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International competition, downsizing and wage inequality [☆]

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Abstract

A country with Cournot competition and free entry experiences an increase of its market size either due to economic growth or international integration of its goods markets. This implied increase in competition leads to shrinking mark-ups and forces firms to reduce overhead costs relative to output. This implies a reallocation at the aggregate level from administrative to productive activities. Relative factor rewards change and wage inequality increases. The factor which loses in relative terms can even lose in real terms. From a quantitative perspective, international competition is demonstrated to be the more plausible cause of rising wage inequality.

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1. Introduction

The increase in wage inequality especially in the U.S. is a well-documented fact (Katz and Autor, 1999). This increase can be split into increases within and between groups, defined e.g. by age, education, experience and other observable characteristics. Almost three quarters of the overall increase in wage inequality can be attributed to increases within groups.

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Most of the theoretical explanations have been suggested for increases between groups. Biased technological change and international trade are the most commonly suggested causes (e.g. Acemoglu, 2002; Johnson and Stafford, 1999). This paper is concerned with increases in wage inequality within groups, given that this is the quantitatively more important source. It is part of a literature (cf. e.g. Neary, 2002 or the short overview by Feenstra, 2001) that resuscitates international trade as a potential explanation for rising wage inequality, reacting to the tendency that the trade channel had become less popular at some point (e.g. Krugman, 2000). Mechanisms based on the Stolper–Samuelson theorem or on implicit strong labour supply increases were not regarded as empirically very relevant as relative prices did not change sufficiently and the factor content of trade was not sufficiently large.

We present a mechanism where neither changes in terms of trade nor international factor flows are required and nevertheless (the potential of) international trade causes rising wage inequality. We propose a simple model where many firms interact in an imperfectly competitive market and where an increase in the degree of competition requires firms to “downsize”, i.e. reduce fixed costs relative to variable costs. We then show how downsizing and rising wage inequality are related.

In our static setup, the degree of competition among firms is captured by a markup of prices over marginal costs. Assuming Cournot competition between firms in a general equilibrium setting, the number of competitors active in a market determines the degree of market power an individual firm has. Allowing free entry and exit, which drives profits down to zero, the number of firms and thereby the markups are endogenous. When the number of firms rises, e.g. because the economy’s resource base increases due to growth or because it opens up to trade, competition rises and markups of firms shrink. If a firm wants to stay in the market despite lower markups and implied lower operating profits, it needs to reduce overhead costs per unit of output. This reorganization at the firm level induces factor flows at the aggregate level away from administrative activities towards production.

A consequence of reallocating factors of production is a change in both relative and absolute wages. Factors of production that are more intensively used in production gain from reallocation and factors of production less intensively used lose from reallocation. In the model presented here, no changes in international goods prices and no increase in the volume of trade is required to understand wage changes.

Calibrating the model for the US economy shows that a sufficiently large reduction in the market power of firms can account for up to 100% of the increase in wage inequality within groups. Since a reduction in endogenous market power is fundamentally caused by changes in the market size of an economy as measured by its factor endowment, accounting for the increase in wage inequality requires an increase of the economy’s endowment by a factor of around 9. Clearly, such an increase could not be explained by economic growth alone: GDP in the US increased by a factor of “only” 2.8 from 1963 to 1995. When thinking of expanding market size, however, economic growth is not the only possible explanation. Such an increase can also be the result of integrating an economy into the world economy: using the active workforce as a proxy for market size, the active workforce (the size of the market) in OECD countries in 1995 is more than 6 times larger than the workforce of the US in 1963. An expansion of market size by factor 9 between 1963 and 1995 can therefore be split into a growth effect and an integration effect. Following this line of reasoning, the paper will conclude that integration in the world economy is the more plausible driving force behind downsizing and implied changes in the wage structure than economic growth.

This mechanism is of interest also from a purely trade-theoretical perspective. Many economists believe (e.g. Bhagwati, 1994; Markusen et al., 1995, ch. 11) that more competition

resulting from international trade benefits the economy as a whole or even all factors of production. This is sometimes referred to as the “lifting-all-boats” effect. We show that more competition per se is indeed beneficial for all factors of production but the reallocation effects caused by more competition can lead to distributional effects including real losses for certain factors of production.

