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A NEW LOOK AT OFFSHORING AND INEQUALITY: SPECIALIZATION VERSUS COMPETITION

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ABSTRACT

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JEL Classification: F12, F15, J31 and O33
Keywords: globalization, offshoring, trade and wage inequality

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A new look at offshoring and inequality: specialization versus competition*

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Revised version, November 6, 2007

Abstract

The received wisdom is that a rising skill premium accompanied by a simultaneous rise in skill intensity characterizes relative wages and the employment structure in US manufacturing. However, we present evidence to show that the recent developments in the U.S. do not conform to this pattern and that the evolution of relative wages over the last three decades has in fact been bell-shaped. We argue that this bell-shaped evolution of wage inequality can be linked to globalization and a rise in offshoring. To analyze the relationship between globalization, offshoring and relative wages, we develop a general equilibrium model of trade and offshoring. This reveals that globalization and offshoring have two opposing effects on relative wages: greater vertical specialization increases wage inequality, while greater international competition increases wage inequality. The result is a bell-shaped relationship between wage inequality and offshoring when globalization is driven by falling trade costs for goods. However, we also find that if the globalization process continues as a result of reduced costs of fragmentation, this fosters increased wage inequalities. Consistent with recent observations, our analysis suggests that the fears related to offshoring and inequality may prove unjustified in the short term although the long-term effects may be quite different.

Keywords: globalization, offshoring, trade, relative wages, wage inequality

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1 Introduction

Is globalization a major cause of rising income inequality in high-income countries? The received wisdom about the relative wages of skilled workers in the

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US is that the wage gap is growing at the same time as the skill intensity within industries is increasing. The simultaneous occurrence of an increase in the relative price of a factor and its intensity has been regarded as a crucial piece of evidence against an international trade-based explanation for this development. A widely shared view is that the changes in wage and employment structure are primarily accounted for by skill-biased technical change and not by globalization and trade (see, e.g., Berman, Bound and Griliches, 1994; Desjonqueres, Machin and van Reenen, 1999; Katz and Autor, 1999).

In this paper, we present evidence that the more recent developments in the US manufacturing sector are, in fact, significantly different from the ones in the 1980s and early 1990s – the period on which most empirical studies concerning the role of globalization and trade on the skill premium are based.[1] From the early 1990s and until around 1998 the skill premium, measured by the relative wage of non-production workers, continued to rise, while the skill intensity in manufacturing, measured by the ratio of non-production to production workers, actually fell. Around the year 2000 this development was reversed; and the last few years have been characterized by a declining skill premium and increasing skill intensity.[2]

This tells us that the development of the skill premium over time is non-monotonic rather than simply a trendwise increase. It also makes clear that neither models of skill-biased technological change nor traditional trade theory can provide satisfactory explanations for what has happened to relative wages over the last few decades. Finally, it demonstrates that we still do not have enough information to rule out globalization as a major force behind changing relative wages.

Motivated by the more complex picture of relative wages and skill intensities, we develop a general equilibrium model of imperfect competition, international trade and offshoring to explore how international fragmentation of production affect relative wages and skill intensity in manufacturing. Our analysis shows that the impact of globalization and offshoring on relative wages runs along two different lines: specialization and competition. Globalization triggers offshoring and vertical specialization based on comparative advantages, leading to an increase in the skill premium in the skill-abundant country. However, globalization also generates fiercer competition among skill-intensive firms, squeezing the amount of rents that may be captured by skilled labor. Depending on which force dominates – specialization or competition – offshoring leads to increased or reduced wage inequality.

A number of studies have examined the effect of offshoring on skill intensities and skill premiums (e.g. Jones and Kierzkowski, 2001; Grossman and Rossi-Hansberg, 2006). However, they are all based on a framework of perfect

[1] Note that many of the studies estimating the contribution of various factors to changes in the relative demand for skilled and unskilled labor use the distinction between non-production and production workers. For a discussion about how well this distinction captures relative skills in terms of educational attainment, see, e.g., Head and Ries, 2002.

[2] The skill premium measured by the return to education seems, however, to have either continued to rise or remained fairly constant.

competition, and so have ignored the impact of globalization on competition.[3] Nor have they considered how the effect of offshoring on competition may depend on the different forces behind globalization. Offshoring may be occasioned by falling trade costs for goods or by falling costs of fragmentation (i.e. costs related to the additional service inputs required when production is split across locations). We show that the impact of globalization on competition – and in turn on relative wages – depends crucially on whether offshoring is occasioned by the former or the latter.

The outline of the paper is as follows. In the next section we describe the development of relative wages and the employment structure in US. manufacturing, discussing the empirical evidence for the development of the skill premium and skill intensity, as well as for the relationship between skill premium and offshoring. In section 3 we provide a brief review of related literature. In section 4 we present a two-sector general equilibrium model of international trade with manufacturing and services where firms may choose to engage in costly offshoring of manufacturing activities. Offshoring incurs two types of costs: (i) trade costs for goods, which arise because a relocation of final goods production implies that goods have to be exported back to the home market, and (ii) costs of fragmentation – additional costs for coordination, monitoring and communication, which arise when activities are split up geographically (see, e.g., Barba-Navaretti and Venables, 2004). Based on technology, market characteristics and costs related to offshoring, firms choose their optimal location strategy. This in turns has implications for trade patterns, industrial structures, relative wages and skill intensity. To analyze the impact of globalization on offshoring and relative wages, we conduct a set of numerical experiments. These are presented in sections 5 and 6. Finally, section 7 concludes.

2 Empirical evidence: relative wages and offshoring

We start by presenting evidence on how skill intensity and relative wages have changed over the last few decades in US manufacturing. We then proceed to examine the scale – and growth – of offshoring, and how this phenomenon has contributed to the evolution of skill intensity and relative wages.

