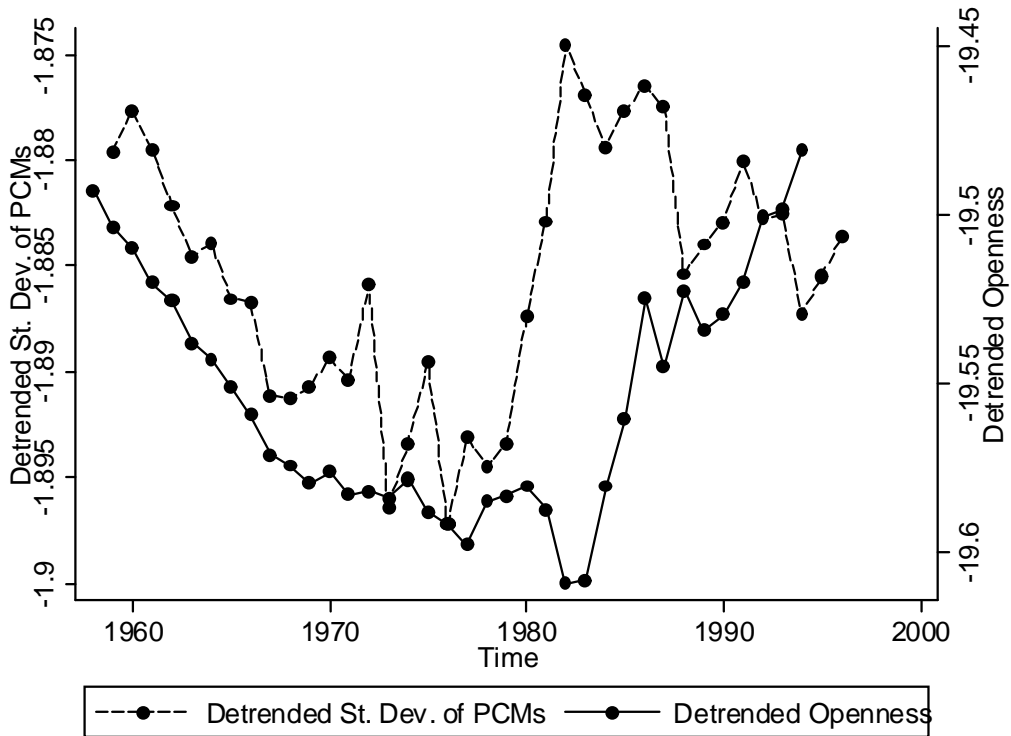


Figure 2: Openness and the Dispersion of PCMs (Detrended Series)

goods and compete in quantities. Yet, the intuition for their result relies on the fact that trade is intrinsically wasteful in their model, while in our paper trade does not impose any additional cost. More than being just an application of second-best theory, this paper is to our knowledge the first to emphasize the general insight that trade can affect welfare by changing the cross-sectoral dispersion of market power. A noteworthy corollary of our results is that it may rationalize the often heard concern that trade may be detrimental in countries (especially the less developed ones) where domestic markets are not competitive enough. The reason is not that domestic firms are unable to survive against foreigners (as emphasized by the infant-industry theory), but rather that international competition may inefficiently increase asymmetries across sectors in the economy.³

³Using data from the OECD STAN database for the year 2002, we find a strong negative association between per capita income and asymmetries in markups between services and manufacturing among OECD countries. In particular, the difference between average PCMs in services and manufacturing is largest in Mexico and Greece (more than 35 percentage points) and smallest in Luxembourg (less than 15 percentage points).

This paper is also related to the relatively small literature on the cost of monopoly in general equilibrium. Some papers have recognized that symmetry may neutralize monopoly distortions. These include the classical article by Lerner (1934), the book by Samuleson (1947) and more recent contributions such as Neary (2003), Koeniger and Licandro (2006) and Bilbiie, Ghironi and Melitz (2006). Yet, no paper takes the next step of studying the determinants of markup dispersion and its induced welfare cost. Perhaps surprisingly, the importance of markup dispersion is usually overlooked also in the large body of works studying competition policy.

Finally, this paper contributes to the growing literature on deregulation of markets (i.e., policies aimed at promoting competition and firms' entry), such as Blanchard and Giavazzi (2003).⁴ Most of the works in this area focus on entry regulations in closed economy or identify trade liberalization as a free market policy. On the contrary, this paper suggests that international trade and entry regulations in domestic markets should be studied together. In particular, it shows that the process of globalization, by increasing the wedge between market power in local and international markets, may reinforce the case for deregulation in sectors, such as services, that remain less exposed to foreign competition.

The remainder of the paper is organized as follows. Section 2 builds a stylized model to make our theoretical point: that trade may have perverse effects when it alters the dispersion of market power. The model is then used to show that the welfare costs associated to the increase in the cross-sectional dispersion of markups observed in the US economy may not be negligible. Section 3 shows evidence that trade may be responsible for this phenomenon. Section 4 concludes.

2 INTERNATIONAL TRADE, COMPETITION AND WELFARE

We build a simple model of a world economy populated by $N \in \mathbb{N}^+$ identical countries. There is a continuum $[0, 1]$ of industries, each composed of varieties of differentiated goods. Countries are specialized in different varieties and may trade with each other. Market integration is however imperfect in that trade may not be allowed in all industries. To introduce imperfect competition and rents in the simplest way, we assume that there is a monopolistic firm per country and sector and that entry is restricted. Firms in different industries are exposed to

⁴See Schiantarelli (2005) for an extensive survey.

different degrees of competition depending on the possibility to trade their products internationally. In particular, firms producing nontraded goods only face competition from other sectors in the economy, whereas firms in traded sectors must also compete with foreign firms producing similar varieties within the same sector. We use this model to explore how the process of international integration, described as an increase in the number of traded sectors and/or trading partners, can affect the pricing decision of firms and welfare.

2.0.1 The Basic Set-Up

In what follows, we use the letters $i, j \in [0, 1]$ to indicate sectors and the letters $n, m \in \{1, \dots, N\}$ to indicate varieties within a sector. Given that each country produces a single variety in every sector, N is also the number of countries. Preferences of the representative agent in any country are given by the following CES utility function:

$$U = \left[\int_0^1 \gamma(i) C(i)^\alpha di \right]^{1/\alpha}, \quad \alpha \in (0, 1), \quad \int_0^1 \gamma(i) di = 1, \quad (1)$$

where $C(i)$ is the sub-utility derived from consumption of differentiated varieties produced in sector $i \in [0, 1]$, $1/(1 - \alpha)$ is the elasticity of substitution between sectors and $\gamma(i)$ is the weight of sector i in utility. Maximization of (1) subject to a budget constraint yields relative demand:

$$\frac{P(i)}{P(j)} = \frac{\gamma(i)}{\gamma(j)} \left[\frac{C(j)}{C(i)} \right]^{1-\alpha}, \quad (2)$$

where $P(i)$ ($P(j)$) is the cost of one unit of the consumption basket $C(i)$ ($C(j)$). Demand for sector i 's basket can be rewritten as:

$$C(i) = \left[\frac{P(i)}{\gamma(i) Q^\alpha} \right]^{1/(\alpha-1)} E, \quad (3)$$

where

$$Q = \left[\int_0^1 \gamma(j)^{1/(1-\alpha)} P(j)^{\alpha/(\alpha-1)} dj \right]^{(\alpha-1)/\alpha} = 1 \quad (4)$$

is the minimum cost of one unit of U (taken as the numeraire) and E is total expenditure.