Clearly, the mechanism whereby international integration leads to more competition is well-understood from other models with Cournot competition (Dixit, 1984; Venables, 1985; Eaton and Grossman, 1986; Ruffin, 2003). Distributional effects have not been studied in these models, however, as usually only one factor of production is used.

2. The model

2.1. A closed economy

The economy is endowed with a fixed amount of highly-skilled individuals H and less-skilled individuals L , also called labour. Production of the homogeneous consumption good X requires a production process and administration services. Production can take place only under administrative guidance. Administration requires both skilled individuals h_m and labour l_m and is provided under constant returns to scale,

$$m = m(h_m, l_m), \quad (1)$$

with $m(\cdot)$ having standard neoclassical properties. Administrative services can be provided either in-house or bought on the market. In the former case, each firm minimizes the costs associated with the provision of m . Assuming perfect competition in the administration sector for the latter case, both interpretations are formally equivalent. In either case, the price p_m equals unit costs,

$$p_m = a_{lm}w_L + a_{hm}w_H, \quad (2)$$

where a_{lm} and a_{hm} indicate the amount of less-skilled and skilled workers used to produce one unit of administrative services and w_L and w_H are the respective factor rewards.

The amount of administration services required for production in each firm is fixed at \bar{m} . Hence, output \tilde{x} of a representative firm is given by

$$\tilde{x} = \begin{cases} 0 & \text{if } m < \bar{m}, \\ x(h_x, l_x) & \text{if } m \geq \bar{m}, \end{cases} \quad (3)$$

where $x(\cdot)$ has standard neoclassical properties with constant returns as well and skilled and less-skilled labour employed for production are denoted by h_x and l_x , respectively. Optimal behavior implies $m = \bar{m}$.¹

Remember that the introduction stated our interest in wage inequality within groups. This means that we perceive h_j and $l_j, j=x, m$, to be observationally equivalent. This does not prevent us, however, to model them as imperfect substitutes as individuals might be identical in e.g. education, experience, sex and ethnic background but nevertheless differ in some skills that are

¹ The existence of a fixed input requirement for administrative services is comparable to fixed costs. If factor rewards were constant (which they are not), a fixed requirement for administrative services would be identical to fixed costs of production. Here, the price for management services p_m and, therefore, the associated costs $p_m\bar{m}$ may respond to parameter changes. Fixed costs would not.

usually not captured in standard datasets like quality of their degree, IQ or social skills.² As a consequence, we will later use w_H/w_L as a measure of within group wage inequality.

Total output is given by the sum of output x of all n firms in the market, $X=nx$.³ As firms behave as Cournot competitors, the price p_x of the consumption good is given by

$$p_x = \mu[a_{lx}w_L + a_{hx}w_H], \quad \text{with } \mu = \frac{n}{n-1} > 1, \quad (4)$$

where unit input factors for factor i are given by a_{ix} and the parameter μ denotes the markup over the unit costs in squared brackets (see Appendix 7.1).

We assume throughout that the skill intensity ρ_x is higher in the production unit of the firm than in the administration unit,

$$\rho_x \equiv \frac{a_{hx}}{a_{lx}} > \frac{a_{hm}}{a_{lm}} \equiv \rho_m. \quad (5)$$

This assumption is crucial for our results and is therefore discussed in detail in Section 5.

With free entry, profits are driven to zero, so that $p_x x = (a_{lx}w_L + a_{hx}w_H)x + p_m \bar{m}$. Using the pricing Eq. (4), the zero profit condition requires the equality between operating profits (defined as the difference between revenues and variable production costs) and administration costs (see Appendix 7.1),

$$\frac{p_x x}{n} = p_m \bar{m}. \quad (6)$$

A factor market equilibrium requires the equality of labour supply L and labour demand from production, $a_{lx}nx$, and from administration, $a_{lm}n\bar{m}$. With an identical equation for skilled individuals, we obtain

$$L = a_{lx}nx + a_{lm}n\bar{m}, \quad (7)$$

$$H = a_{hx}nx + a_{hm}n\bar{m}. \quad (8)$$

The system of Eqs. (2), (4) and (6)–(8) characterizes the equilibrium of the economy. We choose administration services as numeraire and normalize p_m to unity. These equations specify the values for the factor prices (w_L , w_H), the product price p_x , the number n of firms and the output x of an individual firm as a function of the exogenously given factor endowments H and L .