2.1 What has happened to relative wages and skill intensity in U.S. manufacturing?

Figure 1 shows the ratio of non-production to production workers and the relative wage of non-production workers in US manufacturing. During the period

[3] One exception is Baldwin and Robert-Nicoud (2007): in an extended version of their model the authors allow for monopolistic competition, but without explicitly discussing the link between globalization, competition and wages. Closest in the spirit to this paper is one by Andersen and Sørensen (2006) studying the labour market consequences of globalization and product market integration.

from the late 1970s to the early 1990s the relative wages of non-production workers increased, along with skill intensity as measured by the ratio of non-production to production workers. From the early 1990s and until around 1998 relative wages continued to rise, but the skill intensity actually fell. Around 2000 this development was reversed, and the last few years have been characterized by a decline in relative wages of non-production workers and an increase skill intensity.

{FIGURE 1}

From a policy point of view, the reverse trend in relative wages must be regarded as significant, since it contrasts with the conventional view that production workers are losing out to non-production workers. From a research point of view, the reverse trend is intriguing. A perspective of 30-40 years on employment structure and relative wages makes clear that the forces driving the evolution might be more complex than suggested by the existing literature.

2.2 Globalization and offshoring

Globalization has been driven by falling costs of transportation and communication. Figure 2 illustrates the developments in these areas up to 1990, and shows that the most dramatic fall is in the cost of communication. As documented by various sources (see, e.g., Cairncross, 1997), this trend has continued during the 1990s. According to the World Bank, the number of broadband subscribers per 1,000 people increased tenfold just between 2000 and 2004; the number of Internet users per 1,000 people was multiplied by 46 between 1995 and 2004; and the average cost of a telephone call to the US decreased by 75 percent between 1998 and 2004 (see World Bank Indicators).

{FIGURE 2}

Falling trade barriers and communication costs have led to a large increase in offshoring of material input production over the last few decades. A number of studies of have documented this trend (see, e.g., Campa and Goldberg, 1997; Feenstra and Hanson,1999 and 2003; and Hummels, Ishii and Yi, 2001). According to Feenstra and Hanson (1999), imported inputs roughly doubled during the period from 1972 to 1990 measured as the share of imports in total intermediate purchases.

Until the late 1990s the empirical literature investigating the changes in employment structure and relative wages was almost unanimous in its conclusion that globalization and international trade were not a dominant – or even an important – explanation for the shifts in the skill premium (see e.g. Berman et al, 1994; Katz and Autor, 1999; and Krugman, 1995). However, more recent contributions provide empirical evidence for a greater role played by international

trade and offshoring. Feenstra and Hanson (2003) are among those who argue that international trade is an important driving force behind the increase in the wage gap between skilled and unskilled labor. Their argument rests on the idea that a growing amount of international trade takes the form of trade in intermediate inputs caused by fragmentation of production. They show that trade in inputs has much of the same impact on labor demand as does skill-biased technical change; both will shift demand away from low-skilled activities, increase skill intensity, while raising relative demand for and the wages of skilled workers. Moreover, unlike trade in final goods, trade in intermediate inputs is consistent with skill-upgrading, being a within-industry phenomenon.

Feenstra and Hanson (1999) find that offshoring contributed between 17.5 and 40 percent of the observed increase in the relative wage of non-production workers in the U.S. between 1979 and 1990. Canals (2006) has estimated the contribution of offshoring to observed changes in relative wage in the U.S. from 1980 to 1999. She finds that offshoring of unskilled labor intensive activities accounts for 28 percent of the observed relative wage change, while skill-biased technological change accounts for only 15 percent.

However, existing studies of offshoring are all based on pre-1999 data – a period during which the relative wage of non-production workers was steadily rising, before the trend was reversed in 2000. As our analysis will show, the impact of offshoring may be more ambiguous than is predicted underlying by these studies.

3 Related literature

There is a growing literature, both theoretical and empirical, investigating the causes and effects of the international fragmentation of production. On the theoretical side, a number of papers have analyzed the consequences of fragmentation of production using a perfect competition framework (see, e.g., Deardorff, 2001a,b; Jones and Kierzkowski, 2001; Grossman and Rossi-Hansberg, 2006). Closest to the present paper is probably the partial equilibrium analysis by Deardorff (2001a,b), which investigates the role played by reduced trade costs for services in promoting fragmentation of production, with the resulting gains from trade. Jones and Kierzkowski (2001) point out that offshoring of unskilled-labor intensive activities may lead to increased or decreased relative wages for unskilled labor depending on the specifics involved. In particular they stress that offshoring leads to increases in productivity increases that give rise to effects similar to sector- and factor-biased technological progress. A similar idea is pursued in the recent paper by Grossman and Rossi-Hansberg (2006), which differs from most of the previous work in that here they assume that offshoring is related to certain tasks rather than to certain sectors. They study how falling trade costs affect offshoring and find that it may lead to a rise in the relative wages of unskilled workers if the effect on firms' productivity in an unskilled-labor intensive sector is sufficiently strong.

A seminal contribution on the theoretical as well as the empirical side was

made by Feenstra and Hanson (1996) with their analysis of the effect of offshoring on the relative demand for skills. They used a one-sector model where offshoring is triggered by capital growth or technological progress in the South. More recently, Antràs and Helpman (2004) analyze outsourcing and offshoring in a one-factor model with final and intermediate input production, where differences in productivity levels across firms lead to different choices in terms of ownership structure and supplier location. Their paper, however, does not focus on the implications of the firms' choices for the distribution of income.