Before defining the basket $C(i)$, it proves useful to describe how trade takes place in the model. We assume that in some sectors goods can be freely traded, while in others trade costs are prohibitive. Accordingly, the unit measure of sectors is partitioned into two subsets

of traded and nontraded sectors, ordered such that sectors with an index $i \leq \tau \in [0, 1]$ are subject to negligible trade costs while the others, with an index $i > \tau$, face prohibitive trade costs. We consider two complementary aspects of international integration: (1) an increase in the range τ of traded sectors and (2) an increase in the number N of trading partners. We believe that both aspects capture important trends in the world economy.⁵

We are now ready to define $C(i)$. Preferences for sector i 's varieties, produced in N different countries, are represented by another CES sub-utility function:

$$C(i) = N^{\nu+1} \left[\frac{1}{N} \sum_{n \in N} c(i, n)^\beta \right]^{1/\beta}, \quad 1 \geq \beta > \alpha, \quad \nu \geq 0, \quad (5)$$

where $c(i, n)$ is consumption of the variety produced by country n in sector i and $1/(1 - \beta) > 1$ is the elasticity of substitution between varieties produced in different countries. Note that, in nontraded sectors, (5) reduces to $c(i, n)$ where n is the domestically produced variety.

Equation (5) is a generalization, introduced by Benassy (1998), of well known Dixit-Stiglitz preferences. Its special feature is that the factor $N^{\nu+1-1/\beta}$ allows to disentangle the elasticity of substitution between varieties from the preference for variety. From (5), greater variety is associated with higher utility whenever $\nu > 0$. To see this, suppose that $c(i, n) = \bar{c}$ so that the total quantity consumed is $\bar{c}N = \bar{C}$. Then, the sub-utility derived in the typical country from consumption in sector i will be $N^\nu \bar{C}$, which, holding constant total consumption \bar{C} , is increasing in N whenever $\nu > 0$. The standard Dixit-Stiglitz preferences are a special case of (5) for $\nu = (1 - \beta)/\beta$. There are two main reasons why we choose the Benassy formulation.

First, in our model the degree of competition in international markets will depend on the elasticity of substitution, $1/(1 - \beta)$: a high elasticity limits the ability of firms to charge high markups over marginal costs, as an increase in prices would translate into a large drop in demand. However, in studying the welfare effects of international trade, we do not want to mix the effect through competition in world markets, which is our focus, with that through the value of product diversity. Thus, we want the elasticity of demand to be potentially independent from the preference for variety. To preserve the highest clarity, throughout part of the paper we will shut down completely the preference for variety by assuming $\nu = 0$, thereby isolating

⁵For example, there is growing evidence that international trade has increased mostly along the extensive margin (we trade now goods that we did not trade before), while the number of countries that are members of the WTO has increased dramatically during the past decades.

the procompetitive effect of trade. This is the same route taken by Blanchard and Giavazzi (2003) in their related work on product and labor market competition. Nevertheless, we will also discuss the important case when $\nu > 0$.

Second, we want a model in which competition is, in principle, desirable. When competition is parametrized by β , this need not be the case in a standard Dixit-Stiglitz framework. The reason is that, when $\nu = (1 - \beta) / \beta$, high competition means a low preference for variety ν which translates into a lower utility for a given $N > 1$. Having ν independent from β gives competition the best chance to be welfare improving.⁶

Finally, it is important to understand the natural assumption $\alpha < \beta$. It means that goods within the same sectors are closer substitute than goods produced in different sectors. Given that varieties belonging to the same sector are produced by different countries, the restriction $\alpha < \beta$ will imply that competition in international markets is stiffer than in domestic markets and will deliver the procompetitive effect of trade: that exposure to international trade and larger world markets reduce the monopoly power of firms. With $\nu = 0$, this will be the only effect of trade.

In any traded sector ($i \leq \tau$), maximization of (5) subject to a budget constraint yields relative demand functions with a price-elasticity of $1 / (1 - \beta)$:

$$\frac{p(i, n)}{p(i, m)} = \left[\frac{c(i, m)}{c(i, n)} \right]^{1-\beta}, \quad (6)$$

where $p(i, n)$ ($p(i, m)$) is the price of the variety produced by country n (m) in sector i . Cost-minimization also yields the minimum price of one unit of the consumption basket $C(i)$:

$$P(i) = N^{-\nu} \left[\frac{1}{N} \sum_{n \in N} p(i, n)^{\beta / (\beta - 1)} \right]^{(\beta - 1) / \beta}. \quad (7)$$

Integrating (6) and using (7), we can write demand for an individual variety as:

$$c(i, n) = \left[\frac{P(i) N^\nu}{p(i, n)} \right]^{1 / (1 - \beta)} C(i). \quad (8)$$

⁶Yet, we want to reassure the reader that our main results would hold in a Dixit-Stiglitz world too.

2.0.2 Firms and Market Power

Each variety is produced by a single monopolist and entry is restricted. The absence of free entry may result from the fact that conditions in each industry are such that when a second firm enters profits would drop below zero (perhaps due to the presence of fixed costs) or that there are sunk costs associated with entry and a fixed number of firms (one per sector in every country, for simplicity) have already paid it. Restricted entry also captures the presence of government regulations (e.g., licences) and reflects our desire to study the effect of trade when firms make pure profits. Although free entry might be a reasonable assumption in some industries, we believe that rents are fairly common so that our case is equally relevant. Later in the paper, we will see how fixed costs at firm level and free entry can modify our results. Pure profits are rebated to consumers, though the exact form of redistribution is irrelevant in our representative agent economy.

Monopolistic firms charge a price that is a constant markup over the marginal cost, where the latter is for simplicity the wage w (identical across countries in a symmetric world). For convenience, we define $\mu(i)$ as the inverse of the markup prevailing in sector i . The optimal markup is the usual function of the relevant price elasticity of demand ϵ : $\mu(i) = (1 - 1/\epsilon)^{-1}$. To find ϵ , combine (3), (4) and (8) to get demand for a given variety:

$$c(i, n) = \left[\frac{N^\nu}{p(i, n)} \right]^{1/(1-\beta)} P(i)^{\frac{1}{\alpha-1} + \frac{1}{1-\beta}} \gamma(i)^{1/(1-\alpha)} E. \quad (9)$$

From (9), the price elasticity is easily derived:

$$\epsilon \equiv -\frac{\partial \ln c(i, n)}{\partial \ln p(i, n)} = \frac{1}{1-\beta} \left(1 - \frac{1}{N} \right) + \frac{1}{1-\alpha} \left(\frac{1}{N} \right), \quad (10)$$

where symmetry across varieties ($p(i, n) = p(i, m)$) has been used. Note that the perceived demand elasticity is a linear combination of the elasticity of substitution between varieties, $1/(1-\beta)$, and sectors, $1/(1-\alpha)$. An increase in N shifts the weight in favor of the first term, which is the larger one. Thus, the perceived demand elasticity is a positive function of the number of competing firms N in a given sector.⁷ This immediately delivers the procompetitive

⁷This happens because each firm's impact on the industry price index $P(i)$ is proportional to $1/N$. When there is a continuum of firms, instead, each of them has zero measure and therefore has no impact on the price index. This is also the reason why each firm takes the overall price index $Q = 1$ as given.

effect of trade. In a closed sector, where $N = 1$, the perceived demand elasticity is $1/(1 - \alpha)$, as a firm producing nontraded goods only competes against firms in other sectors. In open sectors, the perceived demand elasticity is higher, because firms also compete against foreign varieties that are closer substitutes; moreover, ϵ increases with the number of trading countries N and converges to $1/(1 - \beta)$ as N approaches infinity.⁸

To summarize, the pricing behavior is as follows:

$$p(i, n) = p(i) = \frac{w}{\mu(i)}, \text{ with } \begin{cases} \alpha < \mu(i) < \beta \text{ for } i \in [0, \tau] \\ \mu(i) = \alpha \text{ for } i \in (\tau, 1] \end{cases}. \quad (11)$$

Note that $\mu(i) \in (0, 1)$ parametrizes the degree of competition. As $\mu(i) \rightarrow 0$ the monopolist is facing a demand with a unit price elasticity and would want to sell an infinitesimal quantity at an infinite price. In the limit $\mu(i) \rightarrow 1$ the elasticity of demand is infinite so that firms cannot raise the price above marginal cost, or else demand would drop to zero. From (11) it follows that markups and prices are lower in traded sectors.

