Procompetitive Losses from Trade*

Paolo Epifani†
Bocconi University

Gino Gancia‡
CREI and CEPR

May 2007

PRELIMINARY

Abstract

In this paper, 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 show evidence that trade might be responsible for it, and provide some quantifications of the induced welfare cost. We conclude that, to avoid some unpleasant effects of globalization, trade integration should be followed by deregulation (i.e., procompetitive reforms) in non-traded sectors. Our results also suggest that having competitive domestic markets may be a pre-requisite to fully benefit from trade integration.

JEL Numbers: F12, F15.

Keywords: Markups, Market Power Dispersion, Procompetitive Effect, Trade and Welfare.

*We would like to thank Winfried Koeniger, Omar Licandro, Jaume Ventura and partecipants at the UPF Faculty Lunch, the Macro workshop at IEW, Zurich University and the IADB-ELSNIT (Paris, 2006) for comments and discussion. All errors are our own.

†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

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 barrier (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, independently of its 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 the 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 increase or decrease 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 change

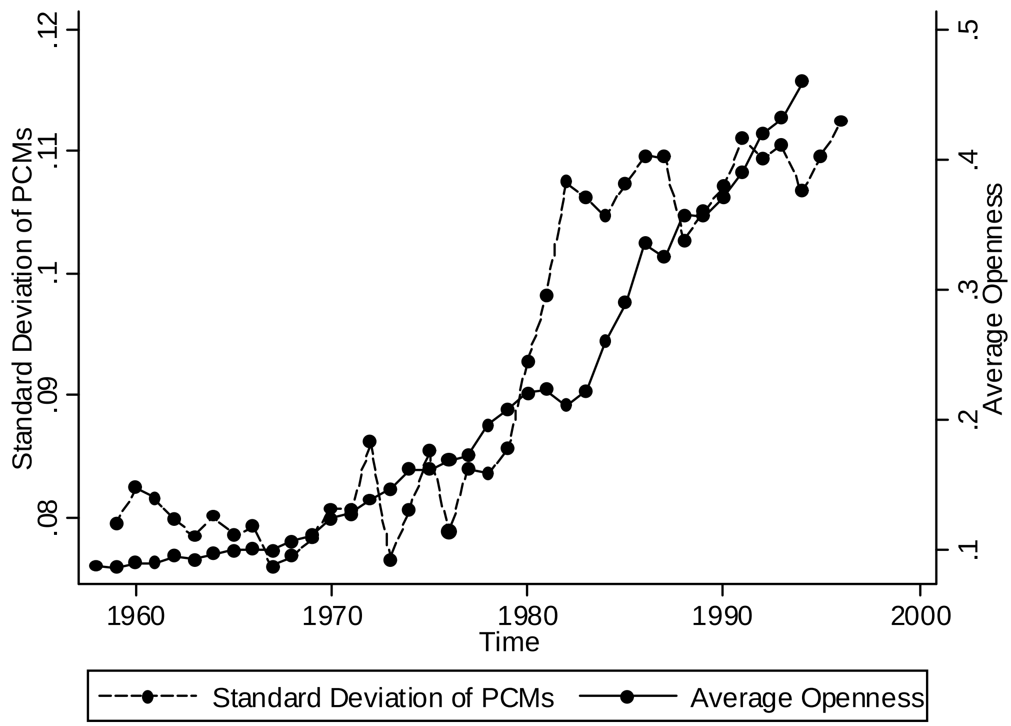

Figure 1: Openness and the Dispersion of PCMs

the dispersion of monopoly power in the economy. There are good reasons to expect the impact of trade to differ across industries. This might be the case because trade policy varies substantially across sectors and because there are sectors (e.g., services) that are naturally less exposed to international competition. Even among freely traded goods, transportation costs vary dramatically implying that some sectors are more shielded from foreign competition than others.

How trade affects the dispersion of market power is ultimately an empirical question to which Figure 1 provides a first answer. The graph shows the evolution of the dispersion of markups across industries in the US economy and average trade openness over the period 1958-1996. Following Tybout (2003), Aghion et al. (2005) and others, we use Price-Cost Margins (PCMs) as a proxy for industry markups, computed for 450 manufacturing sectors from the Bartelsman and Gray database.[1] The broken line in Figure 1 represents the standard

[1] See section 3 of the paper for more details on the data.