Our paper differs from these other works in the way we combine (*i*) imperfect competition and intra-industry trade, (*ii*) explicit modelling of services as an input of manufacturing production, and (*iii*) analysis of the distributional effects of changes in the firms' location strategies. Moreover we investigate how the impact of offshoring on factor prices and income distribution depends on whether it is triggered by falling trade costs or by falling costs of fragmentation.[4]

4 A general equilibrium model of offshoring

There are two economies, Home (H) and Foreign (F), and two factors of production, skilled and unskilled labor (S and L respectively). Consumers have preferences over both manufacturing goods (X) and services (Y). Consumer services have to be produced locally, while producer services are tradable. Services are assumed to be more skill-intensive than the actual production of manufacturing goods, but there are also skill-intensive headquarters activities in manufacturing.[5] Labor is mobile between sectors, but not between countries. Services are homogeneous and produced with constant returns to scale, while manufacturing products are also homogeneous but produced with increasing returns to scale. Manufacturing firms compete as Cournot oligopolists and markets are assumed to be segmented. The number of firms is endogenously determined by free entry and exit.

We present the equations describing Home's tastes and technology, and note that corresponding equations apply to Foreign. Preferences over manufactured goods and services are given by a Cobb-Douglas function and the expenditure share of manufactured goods is given by the parameter μ. The utility of a representative consumer yields the following demand functions in Home:

$$C_Y = (1-\mu)E/p_Y, \tag{1}$$
$$C_X = \mu E/p_X, \tag{2}$$

where p_Y denotes price of services and p_X price of manufactured goods. E denotes total income and is given by

$$E = w_L L + w_S S. \tag{3}$$

[4] A few papers have analyzed the effects on trade patterns of a reduction in the trade costs of producer services (see, e.g., Markusen, 1989; Francois, 1990).

[5] This assumption is supported by data from the OECD (2000).

L and S are Home's endowments of unskilled and skilled labor, respectively, while w_L and w_S denote the returns to unskilled and skilled labor.

Production of services requires inputs of unskilled (L) as well as skilled (S) labor. We let output of services (Y) be related to inputs of L and S through a Cobb-Douglas production function:

$$Y = S_Y^{\eta} L_Y^{1-\eta} \tag{4}$$

To simplify matters, we assume that the same production function applies for consumer as well as producer services. We also make the assumption that the market for services is characterized by perfect competition, implying that the price of services is the same irrespective of whether they are sold as final goods to the consumer or used as intermediates by firms. Hence, the f.o.b. price of services equal marginal costs

$$p_Y = \Gamma(w_S^{\eta} w_L^{(1-\eta)}). \tag{5}$$

where $\Gamma \equiv \eta^{-\eta}(1-\eta)^{\eta-1}$.

Manufacturers' production costs can be divided into three groups: (i) skill-intensive fixed costs related to headquarter activities, (ii) costs of inputs of producer services, and (iii) unskilled labor intensive variable costs related to the actual manufacturing activities (i.e. the production and assembly of materials). All firms are assumed to be vertically integrated firms, but they may differ with regard to the way they allocate of activities. Manufacturers may choose to locate the production of producer services and manufacturing activity in the same country as the firm's headquarters, or to offshore the manufacturing activities abroad. To split the production of producer services and manufacturing production geographically involves costs of fragmentation, which we model as costly trade in services: the higher the cost of fragmentation, the higher the trade costs linked to producer services. The magnitude of these costs is determined by the ease with which communication, coordination and monitoring take place across borders. Hence the model contains two tradables, final manufactured goods and producer services. Figure 3 illustrates the organization of production and markets disregarding the location of production activities.

{FIGURE 3}

We use subscripts to denote the location of activities, assuming that the nationality of the firm is given by the location of its headquarters. The first subscript denotes the location of producer services, while the second denotes the location of production of manufactures. So a firm that has services input production, as well as materials production and assembly in country H, will have the subscript HH. If the headquarters are in F any variables related to this firm will have an asterisk (*). This asterisk is also used to denote wages, prices and endowments in F.

For sales we need to distinguish between local sales and exports. To do so we use a third subscript, which indicates the destination of sales. The domestic sales of a firm that has services as well as manufacturing production in country H will be denoted x_{HHH}, while its exports will be denoted x_{HHF}. Manufactured goods are tradable, but trade involves costs, and we assume a Samuelson iceberg type of trade costs ($\tau_X > 1$), so that only $1/\tau_X$ of each unit shipped reaches its destination. This means that imports of x_{HHF} requires exports of $\tau_X x_{HHF}$.

Total costs of a representative manufacturing firm with headquarters in country H carrying out all the production stages in the same country are given by

$$TC_{HH} = \alpha w_S + (a_L w_L + a_Y p_Y) x_{HH}, \tag{6}$$

where α is the input requirement in terms of skilled labor to cover fixed costs, a_L the fixed unskilled-labor input coefficient, a_Y the fixed service input coefficient of services and $x_{HH} \equiv (x_{HHH} + \tau_X x_{HHF})$ is the firm's output of manufacturing goods. Total costs of a firm from H that offshores its manufacturing production are given by

$$TC_{HF} = \alpha w_S + (a_L w_L^* + a_Y \tau_Y p_Y) x_{HF}. \tag{7}$$

where $x_{HF} \equiv (x_{HFH}\tau_X + x_{HFF})$. This firm pays the foreign wage (w_L^*) to cover variable costs for manufacturing, but offshoring of manufacturing production requires costly fragmentation, reflected through costly export of services (τ_Y).