Finally, we define by x the price of any nontraded variety $i \in (\tau, 1]$ relative to that of any traded variety $j \in [0, \tau]$:

$$x \equiv \frac{p(i)}{p(j)} = \frac{\mu(j)}{\mu(i)}, \text{ with } 1 < x < \frac{\beta}{\alpha}.$$

2.0.3 General Equilibrium

Goods market clearing, together with symmetry across countries, allows us to solve for consumption of the representative agent:

$$C(i) = \begin{cases} N^\nu L(i)/L \text{ for } i \in [0, \tau] \\ L(i)/L \text{ for } i \in (\tau, 1] \end{cases}, \quad (12)$$

where $L(i)$ is employment in sector i and L is the total labor supply of any country. Equations (12) show that domestic consumption equals $1/N$ of world output of traded sectors, while it

⁸In this model, trade cannot lead to perfect competition, unless $\beta = 1$. In other models, instead, an increase in N will eventually make demand infinitely elastic. This is the case, for example, in the Hotelling model of competition around the circle. Competition in quantities between firms producing homogeneous goods would deliver the same result. For more details about these models, see for example Epifani and Gancia (2006). The translog demand function proposed by Feenstra (2003) also has the property that β is a positive function of N .

equals domestic production in nontraded industries. Finally, allocation of labor across sectors can be solved using (12), (11) and (7) into (2). Comparing employment in any sector $j \in [0, \tau]$ exposed to trade to any other nontraded sector $i \in (\tau, 1]$ yields:

$$L(j) = L(i) \left[\frac{\mu(j) \gamma(j)}{\mu(i) \gamma(i)} \right]^{1/(1-\alpha)} N^{\nu\alpha/(1-\alpha)}. \quad (13)$$

That is, sectors with a lower markup (high μ) and facing stronger demand (high γ) attract more workers. Demand for traded goods is also stronger the higher the gains from product variety, $N^{\nu\alpha/(1-\alpha)}$. Finally, we assume for now that labor supply is inelastic and impose labor market clearing:

$$\int_0^1 L(i) di = L. \quad (14)$$

2.1 PROCOMPETITIVE LOSSES FROM TRADE

We are now ready to discuss how trade affects welfare. To gain intuition, we start with the simplest case of symmetric preferences, $\gamma(j) = 1 \forall j \in [0, 1]$, and no preference for variety, $\nu = 0$, so that trade has no effects other than through changes in firms' market power. Equations (13) and (14) imply:

$$L(i) = \begin{cases} L \left[\tau + (1 - \tau) (x)^{1/(\alpha-1)} \right]^{-1} & \text{for } i \in [0, \tau] \\ L \left[\tau (x)^{1/(1-\alpha)} + (1 - \tau) \right]^{-1} & \text{for } i \in (\tau, 1] \end{cases}. \quad (15)$$

Note that traded sectors attract more workers for they are more competitive and thus pay a higher share of revenues in wages. Substituting (15) and (12) into (1) we obtain utility of the representative agent as a function of τ and x :

$$U(\tau, x) = \frac{[1 - \tau + \tau x^{\alpha/(1-\alpha)}]^{1/\alpha}}{1 - \tau + \tau x^{1/(1-\alpha)}}. \quad (16)$$

Equation (16) is our measure of welfare. We start by noting that in a fully competitive, first-best world we have $x = 1$ and $U(\tau, x) = 1$. The same utility level is attained both in the case of autarky ($\tau = 0$) and when trade is free in all sectors ($\tau = 1$). However, the opening of trade in some sectors starting from autarky necessarily lowers welfare, while it is welfare increasing only after τ has reached a critical point. To see this, we derive equation (16) with respect to

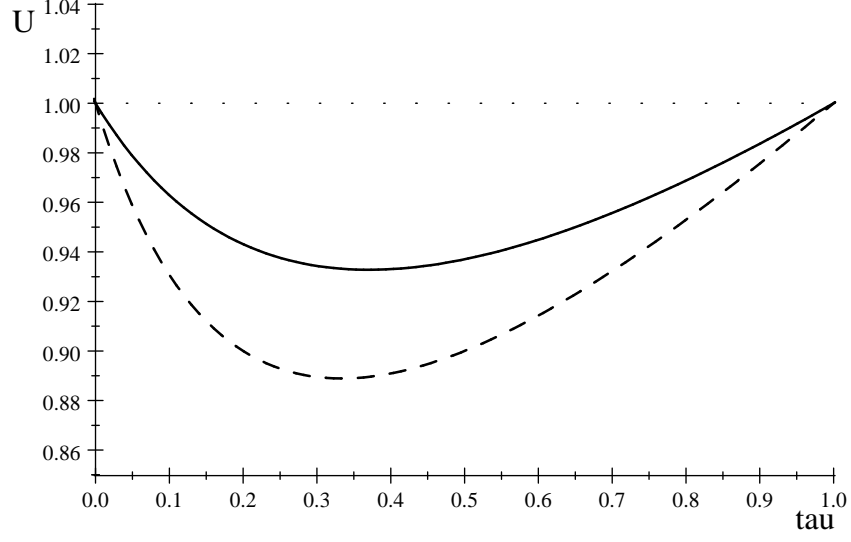


Figure 3: Trade and Welfare

τ and evaluate the expression at $\tau = 0$ and $\tau = 1$:

$$\left. \frac{\partial U}{\partial \tau} \right|_{\tau=0} = 1 - \frac{1}{\alpha} - x^{1/(1-\alpha)} \left(1 - \frac{1}{\alpha x} \right) < 0,$$

$$\left. \frac{\partial U}{\partial \tau} \right|_{\tau=1} = 1 - \frac{x}{\alpha} - x^{1/(1-\alpha)} \left(1 - \frac{1}{\alpha} \right) > 0.$$

Proof. See the Appendix ■

Thus, as depicted in Figure 3 (solid line), welfare is a U-shaped function of τ and converges to the autarky level only once all sectors have become open. In other words, *an equilibrium with trade is (weakly) Pareto inferior to autarky: $U(\tau, x) \leq U(0, x)$.*

What happens as international integration increases the number of trading partners N ? From (10), $\partial \epsilon / \partial N > 0$, so that an increase in N makes demand for traded varieties more elastic and forces firms in open sectors to lower their markups. The markup in sectors closed to trade remains unaffected, so that an increase in N raises the relative price of nontraded goods, as captured by x . In turn, as shown in Figure 3 (broken line) a higher x necessarily lowers welfare:

$$\frac{\partial U}{\partial x} = \frac{\tau(1-\tau)(1-x)x^{\frac{2\alpha-1}{1-\alpha}}[1-\tau+\tau x^{\alpha/(1-\alpha)}]^{1/\alpha-1}}{(1-\alpha)[1-\tau+\tau x^{1/(1-\alpha)}]^2} < 0, \forall \tau \in (0, 1).$$

The inequality follows as all factors are positive, except for $(1 - x)$.