2.2. Equilibrium structure

The structure of the equilibrium in this model can easily be understood by thinking of an auxiliary variable $q \equiv p_x/\mu$, representing the price without the markup, i.e. marginal costs to produce one unit of x .⁴ When taking q as exogenous for an instant, Eqs. (2) and (4) determine w_L and w_H which in turn with Eqs. (7) and (8) determine $X \equiv nx$ and $M \equiv n\bar{m}$. Knowing X and M , given that \bar{m} is exogenous and constant, we know n and x as well. Eqs. (2), (4), (7) and (8) therefore determine endogenous variables w_L , w_H , n and x as a function of q and parameters of

² It would be hard to argue that a randomly selected group of e.g. 100 PhDs in economics is homogeneous.

³ We anticipate the fact that all firms will have the same size as they all face identical marginal costs.

⁴ We are indebted to Kala Krishna for her detailed suggestions to go into this direction.

the model (like e.g. factor endowment and technology properties). This simply exploits the standard two by two structure of this model: thinking of q as “perfect-competition terms of trade” (given that p_m equals unity), this part of the model could be called the “small-open economy part”. The equation which determines q is given by the free entry condition (6).

The zero-profit condition (6) and the small-open economy part of the model are jointly plotted in Fig. 1. The horizontal axis plots marginal costs q . The vertical axis plots $(n - 1)M/X$. The 45°-line in this figure is q , the left-hand side (LHS) of $q=(n - 1)M/X$, a rewritten version of the free entry condition (6). The RHS of this equation is captured by the function $Z(q) \equiv (M(q, \Pi)/\bar{m} - 1) M(q, \Pi)/X(q, \Pi)$. It plots $(n - 1) M/X$ as a function of q and parameters Π . With q given on the horizontal axis, $Z(q)$ summarizes the behaviour of the economy that corresponds to the small-open economy part. We know that $Z(q)$ decreases as both M/X and M decrease in q (we move on the production possibility frontier in favour of X and observe the usual supply response). The unique equilibrium value of q can be found where $Z(q)$ intersects with the 45° line.

The advantage of this equilibrium representation is that any parameter change only affects the $Z(q)$ curve. Comparative static analyses can then be undertaken for a given q which then indicates whether the $Z(q)$ curve shifts up or down. This has the big intuitive advantage that results for a given q can be borrowed from results known from small open economy models.

2.3. Modelling international integration

We view international integration, economic growth or both as the driving force behind downsizing and changes in wage inequality. Both international integration and growth can be captured in a simple way by an increase in factor endowments of the economy. When economic growth is labour saving and the same for both technologies x and m , growth is identical to an increase in factor endowment. When growth stems from increases in workers’ productivity due to human capital accumulation or learning by doing, this is again formally identical to an increase in factor endowment. While a fully dynamic model would be more complete, we believe that our main results are robust to this extension.

When integration in international goods markets is considered, this can again be captured by increases in the resource base. Imagine that an economy opens up to world markets where other