First-order conditions for profit maximization in each market imply that marginal revenue equals marginal cost. Written in complementary slackness form, we have that

$$p_X(1 - e_{HHH}) \leq (a_L w_L + a_Y p_Y), \qquad x_{HHH} \geq 0 \tag{8}$$

$$p_X^*(1 - e_{HHF}) \leq (a_L w_L + a_Y p_Y)\tau_X, \qquad x_{HHF} \geq 0 \tag{9}$$

for firms with headquarters in H with no offshoring, and

$$p_X(1 - e_{HFH}) \leq (a_L w_L^* + a_Y \tau_Y p_Y)\tau_X, \qquad x_{HFH} \geq 0 \tag{10}$$

$$p_X^*(1 - e_{HFF}) \leq (a_L w_L^* + a_Y \tau_Y p_Y), \qquad x_{HFF} \geq 0 \tag{11}$$

for firms offshoring manufacturing production. The optimal markup, e, is given by the firm's market share divided by the Marshallian price elasticity of demand, which in the Cobb-Douglas case is one. Thus, the firm's markup is simply its market share, i.e.

$$e_{HHH} = \frac{x_{HHH}}{n_{HH}x_{HHH} + n_{HF}x_{HFH} + n_{FF}^* x_{FFH}^* + n_{FH}^* x_{FHH}^*}, \tag{12}$$

$$e_{HHF} = \frac{x_{HHF}}{n_{HH}x_{HHF} + n_{HF}x_{HFF} + n_{FF}^* x_{FFF}^* + n_{FH}^* x_{FHF}^*}, \tag{13}$$

$$e_{HFH} = \frac{x_{HFH}}{n_{HH}x_{HHH} + n_{HF}x_{HFH} + n_{FF}^* x_{FFH}^* + n_{FH}^* x_{FHH}^*}, \tag{14}$$

$$e_{HHF} = \frac{x_{HFF}}{n_{HH}x_{HHF} + n_{HF}x_{HFF} + n_{FF}^* x_{FFF}^* + n_{FH}^* x_{FHF}^*}, \tag{15}$$

where n_{HH} (n^*_{FF}) is the number of firms headquartered in H (F) without offshored production, and n_{HF} (n^*_{FH}) is the number of firms headquartered in H (F) with offshored production. Free entry and exit in the X-sector, along with the number of firms being a continuous variable, implies that profits are either zero (for firms that operate in the market), or negative (for potential entrants that do not operate in the market). The zero-profit conditions are satisfied with equality if a given type of firms is active, otherwise they are satisfied as inequalities, that is, the number of firms of a given type (n_{HH} and n_{HF}) is the associated complementary slackness variable.

$$p_X x_{HHH} + p^*_X x_{HHF} \leq \alpha w_S + (a_L w_L + a_Y p_Y) x_{HH}, \qquad n_{HH} \geq 0 \tag{16}$$

$$p_X x_{HFH} + p^*_X x_{HFF} \leq \alpha w_S + (a_L w^*_L + a_Y \tau_Y p_Y) x_{HF}, \qquad n_{HF} \geq 0 \tag{17}$$

Product market equilibrium in the manufacturing sector implies

$$C_X = n_{HH} x_{HHH} + n_{HF} x_{HFH} + n^*_{FF} x^*_{FFH} + n^*_{FH} x^*_{FHH}, \tag{18}$$

Labor market clearing for skilled labor is given by

$$S = \left(\frac{\eta}{1-\eta} \frac{w_L}{w_S} \right)^{(1-\eta)} \left[C_Y + a_Y \left(n_{HH} x_{HH} + n_{HF} \tau_Y x_{HF} \right) \right] + \left(n_{HH} + n_{HF} \right) \alpha, \tag{19}$$

where C_Y denotes output of services for *final consumption* in H. Labor market clearing for unskilled labor is given by

$$L = \left(\frac{1-\eta}{\eta} \frac{w_S}{w_L} \right)^{\eta} \left[C_Y + a_Y \left(n_{HH} x_{HH} + n_{HF} \tau_Y x_{HF} \right) \right] + a_L \left[n_{HH} x_{HH} + n^*_{FH} x^*_{FH} \right], \tag{20}$$

where $x^*_{FH} \equiv (x^*_{FHH} + \tau_X x^*_{FHF})$.

In order to solve the model, we use the following equilibrium conditions: (1)-(3),(5), (8) - (20). In total, when taking the corresponding conditions for Foreign into account, this amounts to 34 equations. These determine the following 17 variables for Home; n_{HH}, n_{HF}, x_{HHH}, x_{HHF}, x_{HFH}, x_{HFF}, p_X, p_Y, e_{HHH}, e_{HHF}, e_{HFH}, e_{HFF}, E, C_Y, C_X, w_L, and w_S; and the corresponding 17 variables for Foreign We choose unskilled wages in Home as the numeraire. The model is however too large and too non-linear to solve explicitly. Therefore, to explore the general equilibrium effects we will have to rely on numerical simulations.[6] Note that all simulations are based on the assumption that Home is relatively skill-abundant compared to Foreign (i.e. $S/L > S^*/L^*$).

[6] The simulations are carried out using a solver supplied in the GAMS package that is able to handle complementary slackness problems directly (see Rutherford, 1995). See the Appendix for parameter values used in the simulations.

5 Globalization I: falling trade costs for goods

As shown above, trade costs for goods fell steadily through the last century and have continued to do so up to today. We start by analyzing the impact of this feature of globalization on offshoring, production patterns, trade, factor returns and income distribution.

Reducing trade costs for goods while maintaining high costs of fragmentation does not change a firm's structure or the location of activities, since there are no incentives to split manufacturing and services production if the producer services cannot be traded across borders. Unless costs of fragmentation fall below a certain threshold, both Home and Foreign will host only purely national firms, with all their operations concentrated domestically. This feature of the model mirrors real-world development, where there is evidence that vertical international specialization has become relatively more important over the last few decades (see Yi, 2003). So for offshoring to take off, trade liberalization and falling transport costs for goods are not sufficient. We also need an 'IT-revolution' that reduces the costs of communication and transmitting information.

Starting from a situation where there are firms with all their production in Home, under what conditions would there be entry of firms offshoring manufacturing activities to Foreign? Profits would have to be greater than or equal to profits of firms with all production in Home. Since both types of firm pay the same fixed costs, this puts a condition on operating profits of the two types of firm. By using the first-order conditions for profit maximizing, we can express this condition as

$$(a_L w_L^* + a_Y \tau_Y p_Y) x_{HF} \geq (a_L w_L + a_Y p_Y) x_{HH}.$$

Assuming that the two markets are relatively similar in size, implying that x_{HF} is similar to x_{HH}, we see that whether this condition is fulfilled or not depends on τ_Y and on the wage of unskilled labor in Foreign compared to Home. For a sufficiently low τ_Y and a sufficiently large difference between w_L and w_L^*, there will be incentives for Home firms to separate the relatively S-intensive services production from the relatively L-intensive manufacturing production and locate the former in Home and the latter in Foreign. A necessary condition for offshoring to arise is thus a sufficiently low fragmentation cost and a sufficiently large difference in relative factor endowments between Home and Foreign.