Thus, the *procompetitive effect of an increase in the number of trading countries brings welfare losses*. The intuition behind this rather dismal view of the effects of trade integration is simple. In this model, the only distortion is noncompetitive pricing. Yet, markup pricing distorts decisions only to the extent that the degree of market power varies across goods. For $\tau = 0$ or $\tau = 1$, the markup is the same for all products, meaning that relative prices reflect relative marginal costs and the allocation of resources dictated by relative prices is the optimal one.⁹ Trade breaks this symmetry by lowering markups in some sectors but not in others. This distorts the allocation of labor: the relative price of traded goods falls and the resulting increase in demand is met by hiring more workers. Thus, despite the fact that preferences and marginal costs are identical across goods, the economy experiences underproduction of the more expensive nontraded goods.¹⁰

What can be done to counteract this negative effect of market integration? We have seen that the first best solution is attained when $x = 1$. Thus, if trade lowers markups in some sectors, competition policy might be used to match the change in market power in nontraded sectors too.¹¹ If competition policy cannot be used, the first best solution can still be achieved by giving an appropriate subsidy to sectors producing nontraded goods.

Finally, it is shown in the Appendix that the potential loss from trade is increasing in α . The effect of substitutability across sectors, captured by α , on the monopoly distortion induced by asymmetric markups is not an obvious one. On the one hand, a high substitutability means that the cost of overproduction in traded sectors is small: indeed, this cost goes to zero as goods become perfect substitutes. On the other hand, equation (15) shows that, for a given x , a high substitutability magnifies the misallocation of labor towards traded sectors. It turns out that the latter effects dominates if $\alpha < 1/x$, as we assumed, so that perhaps counter-intuitively a lower curvature in the utility function leads to a higher cost of markup dispersion.

What happens when trade also brings gains by increasing product variety? It is easy to

⁹Markup pricing also implies that wages are too low, but this does not distort any decision as long as labor supply is inelastic.

¹⁰A real world example might be illustrative. Assume that producers of mobile phones are more competitive than providers of telecommunication services, because the former are more exposed than the latter to foreign competition. Then, our paper suggests that the price of mobile phones is too low relative to the price of telecommunication services, and hence that consumers buy too many mobile phones, but use them too little, with respect to the social optimum.

¹¹For example, deregulation may lower the costs for potential competitors, thereby forcing the domestic monopolist to charge a lower markup to prevent entry.

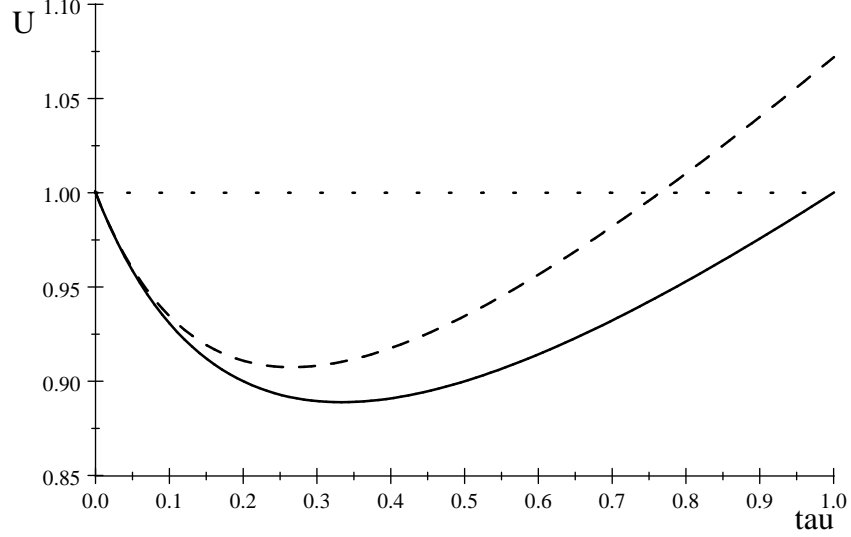


Figure 4: Trade and Welfare with $\nu \geq 0$

show that, when $\nu > 0$, utility of the representative agent becomes:

$$U(\tau, x, \nu, N) = \frac{\left[1 - \tau + \tau (xN^\nu)^\alpha / (1-\alpha)\right]^{1/\alpha}}{1 - \tau + \tau (xN^{\nu\alpha})^{1/(1-\alpha)}}.$$

Figure 4 depicts welfare as a function of τ for the previous case $\nu = 0$ (solid line) and the new case $\nu > 0$ (broken line). In the latter, an equilibrium with some trade might still be Pareto inferior to autarky when τ is low, for the gains from small volumes of trade might be too low to dominate the price distortion. However, when τ is large enough, the gains from variety will eventually dominate the (falling) cost of misallocations. With gains from trade of any sort, the equilibrium with full integration ($\tau = 1$) must necessarily dominate autarky.

Note also that the likelihood that trade may be harmful increases with x and that positive gains from trade will surely materialize if an economy is perfectly competitive. In other words, the potential for welfare losses is higher when domestic markets are not competitive enough and trade brings large asymmetries between sectors selling in world markets and the rest of the economy. These considerations may be particularly relevant for less developed countries, suggesting that in some cases *promoting competition may be a pre-requisite to make sure to reap positive gains from trade.*

2.2 MARKET POWER AND WELFARE

The case we discussed in the previous section is admittedly special and it should be understood that some of the provocative results we derived depend on arbitrary assumptions, like having a uniform markup in autarky. Yet, the model delivers two important and fairly general messages: that asymmetries in market power may lower allocative efficiency and that trade can play an important role in shaping them. The remaining of the paper will be devoted to showing that such asymmetries in markups are not inconsequential for welfare and that trade seems to be an important driving force behind them. To this purpose, we now use our model to derive a more general formula to quantify the welfare loss due to the monopolistic distortion when markups and demand conditions are allowed to vary across sectors. This will enable us to show how the monopolistic distortion depends on a precise measure of markup dispersion and to quantify its social cost.¹² We will then discuss some conditions under which the average markup matters too, such as when there is free entry or the labor supply is elastic.

We start by relaxing the restriction that $\gamma(i)$ be equal to one in all sectors. We also allow $\mu(i)$ to vary freely across sectors. This will be the case if β and domestic entry regulations can vary across goods. For the purpose of this section, we are not interested in quantifying overall gains from trade so that we can safely maintain the assumption $\nu = 0$. Next, we solve for labor allocation in any sector i :

$$L(i) = \frac{[\mu(i)\gamma(i)]^{1/(1-\alpha)}}{\int_0^1 [\mu(i)\gamma(i)]^{1/(1-\alpha)} di} L. \quad (17)$$

Using (17) together with the goods market clearing condition $C(i) = L(i)/L$ into (1) we find a general expression for utility:

$$U = \frac{\left\{ \int_0^1 [\gamma(i)\mu(i)^\alpha]^{1/(1-\alpha)} di \right\}^{1/\alpha}}{\int_0^1 [\gamma(i)\mu(i)]^{1/(1-\alpha)} di}. \quad (18)$$

From (18) it is easy to verify that when $\mu(i)$ is constant across sectors (no dispersion in market power), then utility is independent of $\mu(i)$. Likewise, utility is homogeneous of degree zero in

¹²Lerner (1934) conjectured: “the standard deviation (...) may perhaps be used some day to give an estimate of the divergence of society from the social optimum of production relative to a given distribution of income.” We qualify and implement his suggestion, by deriving the right measure of markup dispersion and quantifying its social cost.

average markup: multiplying $\mu(i)$ by any given constant leaves welfare unaffected. Welfare is instead a complex function of the dispersion of markups. To see this, rewrite (18) as follows:

$$U^\alpha = \frac{E(\widehat{\mu}^\alpha) E(\widehat{\gamma}) + \text{cov}(\widehat{\gamma}, \widehat{\mu}^\alpha)}{[E(\widehat{\mu}) E(\widehat{\gamma}) + \text{cov}(\widehat{\gamma}, \widehat{\mu})]^\alpha}, \quad (19)$$

where $\widehat{\gamma} = \gamma(i)^{1/(1-\alpha)}$ and $\widehat{\mu} = \mu(i)^{1/(1-\alpha)}$. Then, assuming for simplicity that $\widehat{\mu}$ and $\widehat{\gamma}$ are independently distributed and given the concavity of the function $\widehat{\mu}^\alpha$, equation (19) shows that a mean preserving spread of the distribution of $\widehat{\mu}$ lowers the numerator while leaving the denominator unaffected. Thus, more dispersion from the mean leads to lower welfare.