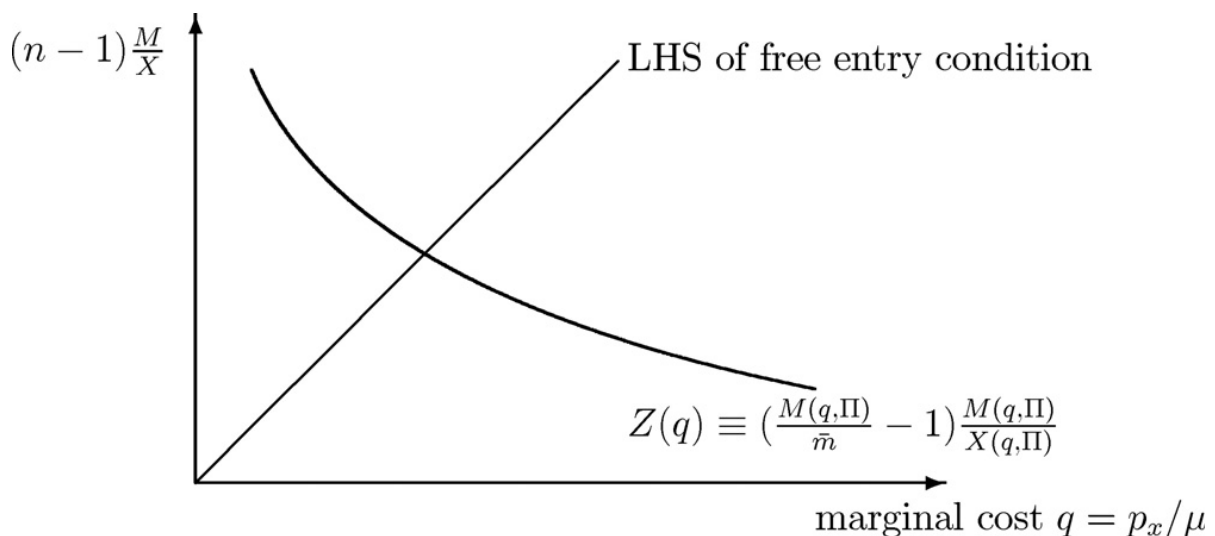


Fig. 1. Equilibrium structure of the model.

countries are characterized by the same relative endowment H/L , i.e. a situation where integration takes place among countries with roughly similar education structures. The fundamental effect integration has is to embed the formerly autarkic economy in a world economy that has a larger factor endowment of H and L but the same ratio H/L . Hence, integration is identical to an equiproportional increase of H and L and we capture this in the main text by $\hat{L}=\hat{H}=\hat{s}$, where a hat indicates a proportional increase, $\hat{z}\equiv dz/z$.⁵

3. Aggregate effects of an increasing resource base

We start by reminding readers of some properties of our economy (see e.g. Dixit and Norman, 1980) which are important for understanding the general argument of the paper. More details are available in Wälde and Weiß (2006): An increase in the market size, $\hat{s}>0$, induces (i) the number n of firms to rise under-proportionally, $0<\hat{n}<\hat{s}$, (ii) output x of a firm to increase, $\hat{x}>0$, and (iii) output nx of the consumption good to rise over-proportionally, $\hat{n}+\hat{x}>\hat{s}$. This implies gains from trade.

In a world where all countries are in autarky, the number of active firms is given by $\sum n_c^a$ firms in the market, where n_c^a is the number of firms in autarky in country c . In an integrated world economy – i.e. when the market size s has increased – the number $\sum n_c^a$ of firms is not sustainable in the long run. Firms need to exit under trade as the markup μ in Eq. (4) reduces due to the increased number of competitors. For each country, the number of firms increases from autarky to trade, in the world as a whole the number of firms reduces.

As the markup is lower and production requires fixed administration services \bar{m} , the zero profit condition can be restored only by an expansion of output per firm, implying (ii). Finally, as integration reduces the number of firms, there are fewer administrative jobs. Factors of production move from administrative to productive activities and total output increases. As this effect also holds for each country individually, there are gains from trade.

These properties can be illustrated by using Fig. 1. Looking at the “small-open-economy curve” $Z(q)$, an increase in the scale s of the economy (i.e. integration in the world economy) at fixed terms of trade q increases M but leaves M/X unchanged; the $Z(q)$ curve therefore shifts upwards. As a consequence, q increases when the equilibrium point moves up on the free entry condition. This increase in q now raises X/M : the number of firms therefore increases under-proportionally, output increases over-proportionally and there are gains from trade.

4. Distributional effects of an increasing resource base

4.1. General results

Proposition 1. *Let the production of the consumption good be more skill intensive than the production of administration services. An increase in the market size s , leaving relative factor endowment unchanged, increases human capital rewards w_H relative to wages w_L ,*

$$\hat{s}>0 \quad \text{and} \quad \rho_x \geq \rho_m \quad \Rightarrow \quad \hat{w}_H - \hat{w}_L \geq 0.$$

The intuition behind this proposition is similar to the intuition behind changes of relative factor rewards in small open economies. When relative output of administrative services declines due to

⁵ Appendix 7.2 derives the fundamental relationships in our model allowing for international differences in human capital richness. Appendix 7.3 then shows that the main point of our paper holds in this more general case as well.

an increase of the economy, the proportion of less-skilled relative to skilled labour that becomes available is, at given relative factor prices, higher than the proportion that production is willing to absorb. Full employment can therefore only be restored if firms substitute less-skilled by skilled individuals. The latter takes place only if factor rewards for labour decrease relatively to factor rewards for the skilled.