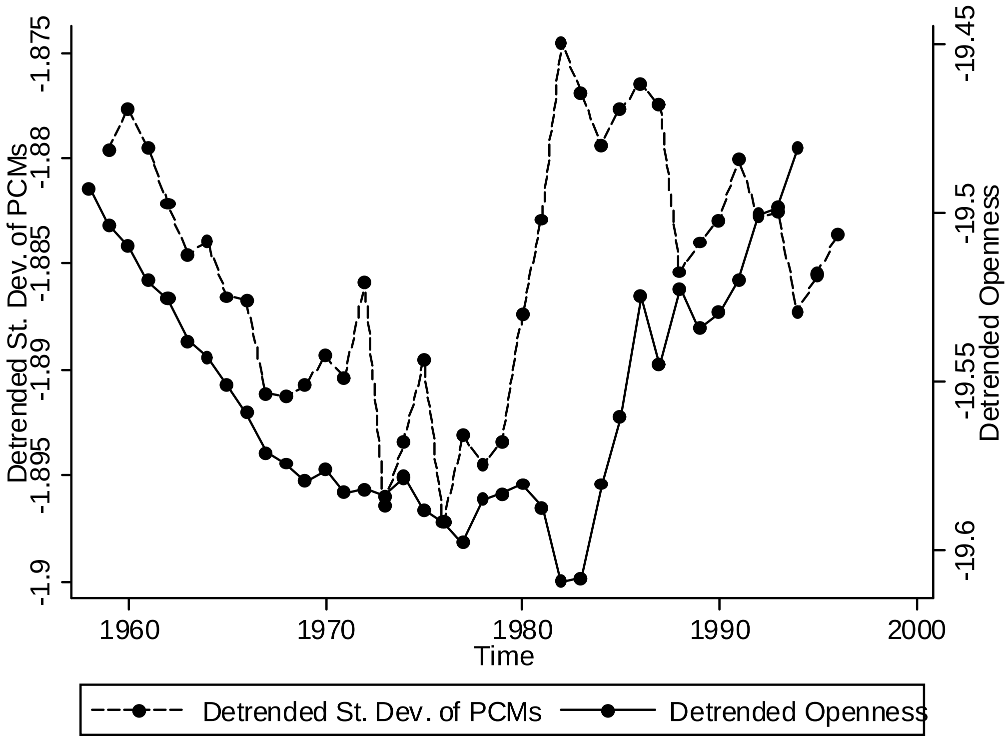

Figure 2: Openness and the Dispersion of PCMs (Detrended Series)

deviation of the PCMs. It is immediate to see that, starting from the mid 70s, the dispersion of PCMs shows a relentless increase. The solid line displays instead the evolution of the average openness of US industries taken from the NBER Trade Database by Feenstra. It is equally apparent that the two series chase each other closely. Figure 2 reinforce 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 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 also 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 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.[2] 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, but rather that international competition may inefficiently increase inequality across the sectors of the economy.

This paper also contributes to the growing literature on deregulation of markets (i.e., policies aimed at promoting competition and firms' entry).[3] 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 II shows how the procompetitive effect associated to international trade affects welfare by changing the dispersion of market power and might lead to welfare losses. It also shows that the welfare effects may not be negligible. Section III shows evidence that the dispersion of market power increased across US manufacturing sectors and that trade might be responsible for it. Section IV concludes.

[2] A number of papers have instead recognized that symmetry may neutralize monopoly distortions. These include the classical article by Lerner (1934) and more recent contributions such as Neary (2003), Koeniger and Licandro (2006) and Bilbiie, Ghironi and Melitz (2006).

[3] Blanchard and Giavazzi (2003) is a prominent example. See Schiantarelli (2005) for an extensive survey.