Figure 4 shows how the extent of offshoring in manufacturing and the relative wage of skilled workers in Home are affected by a reduction in the trade cost for goods, τ_X.[7] In the graph, a reduction in τ_X is shown as a movement to

[7] Simulations are based on a sufficiently low level of τ_Y and a sufficiently large difference in relative factor endowments for reductions in τ_X to induce offshoring. The following parameter values have been used: $\tau_Y = 1.25$, $\mu = 5/8$, $\eta = 0.5$, $\alpha = 1$, $S = L^* = 200$, $L = S^* = 100$. The share of offshoring in production is calculated as total production of offshoring firms with headquarters in Home divided by total production of all firms headquartered in Home: $\frac{n_{HF} x_{HF}}{n_{HH} x_{HH} + n_{HF} x_{HF}}$.

the right along the x-axis. Starting from a high level of τ_X, we see that a reduction is associated with an increase in both the extent of offshoring and the skill premium. These increases are caused by a successive shift in the mix of firms from one where there are mainly firms with all operations concentrated domestically (HH-type firms) to one where most active firms have offshored their manufacturing activities to Foreign (HF-type firms). The rise in offshoring increases the relative demand for skills and the relative wage of skilled labor.

{FIGURE 4}

However, as trade costs for goods fall below a critical level, further reductions result in a decrease in the relative wage of skilled workers, while the degree of offshoring continues to increase. The negative impact on the relative demand for skilled labor is driven by exit of firms and the closing down of skill-demanding headquarters activities. The exit of firms is in turn driven by increased competition. As in the model developed by Grossman and Rossi-Hansberg (2006), offshoring improves the firms' productivity since it enables them to produce with lower marginal costs. The increase in productivity leads to an increase in supply and a fall in the relative price of manufacturing goods. This increased competitive pressure causes firms' exit. High trade costs serve to dampen the competitive pressure from offshored and foreign plants, but as trade costs fall below a certain threshold, competition becomes fiercer and the rate of firms' exit accelerates. The change in the relative demand for skills caused by the exit of skill-intensive firms outweighs the effect of a rising proportion of offshored production. The development of the extent of offshoring and the number of firms is illustrated in Figure 5.

{FIGURE 5}

While the complexity of the model prevents us from deriving an explicit expression for relative wages, we may still be able to shed light on the forces at work in the model by reviewing the labor market clearing conditions. By combining (1), (19) and (20) under the condition that $n_{FH} = 0$, we can express the relative wage of skilled workers in Home as

$$\frac{w_S}{w_L} = \frac{\eta}{1-\eta}\frac{L_Y}{S_Y} \tag{21}$$

where

$$S_Y \equiv S - (n_{HH} + n_{HF})\alpha > 0,$$

and

$$L_Y \equiv L - a_L \left[n_{HH} x_{HH} + n_{FH} x_{FH}\right] > 0.$$

L_Y/S_Y is the inverse of the skill intensity in services production in Home. Noting that w_L is chosen to be the numeraire and holding L and S constant, total differentiation of (21) yields

$$dw_S = \frac{\eta}{1-\eta}\frac{1}{S_Y}\left[\underbrace{-a_L(n_{HH}dx_{HH} + x_{HH}dn_{HH})}_{Specialization-effect}\underbrace{+\alpha\frac{L_Y}{S_Y}(dn_{HH} + dn_{HF})}_{Competition-effect}\right], \tag{22}$$

Expression (22) makes clear that changes in the relative return to skilled labor in Home depend on the result of two opposing effects:

(i) a *specialization* effect due to a change in the demand for unskilled labor as less manufacturing production is carried out in Home, and

(ii) a *competition* effect due to a change in demand for skilled labor stemming from a change in the total number of firms headquartered in Home.

The more unskilled labor required for manufacturing (i.e. the larger the value of a_L), the greater the positive effect on w_S from increased offshoring. However, this positive effect may be counteracted by a decreased number of firms headquartered in Home, since a decline in the number of firms has a negative impact on w_S. The magnitude of such a counteracting effect is larger the more skill-intensive are headquarter activities relative to services production (i.e. the higher are α relative to S_Y/L_Y). Depending on which of these two forces dominates, offshoring may – contrary to what we might expect – lead to a decrease rather than an increase in the relative wage of skilled workers.

Suppose that $dn_{HH} = -1$, i.e. one that HH-type firm exits the market. By (22), this change in the composition of firms will, all else equal, have a positive effect on the relative wage as long as

$$dn_{HF} > 1 - \frac{S_Y}{L_Y}\left(\frac{a_L x_{HH}}{\alpha}\right). \tag{23}$$

From this condition follows that a one-to-one change (i.e.$dn_{HF} = 1$) will always bring a positive effect on w_S. For changes in $n_{HF} < 1$, whether the condition holds depends on the skill intensity in manufacturing firms (excluding their producer services activities) relative to the skill intensity in the services sector, i.e. on $\alpha/a_L x_{HH}$ relative to S_Y/L_Y. If services are relatively more skill intensive, the right hand side of (23) is negative, implying that the (23) holds for any non-negative change in the number of offshoring firms. Even if there is no increase in the number of offshoring firms, w_S will increase because the resources freed up by the exit of the HH-type firm are less skill intensive than services, which will have to absorb the freed up resources. But if services are less skill-intensive, the impact on w_S will be negative for a sufficiently small but positive dn_{HF}. The resources freed up by the exit of the HH-type firm are then more skill intensive than services. Unless there is entry by a sufficiently large number of even more skill intensive offshoring firms, the change in the composition of firms will assert a negative impact on w_S.