While these relative changes are important, absolute changes allow a better prediction of changes in individual welfare. For real factor rewards we have

Proposition 2. (i) *The factor of production that gains relative to the other factor also gains in real terms,*

$$\hat{w}_H - \hat{w}_L \geq 0 \Rightarrow \left\{ \begin{array}{l} \hat{w}_H \\ \hat{w}_L \end{array} \right\} - \hat{p}_x > 0.$$

(ii) *The factor of production that loses relative to the other factor gains in real terms if the price reduction effect from more competition is stronger than the wage reduction effect coming from reallocation,*

$$\hat{w}_L - \hat{p}_x \geq 0 \Leftrightarrow -\theta_{hx}[\hat{w}_H - \hat{w}_L] + \frac{1}{n-1}\hat{n} \geq 0.$$

Apparently, a relative decline of wages does not necessarily (as in the Stolper–Samuelson theorem for the perfect competition model) imply a decline of wages in terms of the consumption good. After some further steps (see Wälde and Weiß, 2006), we obtain

$$\hat{w}_L - \hat{p}_x = -\theta_{hx}[\hat{w}_H - \hat{w}_L] + \frac{1}{n-1}\hat{n} \quad (9)$$

which nicely reveals the intuition behind Proposition 2: changes in real factor rewards depend on changes in relative factor rewards caused by factor reallocation, as captured by the first term on the right-hand side, and on changes in the number of firms in the economy, the second term on the right-hand side of the equation. An increase of this second term represents an increase in competition and thereby a reduction in the distortion on the final good market. As economic growth or international integration increases the number of competitors, this second term stands for the reduction of the markup which implies, ceteris paribus, lower profits and therefore a larger share of output going to factors of production implying higher real factor rewards.

Real rewards for skilled workers therefore increase as both the relative change in factor rewards (i.e. the reallocation from administration to production) and the increase in competition imply higher rewards for skills. Real wages for unskilled workers decrease as in the perfect competition model if the beneficial effect from more competition is weak. Real wages increase if the competition effect outweighs the loss implied by the reallocation to production activities.

4.2. Cobb–Douglas and CES economies

Eq. (9) provides intuition for potential negative distributional effects of international competition. This expression by itself, however, does not provide information on whether the positive effect of stronger competition (the second term) might not actually always over-compensate the negative effect for low-skilled resulting from reallocation (the first term).

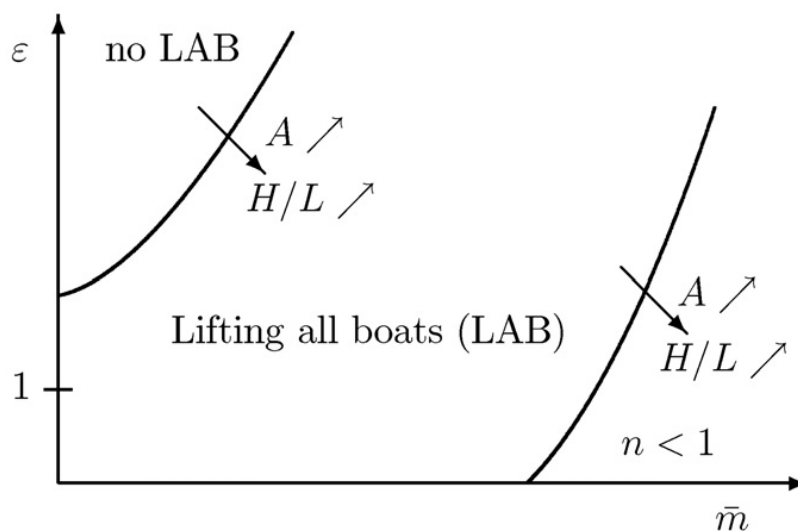


Fig. 2. Lifting-all-boats (LAB) and real losses from trade (no LAB).

In a Cobb–Douglas version of our economy, this is indeed the case. Let technologies (1) and (3) be given by $m(h_m, l_m) = h_m^\beta l_m^{1-\beta}$ and $x(h_x, l_x) = h_x^\alpha l_x^{1-\alpha}$, where $\alpha > \beta$. Going through similar steps as for deriving Proposition 2 gives (cf. Appendix B⁶ for a proof).