2 International Trade, Competition and Welfare

We build a stylized model of a world economy populated by a large number $N \in \mathbb{N}^+$ of identical countries. There is a continuum $[0,1]$ of industries and each industry is composed of varieties of differentiated goods. Following Armington, countries are specialized in different varieties and may trade with each other. However, we consider a situation of imperfect market integration in which 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 per sector and entry is restricted. Firms in different industries are exposed to different degrees of competition depending on possibility to trade their products internationally. Firms producing nontraded goods only face competition from other sectors of the economy. 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 $n, m \in \{1, ..., N\}$ to indicate varieties within a sector. Given that each country produces a single variety in every sectors, N is also the number of countries. Preferences of the representative agent in any country are given by the following CES utility function:

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

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

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

where $P(i)$ $(P(j))$ is the cost of one unit of the consumption basket $C(i)$ $(C(j))$.

Before defining $C(i)$, that will be a basket of the N varieties produced in different countries in sector i, it is 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 industries and sectors are ordered such that those 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.[4] We are now ready to define $C(i)$.

Preferences for varieties produced in different countries in sector i are represented by another CES subutility function:

$$C(i) = N^{\nu+1} \left[\frac{1}{N} \sum_{n \in N} c(i,n)^{\beta} \right]^{1/\beta}, \ 1 \geq \beta > \alpha, \ \nu \geq 0, \tag{3}$$

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. We assume that $\beta = f(N)$ with $f'(N) > 0$ so that an increase in the number of varieties N raises the elasticity of substitution between them. Note that, in nontraded sectors, (3) reduces to $c(i,n)$ where n is the domestically produced variety. Equation (3) has a number of important properties.

The sub-utility function $C(i)$ 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 (3), greater variety is associated with higher utility whenever $\nu > 0$. To see this, suppose that $c(i,n) = c$ so that the total quantity consumed is $cN = C$. Then, the sub-utility derived in the typical country from consumption in sector i will be $N^{\nu}C$, which, holding constant total consumption C, is increasing in N whenever $\nu > 0$. The standard Dixit-Stiglitz preferences are a special case of (3) 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 be identified

[4] For 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.

by the elasticity of demand, $1/(1-\beta)$: a very elastic demand 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 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.[5]

Finally, it is important to understand the assumptions $\alpha < \beta$ and $\beta = f(N)$ with $f'(N) > 0$. The first 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, this implies that competition in international markets is stiffer than competition in domestic markets. The second implies that an increase in the number of trading partners raises the degree of substitutability between the higher number of varieties. This is the case considered more realistic by Krugman (1979) and Blanchard and Giavazzi (2003).[6] These two assumptions deliver the procompetitive effect of trade, in that exposure to international competition 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 (3) subject to a budget constraint yields

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

[6] This is a natural implication of 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). An alternative demand function delivering similar results is the translog formulation proposed by Feenstra (2003). Note also that the assumption $f'(N) > 0$ is not crucial for the main result of the paper.

demand functions with a price-elasticity of $1/(1-\beta)$:

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

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 $C(i)$:

$$P(i) = N^{-\nu}\left[\frac{1}{N}\sum_{n\in N} p(i,n)^{\beta/(\beta-1)}\right]^{(\beta-1)/\beta}. \tag{4}$$

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 capture the presence of government regulations and reflect 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, $(1-1/\epsilon)^{-1}$, of the relevant price elasticity of demand ϵ. In open sectors, this elasticity is $1/(1-\beta)$, because firms compete against foreign varieties. Firms producing nontraded goods, instead, compete only against firms in other sectors, so that their relevant demand elasticity, $1/(1-\alpha)$, is lower. We assume that domestic competition policy might affect the markup charged by firms, setting an upper bound to it. This upper bound can be thought of as the limit price that the monopolist can charge to prevent entry of additional firms. We focus on the most interesting case in which this upper bound may be binding in nontraded sectors but not in open sectors, so that world markets are more competitive than domestic markets. To summarize, pricing behavior is as follows:

$$p(i,n) = p(i) = \frac{w}{\mu(i)} \text{ with } \begin{cases} \mu(i) = \beta \text{ for } i \in [0,\tau] \\ \beta < \mu(i) < \alpha \text{ for } i \in (\tau,1] \end{cases} \tag{5}$$