We define a lower bound of dn_{HF} above which there is a positive effect on w_S:

$$d\underline{n}_{HF} \equiv 1 - (S_Y a_L x_{HH}/L_Y \alpha).$$

This lower bound increases with the skill intensity of headquarters and manufacturing production combined relative to services. As goods trade costs are lowered and the composition of firms changes towards more offshoring firms and less purely national firms, the skill intensity in services will decrease. The reason for this is that services will have to absorb the amount of unskilled labor freed up from the offshoring of manufacturing production. This means that for a given x_{HH}, $d\underline{n}_{HF}$ increases with the number of offshoring firms already entered. At some point, the skill intensity in services is so low that the increase in n_{HF} necessary to increase the relative demand for skilled labor approaches 1. When most of the firms are offshoring firms, however, a further reduction in trade costs will intensify competition in the sense of decreasing markups. This makes entry less attractive. Taken together, this implies that the actual increase in n_{HF} is too small to generate an increase in the relative demand for skilled labor and w_S falls.

6 Globalization II: falling costs of fragmentation

Costs of fragmentation relate to the costs of communications, monitoring and the coordination of activities that are located apart. Similar to trade costs for goods, these types of costs have experienced a steady decline over the last century. In the last decade, the fall appears to have been dramatic. To study the impact of the decline in fragmentation costs on production, trade and relative wages, we analyze the effect of lowering τ_Y.

Independent of the level of trade costs for goods, as the costs of fragmentation fall below a certain threshold, offshoring of manufacturing activity to Foreign becomes profitable. A steady decline in costs of fragmentation induces entry of offshoring firms and a rising share of offshoring in production. As in the previous case with falling trade costs for goods, the change in the composition of firms, which implies a relocation of unskilled labor intensive production to Foreign, is associated with an increase in the demand for skilled labor and increased relative wages for skilled workers. However, unlike in the case with falling trade costs for goods, there is a monotonic relationship between the relative wage of skilled workers and fragmentation costs so that w_S rises as τ_Y falls (see Figure 6) The difference between the two cases is related to the fact that falling trade costs for goods has a direct impact on the degree of product market competition, while falling costs of fragmentation increases productivity of offshoring firms and thereby affects the degree of competition indirectly, but it has no direct impact on competition.

{FIGURE 6}

Both falling trade costs and falling fragmentation costs lead to increased offshoring. However, the effect on the number of firms and thus the degree of product market competition differs depending on which is the major driving force behind offshoring. Falling costs of fragmentation leads to an increased number of firms headquartered in Home because increased productivity in the X-sector induces entry of more manufacturing firms. This contrasts to the case with falling trade costs for goods, where there is a decline in the total number of firms headquartered in Home. In other words, if offshoring is induced by falling costs of fragmentation, the specialization effects dominates (see Figure 7), whereas if it is induced by falling trade costs the specialization effect may or may not dominate.

{FIGURE 7}

Comparing a situation where τ_Y is sufficiently high for all firms to be purely national firms with a situation where τ_Y is sufficiently low to induce offshoring, we see that the number of firms headquartered in Home is higher in the latter situation, i.e. with offshoring. The change in the number of firms as we lower τ_Y is however non-monotonic (see Figure 7). The reason for this is the impact of offshoring on relative wages in Foreign. As more and more manufacturing production is offshored from Home, there is upward pressure on unskilled wages in Foreign and a tendency for factor price convergence. Below some level of τ_Y, and above some level of τ_X, it becomes profitable for firms headquartered in Foreign to offshore manufacturing production to Home rather than to serve this market by exports.[8] As a result of the location of manufacturing production in Home, competition in Home increases, triggering exit of locally headquartered firms.

7 Concluding remarks

Our analysis shows that the relationship between globalization, offshoring and wage inequality is ambiguous and much less straightforward than we have tended to believe. Globalization and offshoring promote not only specialization but also international competition, and these forces may have opposing effects on relative wages in industrialized countries. While increased international specialization is likely to contribute to increased relative demand for skilled labor in industrialized countries, increased international competition in skill-intensive sectors may have the opposite effect. Our analysis suggests that there is a bell-shaped relationship between offshoring and relative wages when offshoring is driven by falling trade costs for goods, while there appears to be a monotonic, positive relationship between offshoring and relative wages when falling costs of fragmentation are the driving force of globalization. In both cases we find that offshoring not only induces increased specialization according to comparative advantage, but also impacts on the degree of competition in the market.

[8] The simulations are based on the same parameter values as in the case with falling trade costs and with $\tau_X = 1.25$.

Hence, in contrast to what seems to be a widely held view, offshoring may not necessarily foster deeper income inequality. Taking our conclusions back to the data, the evolution in relative wages over the last decades is well mirrored by what we have called the 'Globalization I' case, where successively falling trade costs for goods play a key role, but only as fragmentation costs have reached a sufficiently low level. The recent fall in relative wages between non-production and production workers would in the context of our model be interpreted as a consequence of increased international competition faced by skill-intensive firms. From this perspective, in the short term one might expect the decline in inequalities to continue. However, it is tempting to speculate that as globalization progresses through mainly falling costs of fragmentation, this development might be replaced by increased inequality again, posing new challenges to policy-makers.