More generally, from equation (19) it is difficult to assess the precise impact of a particular change in the cross-section of markups. However, the formula can easily be used to quantify the welfare cost of the increase in markup dispersion across US industries documented in Figure 1 for the period 1968-1996. We start by evaluating equation (18) in the simplest case in which goods are equally weighted in utility, i.e., for $\gamma(i) = 1 \forall i \in [0, 1]$. Computing utility requires choosing a value for the elasticity of substitution among manufacturing goods, $1/(1-\alpha)$. Available estimates vary widely across studies, but most of them are in the range (2, 10). This implies a value of α between 0.5 and 0.9, that we take as benchmarks. As a proxy for markups, we use again sectoral price-cost margins, with $PCM(i) = 1 - \mu(i)$.¹³ For $\alpha = 0.5$, the formula yields a fall in utility (dU/U) below 1.5%, while the cost grows to more than 3% when a less prudential value $\alpha = 0.9$ is used. These costs can be larger when the $\gamma(i)$ s are allowed to vary. In particular, the weights in utility associated to different goods can be calibrated using data on PCMs and expenditure shares as follows:

$$\gamma(i) = \frac{\theta(i)^{1-\alpha} \mu(i)^{-\alpha}}{\int_0^1 \theta(i)^{1-\alpha} \mu(i)^{-\alpha} di},$$

where $\theta(i)$ is the expenditure share of good i and is calculated as the value of an industry's production plus net imports, divided by the total expenditure on industrial goods. Note that, calibrated in this way, the $\gamma(i)$ s also account for any asymmetry in costs. For $\alpha = 0.5$, the formula gives pretty much the same loss of 1.5%. Yet, the interesting novelty is that with a high elasticity of substitution ($\alpha = 0.9$), the welfare cost turns into an almost 7% drop in utility over the 37 years of analysis.

¹³See Section 3 for more details on how price cost margins are computed.

Finally, equation (18) has the intuitive implication that competition policy (including trade liberalization) should target large sectors with above average markups. This can be seen by taking the derivative of (18) with respect to our measure of competition in a sector, $\widehat{\mu}(i)$:

$$\frac{\partial U}{\partial \widehat{\mu}(i)} = \widehat{\gamma}(i) \frac{\left[\int_0^1 \widehat{\gamma}(i) \widehat{\mu}(i)^\alpha di \right]^{1/\alpha-1}}{\int_0^1 \widehat{\gamma}(i) \widehat{\mu}(i) di} \left[\frac{1}{\mu(i)} - \frac{\int_0^1 \widehat{\gamma}(i) \widehat{\mu}(i)^\alpha di}{\int_0^1 \widehat{\gamma}(i) \widehat{\mu}(i) di} \right].$$

This formula shows that an increase in the degree of competition in sector i increases (decreases) welfare whenever competition in that sector, $\mu(i)$, is below (above) a given average $\mu^* \equiv \int_0^1 \widehat{\gamma}(i) \widehat{\mu}(i)^\alpha di / \int_0^1 \widehat{\gamma}(i) \widehat{\mu}(i) di$. Moreover, the effect is stronger the bigger the size $\widehat{\gamma}(i)$ of the sector. While intuitive, considerations of these sorts are usually neglected in the debates about the effects of liberalization. They also suggest that further liberalizations in sectors where competition is already strong may be much less beneficial than expected.

2.2.1 Free Entry

So far, each firm is making positive profits and barriers to entry prevent potential competitors from challenging incumbent firms and sharing the rents. Without those barriers, entry will take place until pure profits are driven to zero. We now allow for this possibility in some industries. For the current purpose, we need not specify how competition takes place between producers of the same variety and how the equilibrium markup is determined. All we require is that there is a fixed cost of production and that, given the industry markup, the number of firms adjusts to guarantee that each of them breaks even. In this way, in equilibrium, all operating profits are used to cover the fixed cost.

For simplicity, we assume that the fixed cost is in terms of a bundle of goods with the same composition as final consumption (1). Then, to find utility of the representative agent, we can simply subtract the resources invested in fixed costs (i.e., operating profits) in sectors with free entry from (18):

$$U = \frac{\left\{ \int_0^1 [\gamma(i) \mu(i)^\alpha]^{1/(1-\alpha)} di \right\}^{1/\alpha}}{\int_0^1 [\gamma(i) \mu(i)]^{1/(1-\alpha)} di} - \frac{1}{L} \int_0^1 I(i) \pi(i) di, \quad (20)$$

where $\pi(i) = c(i) [p(i) - w]$ is the sum of all operating profits in sector i and $I(i)$ is an indicator function taking value one if there is free entry in sector i and zero otherwise. Given

that a fraction $1 - \mu(i)$ of revenue $c(i)p(i)$ goes into profits (see equation 11), an increase in competition, $\mu(i)$, has now a direct positive welfare effect in industries with free entry. The reason is that a fall in operating profits means that some firms must exit and less resources are wasted in fixed costs. This is the “rationalizing effect” of competition (see, for example, Helpman and Krugman, 1985), originating from a combination of free entry and fixed costs in models with variable markups. Although free entry introduces an additional (positive) effect of competition, it leaves the first term in (20), and thus our computations of the costs of markup dispersion, unaffected.

2.2.2 Endogenous Labor Supply

We briefly mention another reason why welfare can be decreasing in the average level of market power. In this model, wages are compressed by profits and are thus too low compared to the competitive equilibrium. When labor supply is elastic, this will distort the work-leisure decision. The strength of this distortion will depend upon the elasticity of labor supply. To see this, we normalize the number of workers in any country to one and introduce disutility from labor:

$$U = C - A \frac{L^{1+1/\xi}}{1+1/\xi},$$

where $C \equiv \left[\int_0^1 C(i)^\alpha di \right]^{1/\alpha}$, L is now hours worked by the representative agent, $\xi \geq 0$ is the elasticity of labor supply to wages and A is a positive parameter. For simplicity, we have also set $\gamma(i) = 1, \forall i \in [0, 1]$. Recalling that the price of the consumption basket C is $Q = 1$, the budget constrain of the representative agent is $C = wL + \pi$, where π is average profit. The first order condition for L is easily found as:

$$L = \left(\frac{w}{A} \right)^\xi. \quad (21)$$

If $\xi = 0$, then labor is inelastic to wages and we are back to the previous case. When $\xi > 0$, L depends on wages. Integrating $p(i) = P(i) = w/\mu(i)$ and using (4), wages can be expressed as:

$$w = \left[\int \mu(i)^{\alpha/(1-\alpha)} di \right]^{(1-\alpha)/\alpha} < MPL = 1, \quad (22)$$

where the latter equality follows from the fact that, with $\nu = 0$, labor productivity is one. That is, workers are not paid the full marginal product of labor (MPL), because part of it goes into profits. In this case, the welfare costs of market power can be decomposed into three parts: (1) as before, for a given L , the dispersion of market power lowers C ; (2) the concavity of (22) implies that the dispersion of $\mu(i)$ also reduces w and thus L below optimum. That is, the dispersion of market power also distorts labor supply; (3) given that $\mu(i)$ is less than one, wages are below the marginal product of labor and this lowers L even further. A fall in the dispersion of market power reduces distortions (1) and (2), while an increase in the average level of competition lowers distortion (3).