Note that $\mu(i) \in (0,1)$ parametrizes the degree of competition. As $\mu(i) \to 0$ 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 $\mu(i) \to 1$ the elasticity of demand is infinite so that firms cannot raise the price above the marginal cost, or else demand would drop to zero. From (5) it follows that markups and prices are lower in traded sectors. We define x as the price of any nontraded variety $i \in (\tau,1]$ relative to that of any traded variety $j \in [0,\tau]$:

$$x \equiv \frac{p(i)}{p(j)} = \frac{\mu(j)}{\mu(i)}$$

Our assumptions imply $1 < x < \beta/\alpha$.

2.0.3 General Equilibrium

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

$$C(i) = \begin{cases} N^{\nu} L(i)/L \text{ for } i \in [0,\tau] \\ L(i)/L \text{ for } i \in (\tau,1] \end{cases} \tag{6}$$

where $L(i)$ is employment in sector i and L is the total labor supply of any country. Equations (6) show that domestic consumption equals $1/N$ of world output of traded sectors, while it equals domestic production in nontraded industries. Finally, allocation of labor across sectors can be solved using (6), (5) and (4) into (2). Comparing employment in any sector $j \in [0,\tau]$ exposed to trade to any other nontraded sector $i \in (\tau,1]$ yields:

$$L(j) = L(i)\left[\frac{\mu(j)}{\mu(i)}\frac{\gamma(j)}{\gamma(i)}\right]^{1/(1-\alpha)} N^{\nu\alpha/(1-\alpha)}. \tag{7}$$

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:

$$\int_0^1 L(i)\, di = L \tag{8}$$

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 (7) and (8) imply:

$$L(i) = \begin{cases} L\left[\tau + (1-\tau)(x)^{1/(\alpha-1)}\right]^{-1} & \text{for } i \in [0,\tau] \\ L\left[\tau(x)^{1/(1-\alpha)} + (1-\tau)\right]^{-1} & \text{for } i \in (\tau,1] \end{cases} \tag{9}$$

Note that traded sectors attract more workers for they are more competitive and thus pay a higher share of revenues in wages. Substituting (9) and (6) into (1) we obtain utility of the representative agent as a function of τ and x:

$$U(\tau,x) = \frac{\left[1-\tau+\tau x^{\alpha/(1-\alpha)}\right]^{1/\alpha}}{1-\tau+\tau x^{1/(1-\alpha)}} \tag{10}$$

Equation (10) 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 increases it only after τ has reached a critical point. To see this, we derive equation (10) with respect to 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

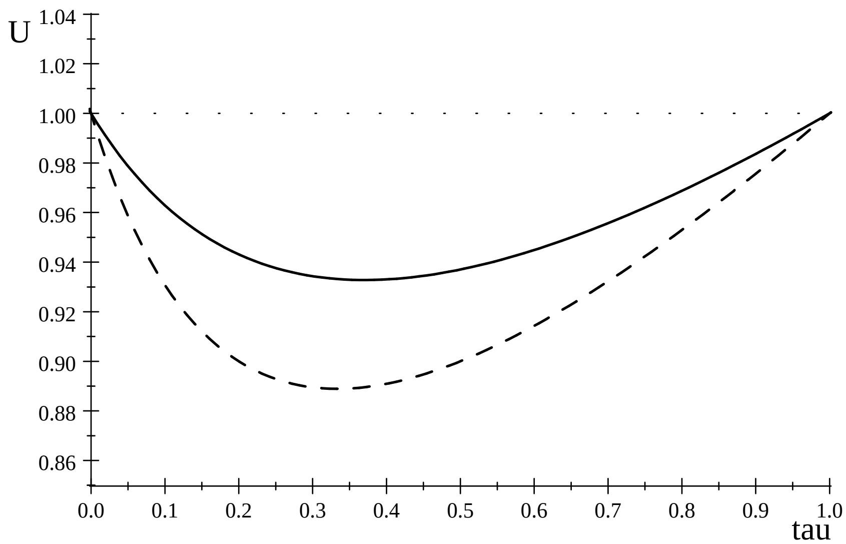

Figure 3: Trade and Welfare

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? Given that $\beta'(N) > 0$, an increase in N makes demand for traded varieties more elastic and force firms in open sectors to lower their markups. The markup in sectors closed to trade remain 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:

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

The inequality follows as all factors are positive, except for $(1-x)$. See the Appendix for more details on the derivation.