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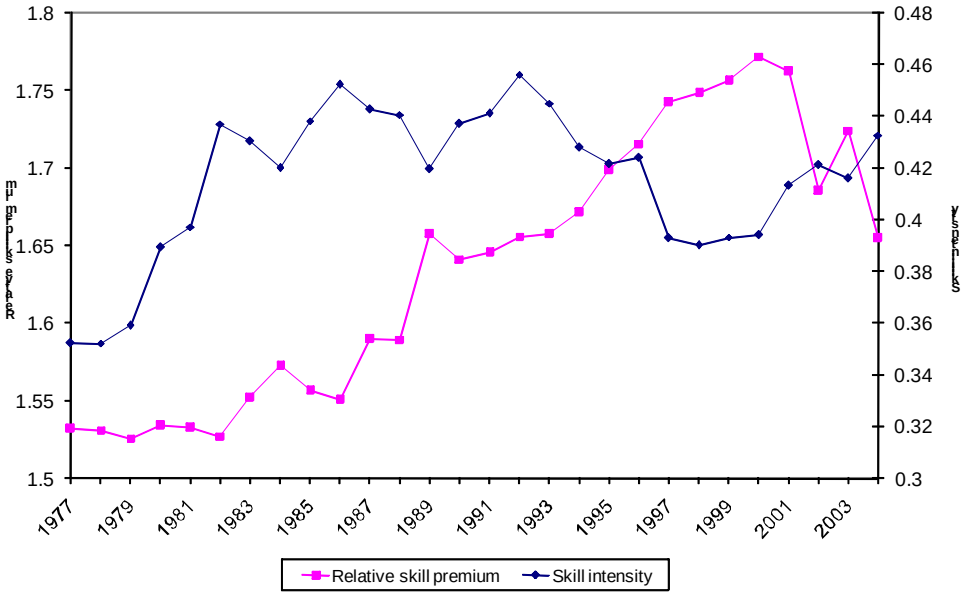

Figure 1: Relative employment and relative wage in U.S. manufacturing. Source: U.S. Census

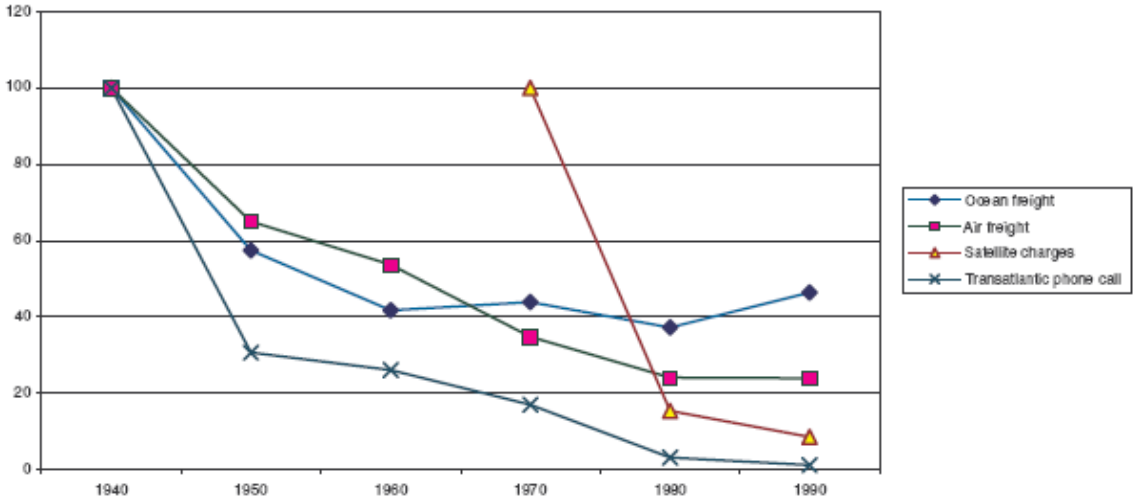

Figure 2: Transportation and communication costs, 1920-1990 (source: World Bank, 1995)

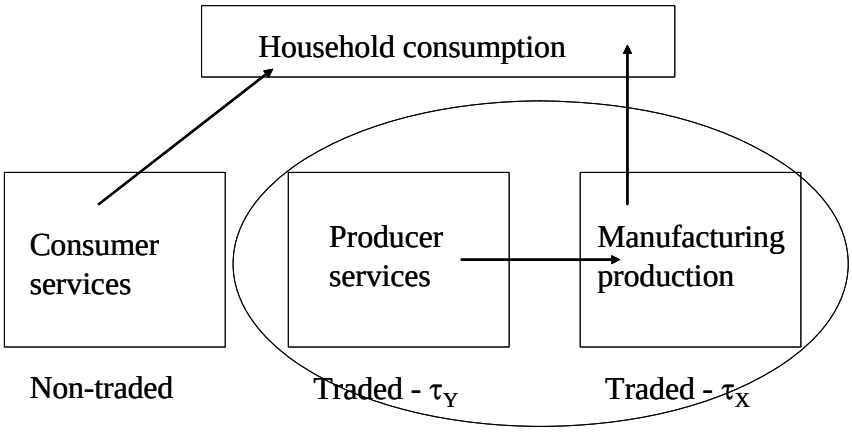

Figure 3: Organization of production and markets

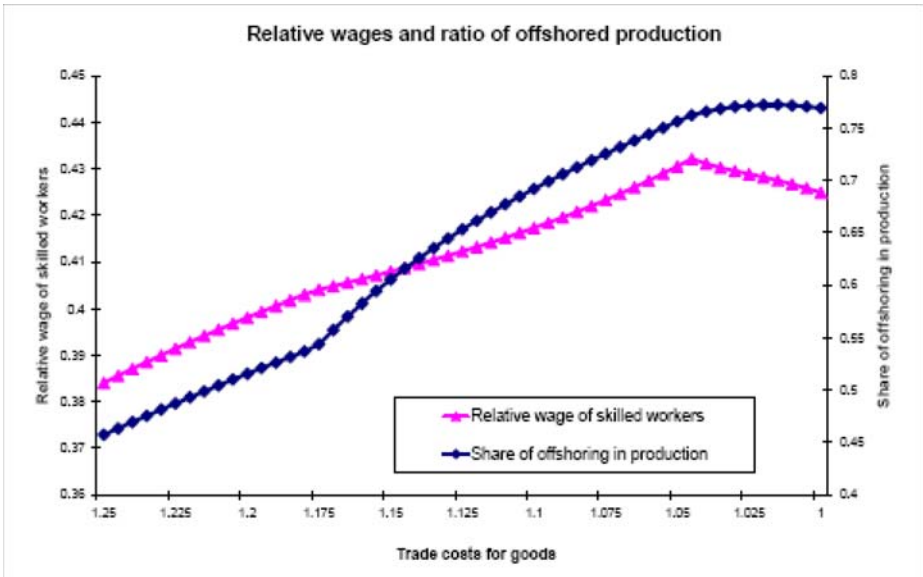

Figure 4: Gloablization I: Relative wages for skilled workers in Home and share of offshoring in production