Proposition 3. *In a Cobb–Douglas economy, both factors gain in real terms.*

More international competition “lifts all boats” indeed: international integration always reduces the inefficiency of imperfect competition sufficiently much.

In a CES specification, technologies are

$$\begin{aligned} m(h_m, l_m) &= A \left[\beta h_m^{(\varepsilon-1)/\varepsilon} + (1-\beta) l_m^{(\varepsilon-1)/\varepsilon} \right]^{\varepsilon/(\varepsilon-1)}, \\ x(h_x, l_x) &= A \left[\alpha h_x^{(\varepsilon-1)/\varepsilon} + (1-\alpha) l_x^{(\varepsilon-1)/\varepsilon} \right]^{\varepsilon/(\varepsilon-1)}. \end{aligned} \quad (10)$$

We assume identical elasticities of substitution ε across activities as this guarantees a more skill intensive production activity, as long as $\alpha > \beta$. Unfortunately, no analytical results more specific than Eq. (9) can be obtained. A numerical analysis, however, allows to plot Fig. 2.⁷

The figure divides the (\bar{m}, ε) space into three regions. In the region to the left, denoted “no LAB”, wages of labour fall in real terms, i.e. Eq. (9) is negative when the economy integrates into the world economy. In the middle region, there is lifting-all-boats, i.e. all factors of production experience real increases in their rewards. In the right region, the parameter set was such that the equilibrium number of firms was too small ($n < 1$). An increase in total factor productivity A or in the human capital to labour ratio H/L (caused by an increase in H) shifts both curves to the right.

The shape of these regions make intuitively sense: if management services \bar{m} required for running a firm are too high, there will be no production at all and we are in the region to the right.

⁶ All sections starting with a letter are contained in a Referees’ appendix. The Referees’ appendix and the “standard” appendix are both in Wälde and Weiß (2006).

⁷ All numerical solutions were computed in Mathematica. The programmes are available upon request. For a parameter set that leads to an increase of all real wages, cf. Wälde and Weiß (2006).

Clearly, the higher TFP or the human capital stock (implying an increase in H/L), the more firms will exist in the economy and the smaller the no-production region $n < 1$.

For elasticities smaller or equal to unity, there is lifting-all-boats. A low elasticity of substitution between factors of production implies that the relative wage effect due to reallocation, the first term in Eq. (9), is weak and the competition effect dominates.⁸ When the elasticity of substitution exceeds unity, the presence of LAB depends on the level of the fixed administration services \bar{m} . When they are low, the economy is in the “no LAB” region. Low \bar{m} imply many firms in autarky and the competition increasing effect of trade is low. Further, a high elasticity of substitution implies that reallocation yields high relative wage effects. With low gains from more competition and strong wage effects, the second term in Eq. (9) is not strong enough to compensate the first one.

This discussion directly implies the following

Corollary 1. (i) *If a country characterized by a strong domestic inefficiency (few domestic firms and high markups caused by high \bar{m}) integrates, there are gains from integration and both factors of production gain in real terms.*

(ii) *If a country with low markups starts trading (low \bar{m}) and the elasticity of substitution ε is high, skilled workers profit and less-skilled workers lose in real terms.*

When we think of trade as an integration between two identical countries and let administrative service be non-tradable, both results hold even though there are no changes in terms of trade (there is only one traded good) and (implied) factor flows are zero. If we think of administrative services as being tradable or we look at within firm terms of trade between production and administration, the relative price p_x/p_m can in- or decrease (cf. Appendix 7.2.3), depending on parameter values. Hence, even with tradable administrative services, terms of trade do not need to change at all while factor rewards do change.

This analysis formalizes and partially contradicts an argument dear to many trade economists. Rising competition by opening up to trade is beneficial for all factors of production as it reduces domestic inefficiencies. Our setup shows that this is not necessarily the case. In fact, rising international competition is the source of more wage inequality and can even lead to a drop in real wages of the less favoured factor of production.

5. Wage inequality and trade

Even though the discussion so far often referred to international trade, the fundamental driving force behind increases in wage inequality has been an increase in factor endowment. This increase can result both from economic growth and international integration. The discussion paper version [Wälde and Weiß \(2006\)](#) uses a CES economy in order to compute to what extent the observed increase in wage inequality in the US between 1963 and 1995 is due to growth and to what extent it is due to integration.