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.[7] 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 fall 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.[8]

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. 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 (9) 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 $\alpha < \beta/x$, 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 show that, when $\nu > 0$, utility of the representative agent becomes:

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

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

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

[8] A 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.

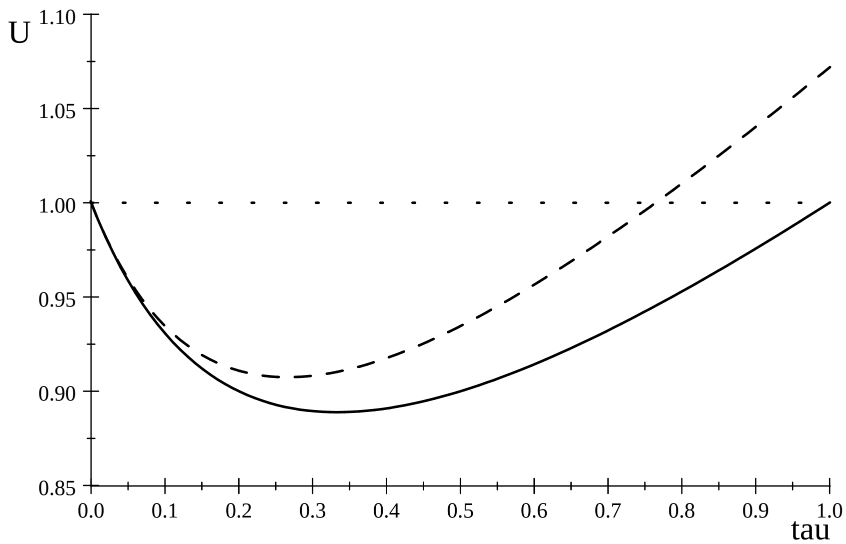

Figure 4: Trade and Welfare with $\nu \geq 0$

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

We now 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 that, under more general conditions, the monopolistic distortion may not depend on the average markup but rather on a precise measure of its dispersion. 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. The formula we derive will also be used to asses whether the effects we discuss are more than just a *curiosum*.

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:

$$L(i) = \frac{[\mu(i)\gamma(i)]^{1/(1-\alpha)}}{\int_0^1 [\mu(i)\gamma(i)]^{1/(1-\alpha)}\,di} L \tag{11}$$

Using (11) together with the goods market clearing condition $C(i) = L(i)/L$ into (1) we find a general expression for utility:

$$U = \frac{\left\{\int_0^1 [\gamma(i)\mu(i)^{\alpha}]^{1/(1-\alpha)}\,di\right\}^{1/\alpha}}{\int_0^1 [\gamma(i)\mu(i)]^{1/(1-\alpha)}\,di} \tag{12}$$

From (12) 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 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 (12) as follows:

$$U^{\alpha} = \frac{\mathrm{E}(\widehat{\mu}^{\alpha})\,\mathrm{E}(\widehat{\gamma}) + \mathrm{cov}(\widehat{\gamma}, \widehat{\mu}^{\alpha})}{[\mathrm{E}(\widehat{\mu})\,\mathrm{E}(\widehat{\gamma}) + \mathrm{cov}(\widehat{\gamma}, \widehat{\mu})]^{\alpha}}, \tag{13}$$

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 (13) 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 (13) 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 the Introduction for the period 1968-1996. We start by evaluating equation (12) 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 benchmark. As a proxy for markups, we use again sectoral price cost margins, with $PCM(i) = 1 - \mu(i)$.[9] 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. 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.

Finally, equation (12) 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 (12) 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 that expected.

[9] See Section 3 for more details on how price cost margins are computed.