3 EMPIRICAL EVIDENCE

In this section we provide more evidence on the relationship between international trade and the dispersion of market power. As in the Introduction, we use the openness ratio as a proxy for trade exposure and price-cost margins (PCMs) as a proxy for market power, in this following a vast empirical literature (see, e.g., Roberts and Tybout, 1996; Tybout, 2003, Aghion et al., 2005).¹⁴ Due to data availability, we limit our analysis to the US manufacturing industries.¹⁵ In particular, we draw trade data from the NBER Trade Database by Feenstra and industry data from the NBER Productivity Database by Bartelsman and Gray. To our knowledge, the latter is the most comprehensive and highest quality database on industry-level inputs and outputs, covering roughly 450 manufacturing (4-digit SIC) industries for the period between 1958 and 1996.

We compute the openness variable as the ratio of imports plus exports divided by the value of shipments. Price-cost margins are instead computed as the value of shipments (adjusted for inventory change) less the cost of labor, capital, materials and energy, divided by the value of

¹⁴An important advantage of PCMs is that they can vary both across industries and overtime. An alternative approach would be to estimate markups from a structural regression *a la* Hall (1988). One problem with this approach is that, to estimate markups across industries or over time, either the time or industry dimension is to be sacrificed, implying that markups have to be assumed constant over time or across industries.

¹⁵We would ideally want to study the dispersion of market power economy-wide. Unfortunately, however, economy-wide data on industry sales and costs are generally available only at a high level of aggregation, thereby hiding much of the cross-industry dispersion of PCMs. Note, however, that focusing on the US manufacturing sector should provide a lower bound for the effects we aim to quantify. In fact, international trade may raise the dispersion of market power also by increasing asymmetries in markups between manufacturing (producing traded goods) and services (most of which are nontraded).

shipments.¹⁶ Capital expenditures are computed as $(r_t + \delta)K_{it-1}$, where K_{it-1} is the capital stock, r_t is the real interest rate and δ is the depreciation rate. Data on US real interest rates come from the World Bank-*World Development Indicators*.¹⁷ For the depreciation rate, δ , we choose a value of 7%, implying that capital expenditures equal, on average, roughly 10 percent of the capital stock.¹⁸ As a robustness check we also try, however, with a simpler measure of PCMs where we do not net out capital expenditures.

Figures 1 and 2 in the Introduction suggest a positive association between openness and the dispersion of price-cost margins in US industries. We now want to explore the robustness of this stylized fact and the causal relationship between the two variables. As a first step, we need an empirical strategy that allows us to exploit the cross-sectional and temporal variation in the NBER datasets. To this purpose, we construct the following industry-level proxy for the dispersion of market power: for each 3-digit SIC industry, we compute the standard deviation of PCMs among the 4-digit industries belonging to it. Next, we run Fixed-Effects within regressions in order to estimate the impact of a rise in the openness of 3-digit industries on the dispersion of market power within them.

What kind of results shall we expect from such an exercise? In principle, trade may increase the dispersion of PCM in some sectors and decrease it in others. In fact, our stylized model shows that trade may increase markup dispersion up to a point and then lower it. Yet, considering the evidence reported in Figures 1 and 2 plus the fact that the volume of trade is still relatively small for the typical US manufacturing sector, we may expect trade to increase dispersion even within 3-digit industries. As a preliminary check, Figure 3 confirms this guess. It reports that the average dispersion of PCMs within 3-digit industries (left scale) has increased together with the average openness of 3-digit industries (right scale) over the period of analysis. Thus, the stylized fact illustrated in the Introduction holds also within industries. Before moving to the more detailed analysis of the data, we want to stress the fact that the empirical exercises performed here are not meant to test our model, but rather to

¹⁶According to our model, $PCM(i) = (p(i)q(i) - wL(i))/p(i)q(i) = 1 - \mu(i)$, where $p(i)q(i)$ is the value of shipments and $wL(i)$ is the variable cost. Although in our simple model labor is the only variable cost, we also net out materials and capital expenditures in our empirical definition of price-cost margins. This avoids spurious variation in the PCMs due to variation in intermediates-intensity and capital-intensity.

¹⁷The US real interest rate has a mean value of 3.75 percent (with a standard deviation of 2.5 percent) over the period of analysis.

¹⁸The depreciation rates used in the empirical studies generally vary from 5% for buildings to 10% for machinery.

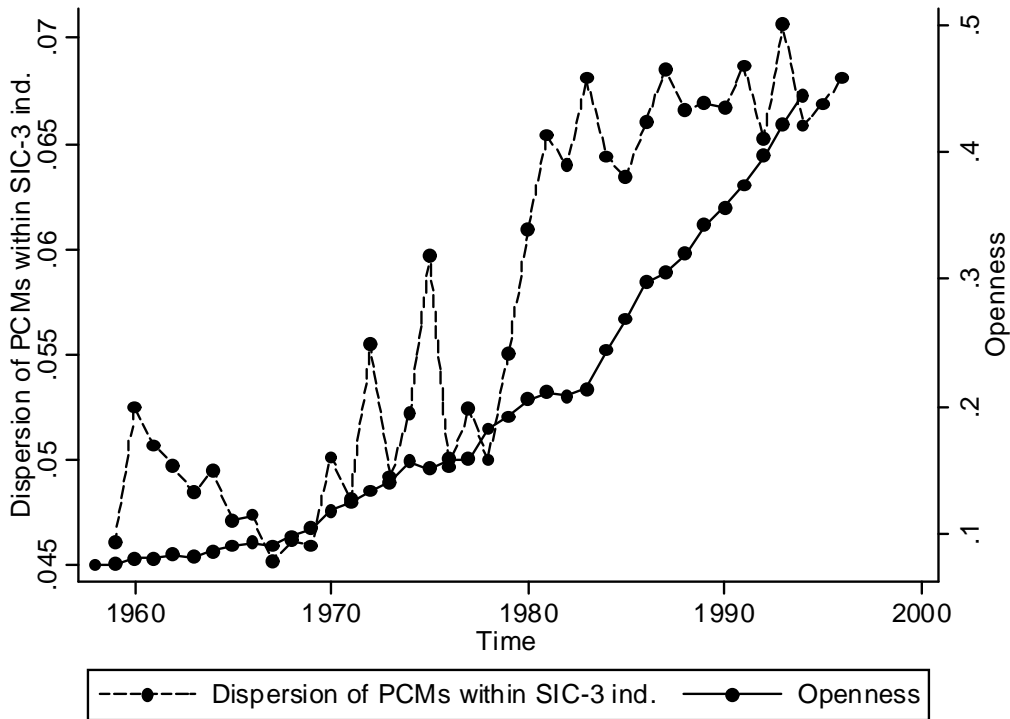


Figure 5: Openness and PCM Dispersion within SIC-3 Industries

provide a first indication of how trade has affected markup dispersion in the US economy.