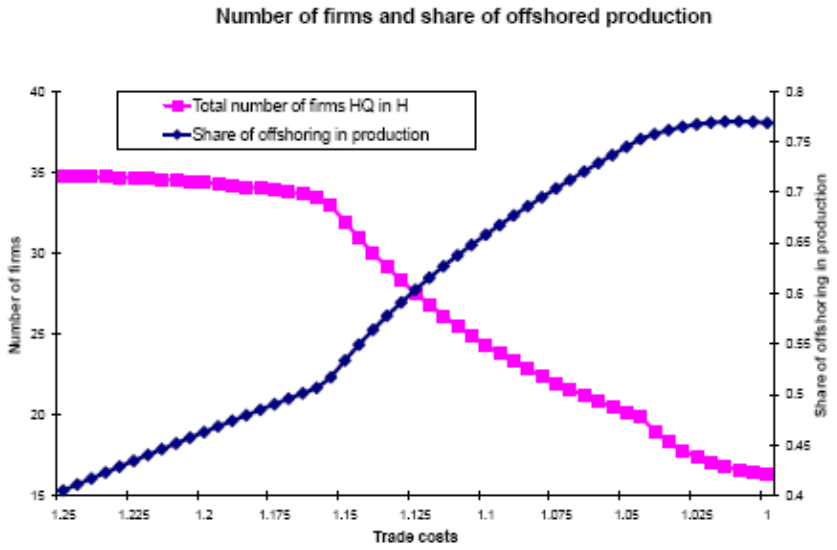

Figure 5: The impact of falling trade costs on number of firms and share of offhoring in production

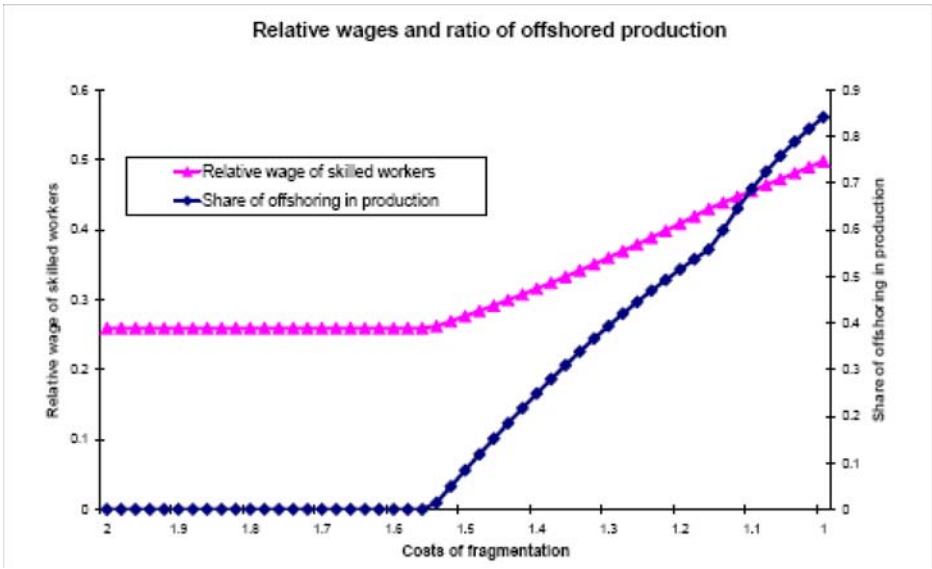

Figure 6: Globalization II: Relative wages of skilled workers in home and share of offshoring in production:

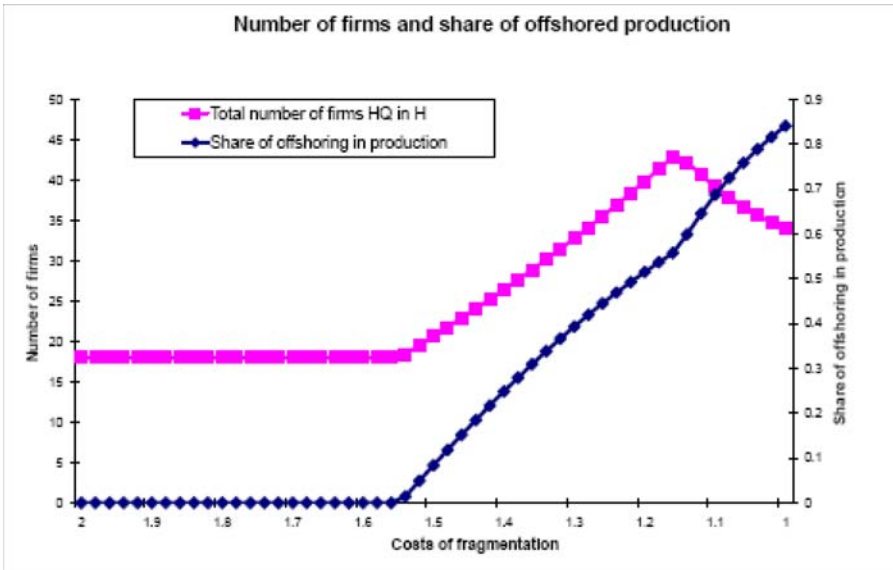

Figure 7: The impact of declining costs of fragmentation on number of firms and share of offshoring in production