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 allows 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 (12):

$$U = \frac{\left\{\int_0^1 \left[\gamma\left(i\right)\mu\left(i\right)^{\alpha}\right]^{1/(1-\alpha)} di\right\}^{1/\alpha}}{\int_0^1 \left[\gamma\left(i\right)\mu\left(i\right)\right]^{1/(1-\alpha)} di} - \int_0^1 I\left(i\right)\pi\left(i\right)di, \tag{14}$$

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 5), 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 and additional (positive) effect of competition, it leaves the first term in (14), 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 $C \equiv \left[\int_0^1 \gamma(i)\, C(i)^{\alpha}\, di\right]^{1/\alpha}$, 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. Setting the price index of the consumption basket C equal to one, 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:

$$L = \left(\frac{w}{A}\right)^{\xi}. \tag{15}$$

If $\xi = 0$, then labor is inelastic to wages and we are back to the previous case. When $\xi > 0$, L depends on wages. Given that the wage bill is a fraction $\mu(i)$ of revenue in any sector and that the aggregate revenue has to be equal to C, wages can be expressed as:

$$w = \left[\int_0^1 \mu(i)\, di\right]\frac{C}{L} < MPL = \frac{C}{L} \tag{16}$$

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. First, as before, for a given L, the dispersion of market power lowers C. Second, (16) and (15) show that a low C also reduces w and L below optimum. That is, the dispersion of market power also distorts labor supply. Third, given that $\mu(i)$ is less that one, wages are below the marginal product of labor and this lowers L even more. 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 on the procompetitive effect of trade liberalization (see, e.g., Roberts and Tybout, 1996; Tybout, 2003).[10] Due to data availability, we limit our analysis to the US manufacturing industries.[11] 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 shipments.[12] 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*.[13] 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.[14] 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 suggests 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 dataset. To this purpose, we construct the following industry-level proxy for the

[10] An 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 là* 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.

[11] We 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).

[12] According 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.

[13] The 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.

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

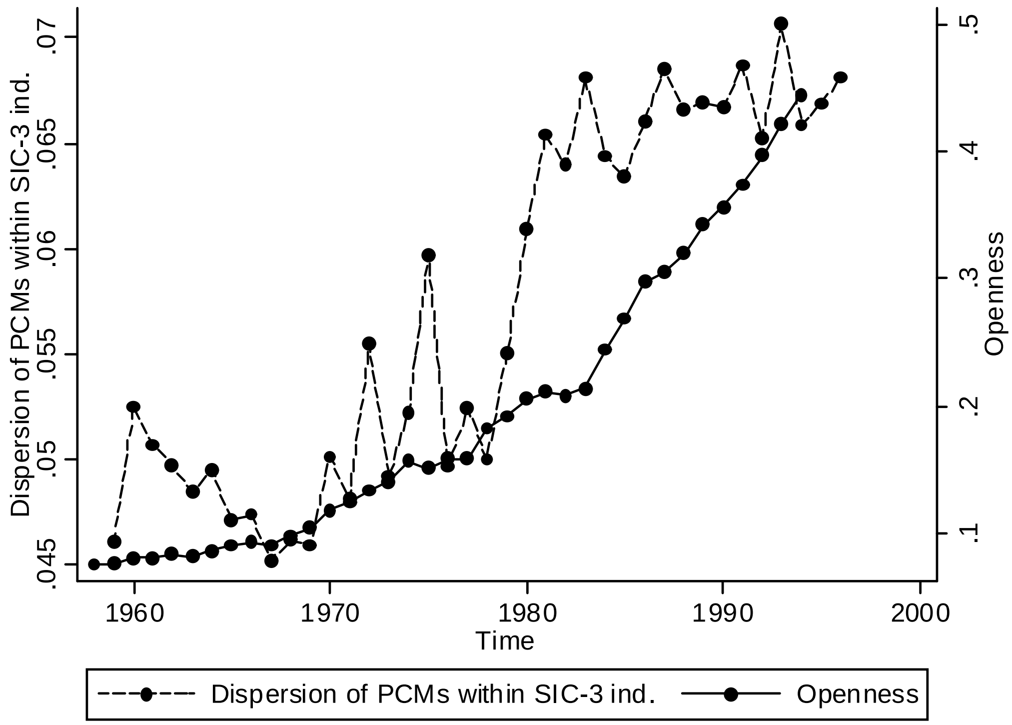

Figure 5: Openness and PCM Dispersion within SIC-3 Industries

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 result shall we expect from such an exercise? In principle, trade may increase the dispersion of PCM in some sectors an 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 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.[15] 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 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 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.[16]

[15] Actually, 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.