Table 1 illustrates the main results of our Fixed-Effects within regressions. In column 1, we regress the standard deviation of the PCMs on the openness ratio only. The openness coefficient turns out positive and highly significant, with a t-statistic of 9. In column 2, we add time dummies to control for spurious results due to correlation of the openness ratio with time effects, e.g., the deregulation of the US economy initiated by the Carter Administration in the mid seventies. Note that in this case the openness coefficient is somewhat reduced, but is still significant well beyond conventional levels. In column 3, we add the average price-cost margin. Although the average PCM is clearly endogenous, including it ensures that the second moment of its distribution is not mechanically driven by variation in the first moment. We find that the size and significance of the openness coefficient are unaffected. Moreover, the coefficient of average PCMs is negative and significant, consistent with the idea that procompetitive forces may induce a fall of average markups while increasing their dispersion across industries.

As shown by the empirical literature on the procompetitive effect of liberalizations, price-cost margins may also be affected by industry characteristics. In this respect, by relying on Fixed-Effects estimates, we implicitly account for time-invariant technological heterogeneity across industries. However, technology may change over time. Therefore, in columns 4-6 we control for various proxies of industry technology. In particular, we add, sequentially, total factor productivity (TFP5, from the Bartelsman and Gray’s database) to control for productivity growth, the ratio of non-production to production workers (which proxies for the skill ratio) to control for skill upgrading, and the capital-output ratio to control for changes in the capital-intensity. While these controls are generally significant, they leave the sign and significance of the openness coefficient virtually unchanged. In column 7, we also control for industry size using the log of the real value of shipments as a proxy. The openness coefficient is slightly reduced but is still significant beyond the one percent level. Finally, in column 8 we use a linear trend instead of time dummies and find no change in the results.

In Table 2, we rerun the same regressions as in Table 1 using a different definition of price-cost margins. In particular, we now treat capital expenditures as a fixed cost paid with operating profits, and therefore do not subtract these costs from the numerator of PCMs.¹⁹ It is reassuring that our main results hold when using this alternative measure of price-cost margins.

The above results suggest that the positive association between openness and the dispersion of market power is a robust stylized fact, yet they do not allow us to infer much about the direction of causality. To address this issue, we next run Fixed-Effects-Instrumental-Variables regressions for the dispersion of PCMs. A unique advantage of the NBER dataset is that its long temporal dimension allows to rely on distant lags of our covariates as potentially valid instruments. To start with, in columns 1 and 2 of Table 3 we rerun a baseline Fixed-Effects regression using lagged instead of current values of openness (see column 2 of Table 1 for a comparison). In particular, we use, respectively, the 5th and 10th lag of the openness ratio. Note that in both cases the coefficient of lagged openness is positive, highly significant and larger than the coefficient estimated using current openness. This is *prima facie* evidence of a possible causal link between openness and the dispersion of market power, and suggests that

¹⁹Actually, capital expenditures are in part variable costs and in part fixed costs. Netting out capital expenditures may therefore cause underestimation of PCMs, whereas not netting them out may induce overestimation of PCMs.

trade liberalization may take some time to fully exert its impact on market structure.

In column 3, we instrument the openness ratio using its lagged values as instruments. The choice of lag structure is dictated by the standard tests for the quality of the instruments. In particular, the table reports the P -value of Hansen’s J -statistic of overidentifying restrictions and the F -statistic of excluded instruments in first stage regressions. Some experimentation suggests that distant lags (around the 10th lag) provide valid instruments for the openness ratio. In particular, the high value of the F -statistic suggests that our instruments are strong, and the J -statistic suggests against their endogeneity. We find that the openness coefficient is positive, highly significant and much larger than in the simple Fixed-Effects regressions. In column 4, we add all the controls used in previous tables treating them as exogenous. Note that the results are unaffected. Finally, in column 5 we treat all our covariates as endogenous and use their distant lags as instruments. The F -statistics of excluded instruments are all high and the Hansen’s statistic is insignificant. Again, the coefficient of the openness ratio is large and very precisely estimated.²⁰

In closing, we briefly comment on the quantitative relevance of our estimates. The average openness of US industries increased by 37 percentage points in the period of analysis (from 0.087 in the late 50s to 0.459 in the mid 90s). Using a value of 0.1 as a benchmark for the impact of openness on the standard deviation of PCMs, this implies that trade increased the dispersion of PCMs by 0.037. This is *more* than the overall observed increase in the dispersion of PCMs (around 0.025, see Figure 3). To conclude, our preliminary analysis suggests the impact of trade on markup dispersion to be large, thereby raising warnings that procompetitive losses from trade may not be negligible.

4 CONCLUDING REMARKS

Competition is imperfect in most sectors of economic activity. By exposing firms to foreign competition, trade is widely believed to help alleviate the distortions stemming from monopolistic pricing. While this argument is certainly appealing and often well-grounded, it neglects that, in general equilibrium, pricing distortions depend on both the *absolute* and *relative* market power and that a trade-induced fall in markups may bring unexpected costs when it raises

²⁰Remarkably, the coefficient is virtually identical to the one estimated by OLS on aggregate data in the Introduction.

their variance. Our simple model illustrates this point with the highest transparency.

By no mean we want to claim that the dispersion of monopoly power matters more than the average. Yet, our model shows that disregarding it altogether can lead to potentially large mistakes in quantifying the welfare effects of trade and competition policy. As a corollary, policy makers should recognize that the characteristics of sectors affected by the ongoing process of international integration and particularly their competitiveness relative to the rest of the economy are important factors to correctly foresee the costs and benefits of globalization.

Finally, our first look at the evidence suggests that trade is systematically associated with a higher dispersion of markups. This is an interesting and perhaps surprising result, as theory does not impose much restrictions on how trade may affect markup dispersion. Investigating this relationship more in detail and understanding the mechanism generating it seem important questions for future research.

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5 APPENDIX

We prove the properties of the welfare function (16). The derivative with respect to τ is:

$$\frac{\partial U}{\partial \tau} = \frac{\left[1 - \tau + \tau x^{\frac{1}{1-\alpha}}\right] \frac{1}{\alpha} \left[1 - \tau + \tau x^{\frac{\alpha}{1-\alpha}}\right]^{\frac{1-\alpha}{\alpha}} \left[x^{\frac{\alpha}{1-\alpha}} - 1\right] - \left[x^{\frac{1}{1-\alpha}} - 1\right] \left[1 - \tau + \tau x^{\frac{\alpha}{1-\alpha}}\right]^{\frac{1}{\alpha}}}{\left[1 - \tau + \tau x^{\frac{1}{1-\alpha}}\right]^2}. \quad (23)$$

First, we evaluate this derivative at the autarky point ($\tau = 0$):

$$\left. \frac{\partial U}{\partial \tau} \right|_{\tau=0} = 1 - \frac{1}{\alpha} - x^{1/(1-\alpha)} \left(1 - \frac{1}{\alpha x} \right). \quad (24)$$

Note that this derivative is zero when $x = 1$:

$$\left. \frac{\partial U}{\partial \tau} \right|_{\tau=0} = 0 \text{ if } x = 1.$$

That is, if there is no asymmetry in markups, a marginal move from autarky to trade in some sectors does not affect welfare. Taking the derivative of (24) with respect to x we find:

$$\left. \frac{\partial^2 U}{\partial \tau \partial x} \right|_{\tau=0} = \frac{\alpha^2(1-x)}{1-\alpha} x^{1/(1-\alpha)} < 0, \quad (25)$$

because $x > 1$. Thus, as x grows, the effect of trade on welfare given by (24) becomes negative. By inspection of (25), the effect is greater the higher is α . Thus, the negative welfare effect of a marginal increase in trade starting from autarky is stronger when x and α are high.