When wage inequality is measured by the 90/10 weekly wage ratio, one finds that wage income of the 90th percentile male worker was 3.3 times wage income of the 10th percentile worker in 1963 and 4.7 times in 1995 ([Katz and Autor, 1999](#), Fig. 4). Taking into account that

⁸ Remember that the relative wage effect of a terms of trade change in a small open economy is the stronger, the larger the elasticity of substitution. Thanks are due to Willi Kohler for discussion of this point.

only three quarters are intended to be explained by the present model (as we focus on within group wage inequality), the observed increase that should be explained is from 3.3 to 4.35.

We calibrate our model such that we obtain the 1963 90/10 wage ratio of 3.3. This implies, *inter alia*, a markup of $\mu=3$ (i.e. 1/3 of revenue is used to pay variable costs). We then increase the resource base capturing thereby both economic growth and international integration. If we measure the endowment of the US in 1963 by the active workforce (approx. 67 million, full time equivalent) and endowment of the integrated world economy in 1995 by the active workforce of OECD countries (approx. 418 million), endowment increased from 67 to 418 by a factor of 6.2. Real US GDP over this period increased by a factor of approx. 2.8. The total increase of the resource-base, i.e. the size of the market in the sense of the above model, therefore amounts to 9. An increase by factor 9 increases wage inequality in our model from 3.3 to 4.1, i.e. the target of 4.35 is almost fully explained. Given that the overall increase by the factor of 9 splits into an increase due to international trade of 6.2 and only 2.8 due to growth, one can argue that the overwhelming share of the increase in wage inequality within groups is accounted for by international trade.

We also ask in [Wälde and Weiß \(2006\)](#) what we know empirically about markups. According to our model, they should have fallen. The result of our survey is that the specification of the regression equation(s) used in the literature is not consistent with our theoretical setup. Standard results can therefore not be used to judge our prediction. The regression required for testing our prediction is also presented.

The crucial assumption of our argument is that production is more human capital intensive than administration, see Eq. (5). Whether this is empirically convincing can not be answered at this stage, as no studies analyzing this question exist. As we discuss in [Wälde and Weiß \(2006\)](#), the classic distinction between blue-collar and white-collar workers is not appropriate for distinguishing between fix and variable cost. A manager who meets clients to sign a contract is a white-collar worker but also contributes to variable cost. We suggest how an empirical analysis building on controlling and accounting data could resolve this question.

6. Conclusion

We have analyzed a model with Cournot competition and free entry and exit where production requires a fixed amount of administration services. The number of firms active in such an economy and the markup of firms decrease when competition rises. When international integration takes place, competition increases and some domestic and foreign firms exit the market. The number of firms producing in an integrated world economy is therefore lower than the sum of the number of firms producing in autarkic economies. Nevertheless, it is higher than the number of firms in each country in autarky. This is the competition-increasing effect of integration.

More international competition leading to shrinking markups implies an expansion of plant size for surviving firms. Assuming that the production technology is more skill intensive than the administration technology, these factor movements lead to a decrease in skill intensity in all sectors and therefore an increase of factor rewards for skills. When integration takes place between countries with identical factor endowment, integration does not affect relative prices. Nevertheless, relative factor rewards change.

Measuring factor rewards in real terms, integration implies an increase in real rewards for skilled individuals. Real wages for the less-skilled may fall or rise, depending on the degree of domestic distortions before opening up to trade. If domestic distortions were weak (e.g. in a large

country with small markups), more competition would imply a real decrease in wages. If domestic distortions were strong (in a country with high markups), integration would lead to a considerable increase in the number of firms and therefore to a strong reduction of the distortion. This positive effect can outweigh the negative effect of wage reductions caused by factor relocation from administration to production. In summary, more international competition has a lifting-all-boats effect if the increase in competition is sufficiently large. If not, more international competition implies that certain factors of production lose in real terms.

When calibrating the model, we found that the increase in within-group wage inequality in the US from 1963 to 1995 can be attributed both to economic growth and integration in the world economy. Given our theoretical analysis, however, integration in the world economy plays a substantially larger role than economic growth in explaining the increase in wage inequality.

Appendix A

There is a more comprehensive version of this paper available at www.waelde.com → publications which includes the general appendix and also the Referees' appendix.

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