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

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 rasing warnings that the procompetitive losses from trade may have been far from negligible.

4 Concluding Remarks

Competition is not perfect 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 the fact that, in general equilibrium, pricing distortions depend both on *absolute* and *relative* market power and that a trade-induced fall in markups may bring unexpected costs when it raises their variance.

By no mean we want to claim that the dispersion of monopoly power matters more that the average. Yet, we have shown 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.

References

[1] Aghion, P., N. Bloom, R. Blundell, R. Griffith and P. Howitt (2005). "Competition and Innovation: an inverted U Relationship." *Quarterly Journal of Economics* 120, 701-728.

[2] Benassy, J.P. (1998), "Is There Always Too Little Research in Endogenous Growth with Expanding Product Variety?," *European Economic Review*, 42, 61-69.

[3] Bilbiie, F., F. Ghironi and M. Melitz (2006). "Monopoly Power and Endogenous Variety in Dynamic Stochastic General Equilibrium: Distortions and Remedies," mimeo.

[4] Blanchard, O. and F. Giavazzi (2003). "Macroeconomic Effects of Regulation and Deregulation on Goods and Labor Markets," *Quarterly Journal of Economics* 879-907.

[5] Brander, J. and P. Krugman (1983). "A Reciprocal Dumping Model of International Trade," *Journal of International Economics,* 15 313-321.

[6] Campbell, J. and H. Hopenhayn (2005). "Market Size Matters," *Journal of Industrial Economics* 53, 1-25.

[7] Epifani, P. and G. Gancia (2006). "Increasing Returns, Imperfect Competition and factor Prices," *Review of Economics and Statistics,* forthcoming.

[8] Feenstra, R. (2003). "A Homothetic Utility Function for Monopolistic Competition Models, without Constant Price Elasticity," *Economics Letters* 78, 79-86.

[9] Hall, R. E. (1988). "The Relations Between Price and Marginal Cost in U.S. Industry," *Journal of Political Economy* 96, 921-947.

[10] Helpman, E. and P. Krugman, *Market Structure and Foreign Trade* (Cambridge MA: MIT Press, 1985).

[11] Koeniger, W. and O. Licandro (2006). "On the Use of Substitutability as a Measure of Competition," *Topics in Macroeconomics* 6-1.

[12] Krugman, P. (1979). "Increasing Returns, Monopolistic Competition and International Trade," *Journal of International Economics* 9, 469-479.

[13] Lerner, A.P. (1934). "The Concept of Monopoly and the Measurement of Monopoly Power," *Review of Economic Studies* 1, 157-175

[14] Neary, J.P. (2003). "Globalization and Market Structure" *Journal of the European Economic Association* vol 1, 245-271.

[15] Roberts, M. J. and J. R. Tybout, *Industrial Evolution in Developing Countries* (Oxford: Oxford University Press, 1996).

[16] Schiantarelli, F. (2005). "Product Market Regulation and Macroeconomic Performance: A Review of Cross-Country Evidenve," Boston College, mimeo.

[17] Tybout, J. R., "Plant-and Firm-Level Evidence on 'New' Trade Theories," in E. K. Choi and J. Harrigan (eds.) Handbook of International Economics (Oxford: Basil-Blackwell, 2003).