Second, we evaluate the derivative (23) at the point $\tau = 1$:

$$\left. \frac{\partial U}{\partial \tau} \right|_{\tau=1} = 1 - \frac{x}{\alpha} - x^{1/(1-\alpha)} \left(1 - \frac{1}{\alpha} \right). \quad (26)$$

Note that this derivative is zero when $x = 1$:

$$\left. \frac{\partial U}{\partial \tau} \right|_{\tau=1} = 0 \text{ if } x = 1.$$

That is, if there is no asymmetry in markups, a final move to free trade in all sectors (in a neighborhood of $\tau = 1$) does not affect welfare. Taking the derivative of (26) with respect to x we find:

$$\left. \frac{\partial^2 U}{\partial \tau \partial x} \right|_{\tau=1} = \left[x^{\alpha/(1-\alpha)} - 1 \right] > 0, \quad (27)$$

because $x > 1$. Thus, as x grows, the effect of trade on welfare given by (26) becomes positive. By inspection of (27), the effect is greater the higher is α . Thus, the positive welfare effect of a marginal increase in trade in the vicinity of $\tau = 1$ is stronger when x and α are high.

The derivative of the welfare function (16) with respect to x is:

$$\begin{aligned} \frac{\partial U}{\partial x} &= \frac{\tau}{x} \frac{[1 - \tau + \tau x^{\alpha/(1-\alpha)}]^{1/\alpha} x^{\alpha/(1-\alpha)}}{(1-\alpha) [1 - \tau + \tau x^{1/(1-\alpha)}]^2} \left[\frac{1 - \tau + \tau x^{1/(1-\alpha)}}{1 - \tau + \tau x^{\alpha/(1-\alpha)}} - x \right] = \\ &= \frac{\tau}{x} \frac{[1 - \tau + \tau x^{\alpha/(1-\alpha)}]^{1/\alpha} x^{\alpha/(1-\alpha)}}{(1-\alpha) [1 - \tau + \tau x^{1/(1-\alpha)}]^2} \cdot \frac{(1-\tau)(1-x)}{1 - \tau + \tau x^{\alpha/(1-\alpha)}} < 0, \end{aligned}$$

because all factors are positive, except for $1 - x$.

Table 1. Trade and the Dispersion of Market Power

Dependent Variable: Standard Deviation of PCMs within 3-Digit SIC Industries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Openness</i>	0.033*** (0.004)	0.019*** (0.004)	0.019*** (0.004)	0.019*** (0.004)	0.020*** (0.004)	0.020*** (0.004)	0.015*** (0.004)	0.014*** (0.004)
<i>Average PCM</i>			-0.064*** (0.018)	-0.070*** (0.018)	-0.073*** (0.018)	-0.068*** (0.018)	-0.071*** (0.018)	-0.089*** (0.016)
<i>TFP</i>				0.007 (0.007)	0.008 (0.006)	0.009 (0.006)	0.031*** (0.007)	0.033*** (0.007)
<i>Skill ratio</i>					-0.037*** (0.007)	-0.036*** (0.007)	-0.025*** (0.007)	-0.021*** (0.007)
<i>Capital output ratio</i>						0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
<i>log of real shipments</i>							-0.016*** (0.002)	-0.017*** (0.002)
<i>Time trend</i>								0.001*** (0.000)
<i>Time dummies</i>	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Observations	3648	3648	3648	3648	3648	3648	3648	3648
SIC-3 Industries	96	96	96	96	96	96	96	96
R-squared (within)	0.04	0.12	0.12	0.12	0.13	0.14	0.15	0.14

Notes: Fixed-Effects (within) estimates with robust standard errors in parentheses. ***, **, * = significant at the 1, 5 and 10-percent levels, respectively. Coefficients of time dummies not reported. Data sources: NBER Productivity Database (by Bartelsman and Gray) and NBER Trade Database (by Feenstra).

Table 2. Trade and the Dispersion of Market Power – Robustness Check: Capital Expenditures Treated as a Fixed Cost

Dependent Variable: Standard Deviation of PCMs within 3-Digit SIC Industries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Openness</i>	0.021*** (0.003)	0.012*** (0.004)	0.011*** (0.004)	0.011*** (0.004)	0.012*** (0.004)	0.013*** (0.004)	0.010** (0.004)	0.008** (0.004)
<i>Average PCM</i>			0.038** (0.015)	0.029* (0.016)	0.026* (0.016)	0.033** (0.016)	0.031** (0.016)	0.020 (0.014)
<i>TFP</i>				0.010* (0.006)	0.012** (0.006)	0.013** (0.006)	0.026*** (0.006)	0.030*** (0.006)
<i>Skill ratio</i>					-0.047*** (0.007)	-0.046*** (0.007)	-0.039*** (0.007)	-0.033*** (0.007)
<i>Capital output ratio</i>						0.002** (0.001)	0.002* (0.001)	0.002* (0.001)
<i>log of real shipments</i>							-0.010** (0.004)	-0.013*** (0.003)
<i>Time trend</i>								0.001*** (0.000)
<i>Time dummies</i>	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Observations	3744	3744	3648	3648	3648	3648	3648	3648
SIC-3 Industries	96	96	96	96	96	96	96	96
R-squared (within)	0.02	0.08	0.08	0.09	0.10	0.13	0.14	0.12

Notes: Fixed-Effects (within) estimates with robust standard errors in parentheses. ***, **, * = significant at the 1, 5 and 10-percent levels, respectively. Coefficients of time dummies not reported. Data sources: NBER Productivity Database (by Bartelsman and Gray) and NBER Trade Database (by Feenstra).

Table 3. Trade and the Dispersion of Market Power – IV

Dependent Variable: Standard Deviation of PCMs within 3-Digit SIC Industries

	(1)	(2)	(3)	(4)	(5)
	FE	FE	IV	IV	IV
	5-year lagged Openness	10-year lagged Openness	Baseline	Adding exogenous controls	Adding endogenous controls
Openness	0.024***	0.043***	0.069***	0.061***	0.099***
	(0.004)	(0.007)	(0.017)	(0.017)	(0.029)
<i>Average PCM</i>				-0.104***	-0.067
				(0.025)	(0.084)
<i>TFP</i>				0.024**	-0.033*
				(0.011)	(0.011)
<i>Skill ratio</i>				-0.026**	-0.096***
				(0.011)	(0.034)
<i>Capital output ratio</i>				0.001***	0.001
				(0.000)	(0.001)
<i>log of real shipments</i>				-0.012***	0.007
				(0.005)	(0.008)
<i>Time dummies</i>	Yes	Yes	Yes	Yes	Yes
P-value Hansen J- statistic			0.42	0.45	0.93

F-statistics of excluded instruments in first stage regressions

<i>Openness</i>			18.83	17.38	13.88
<i>Average PCM</i>					18.08
<i>TFP</i>					41.6
<i>Skill ratio</i>					16.50
<i>Capital output ratio</i>					9.71
<i>log of real shipments</i>					78.66
Observations	3264	2784	2496	2496	2688
SIC-3 Industries	96	96	96	96	96
R-squared	0.65	0.66	0.64	0.66	0.59

Notes: FE = Fixed-Effects (within) estimates; IV = Fixed-Effects (within) Instrumental-Variables estimates. Robust standard errors in parentheses. ***, **, * = significant at the 1, 5 and 10 percent levels, respectively. In columns (1) and (2) the openness ratio is lagged 5 and 10 years, respectively. In columns (3)-(5), the openness ratio is treated as endogenous using its lagged values as instruments. In column (5), all RHS variables are treated as endogenous using their lagged values as instruments. Time dummies are always used as additional instruments. The middle panel of the table reports the *F*-statistics for the null that excluded instruments do not enter first stage regressions. Data sources: NBER Productivity Database (by Bartelsman and Gray) and NBER Trade Database (by Feenstra).