5 Appendix

We prove the properties of the welfare function (10). The derivative with respect to τ is:

$$\frac{\partial U}{\partial \tau} = \frac{\left[1-\tau+\tau x^{\frac{1}{1-\alpha}}\right] \frac{1}{\alpha}\left[1-\tau+\tau x^{\frac{\alpha}{1-\alpha}}\right]^{\frac{1-\alpha}{\alpha}}\left[x^{\frac{\alpha}{1-\alpha}}-1\right]-\left[x^{\frac{1}{1-\alpha}}-1\right]\left[1-\tau+\tau x^{\frac{\alpha}{1-\alpha}}\right]^{\frac{1}{\alpha}}}{\left[1-\tau+\tau x^{\frac{1}{1-\alpha}}\right]^2} \tag{17}$$

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

$$\left.\frac{\partial U}{\partial \tau}\right|_{\tau=0} = 1 - \frac{1}{\alpha} - x^{1/(1-\alpha)}\left(1 - \frac{1}{\alpha x}\right) \tag{18}$$

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 (18) with respect to x we find:

$$\left.\frac{\partial^2 U}{\partial \tau \partial x}\right|_{\tau=0} = \frac{\alpha^2(1-x)}{1-\alpha} x^{1/(1-\alpha)} < 0, \tag{19}$$

because $x > 1$. Thus, as x grows, the effect of trade on welfare given by (18) becomes negative. By inspection of (19), 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 (17) at the point $\tau = 1$:

$$\left.\frac{\partial U}{\partial \tau}\right|_{\tau=1} = 1 - \frac{x}{\alpha} - x^{1/(1-\alpha)}\left(1 - \frac{1}{\alpha}\right) \tag{20}$$

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 (20) with respect to x we find:

$$\left.\frac{\partial^2 U}{\partial\tau\partial x}\right|_{\tau=1} = \left[x^{\alpha/(1-\alpha)} - 1\right] > 0 \tag{21}$$

because $x > 1$. Thus, as x grows, the effect of trade on welfare given by (20) becomes positive. By inspection of (21), 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 (10) with respect to τ is:

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

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)
Openness	**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)**
Average PCM			-0.064*** (0.018)	-0.070*** (0.018)	-0.073*** (0.018)	-0.068*** (0.018)	-0.071*** (0.018)	-0.089*** (0.016)
TFP				0.007 (0.007)	0.008 (0.006)	0.009 (0.006)	0.031*** (0.007)	0.033*** (0.007)
Skill ratio					-0.037*** (0.007)	-0.036*** (0.007)	-0.025*** (0.007)	-0.021*** (0.007)
Capital output ratio						0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
log of real shipments							-0.016*** (0.002)	-0.017*** (0.002)
Time trend								0.001*** (0.000)
Time dummies	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)
Openness	**0.021*****	**0.012*****	**0.011*****	**0.011*****	**0.012*****	**0.013*****	**0.010****	**0.008****
	(0.003)	**(0.004)**	**(0.004)**	**(0.004)**	**(0.004)**	**(0.004)**	**(0.004)**	**(0.004)**
Average PCM			0.038**	0.029*	0.026*	0.033**	0.031**	0.020
			(0.015)	(0.016)	(0.016)	(0.016)	(0.016)	(0.014)
TFP				0.010*	0.012**	0.013**	0.026***	0.030***
				(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Skill ratio					-0.047***	-0.046***	-0.039***	-0.033***
					(0.007)	(0.007)	(0.007)	(0.007)
Capital output ratio						0.002**	0.002*	0.002*
						(0.001)	(0.001)	(0.001)
log of real shipments							-0.010**	-0.013***
							(0.004)	(0.003)
Time trend								0.001***
								(0.000)
Time dummies	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 5-year lagged Openness	FE 10-year lagged Openness	IV Baseline	IV Adding exogenous controls	IV Adding endogenous controls
Openness	**0.024*****	**0.043*****	**0.069*****	**0.061*****	**0.099*****
	(0.004)	**(0.007)**	**(0.017)**	**(0.017)**	**(0.029)**
Average PCM				-0.104***	-0.067
				(0.025)	(0.084)
TFP				0.024**	-0.033*
				(0.011)	(0.011)
Skill ratio				-0.026**	-0.096***
				(0.011)	(0.034)
Capital output ratio				0.001***	0.001
				(0.000)	(0.001)
log of real shipments				-0.012***	0.007
				(0.005)	(0.008)
Time dummies	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					
Openness			18.83	17.38	13.88
Average PCM					18.08
TFP					41.6
Skill ratio					16.50
Capital output ratio					9.71
log of real shipments					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 columns (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).