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by

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Labor Market Adjustments to Globalization:

Unemployment versus Relative Wages[‡]

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Abstract

The aim of this paper is twofold: First, we analyze the role of wage rigidities in labor market adjustments to international trade and biased technological progress. We introduce efficiency wages into a neoclassical trade model and show that changes in relative wages are independent of wage rigidities in general equilibrium. Secondly, we examine the impact of capital market integration on relative wages and unemployment and find that wage inequality will rise (fall) and unemployment will fall (rise) if capital is being imported (exported).

Keywords: Globalization, Capital Movements, Efficiency Wages, Unemployment, Wage Inequality

JEL: F11, F21, J31

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1. Introduction

A large body of literature, known as the *Globalization and Wage Inequality* literature, tries to untangle the influence of either growing world trade or technological progress on the labor markets of industrialized countries.[1] Along the lines of the Stolper-Samuelson theorem it is argued that an increase in commodity trade with unskilled labor abundant low-wage countries leads to an increase in the wage rate of skilled workers and depresses the wage rate of unskilled workers. On the other side, labor market theorists point to the invasion of computers into our lives and workplaces and argue that they increased the productivity of mainly skilled workers and white collar employees, thereby reducing relative demand for unskilled workers. A lively empirical debate evolved around the question of whether the observed increase in the skill differential in the United States and in the United Kingdom had to be mainly attributed to the increase of international trade with low-wage countries or whether biased technological change was to be blamed for the immiseration of unskilled workers in these countries – as of yet a debate without an apparent winner: both seem to contribute.[2]

However, one puzzle has remained relatively unnoticed: The U.S. and UK experiences of a rapidly rising skill differential have been relatively unique among industrialized countries. Figure 1 illustrates the development of the skill differential in the 1980s by example of six industrialized countries. It shows that while the skill differential has clearly increased in the U.S. and the UK, it has remained almost unchanged in Denmark and France, and it has even fallen in Germany and Italy. This is surprising because trade and technology are worldwide shocks, or at least shocks that most industrialized countries are exposed to. So

[1] For a good overview see Freemann (1995), Richardson (1995), and Wood (1995) in a special feature of the Journal of Economic Perspectives on the *Globalization and Wage Inequality* debate. See also Bhagwati and Dehejia (1994) and Deardorff and Hakura (1994).

[2] A special issue of the Journal of International Economics features the debate on the "factor content" approach. See Deardorff (2000), Krugman (2000), Leamer (2000), and Panagariya (2000) for an overview over the various arguments.

if they are responsible for an increase in the skill differential in some industrialized countries, why did the skill differential in other industrialized countries actually decline?

[INSERT figure 1 here]

Some authors who came across this puzzle point to labor market institutions as a possible explanation (Freeman, 1995, p. 19; Fortin and Lemieux, 1997, p. 76; Siebert, 1997, pp. 44-46). They argue that when relative demand for unskilled labor falls, either prices (i.e. wages) or quantities (i.e. employment) have to adjust. If wages of unskilled workers are rigid due to labor market institutions, then a fall in demand for unskilled labor does not necessarily lead to a higher skill differential but to an increase in unemployment of unskilled workers. However, unemployment rates did not behave uniformly, either. For example, unemployment rates of male workers with low levels of education increased in Denmark and France in the 1980s, whereas they actually fell in the U.S. and the UK (OECD, 1997, table 4.1b, p. 99). So paradoxically, the changes in the rates of unemployment seem to suggest that demand for unskilled labor actually increased in the U.S. and the UK. In addition to the empirical puzzle, the wage rigidity argument raises an important theoretical question as well: If wage rates do not adjust when commodity prices or technologies change, how can firms in contracting industries stay competitive? After all, if relative factor prices are fixed, factor intensities are also fixed, and trade and specialization should follow classical, Ricardian patterns. In this case, however, the Stolper-Samuelson relationship between a country's terms of trade and its relative factor rewards breaks down because this relationship relies on the existence of an equilibrium with imperfect specialization.

The incompatibility of the two theoretical arguments stems from the fact that the two questions have been analyzed in different theoretical frameworks. The impact of trade on wage inequality has traditionally been studied in a general equilibrium framework whereas the impact of wage rigidities on this relationship has been analyzed only in a partial

equilibrium framework of the labor market. In this paper we will show that the wage rigidity argument does not survive a general equilibrium analysis. To this end, we rely on earlier contributions by Agell and Lundborg (1995), Brecher (1992), Copeland (1989), Hoon (1991), and Matusz (1994, 1996) and introduce efficiency wages into a neoclassical trade model with two tradable goods and three factors of production (capital and two types of labor). We show how both the skill differential and the unemployment rate adjust to trade and technology shocks. The results show that the impact of trade and biased technological progress on the skill differential is independent of wage rigidities.

Additionally, we extend the analysis to include capital movements. Even though real capital mobility is one of the key characteristics of globalization, its impact on relative wages and employment have not yet been fully explored. Bhagwati and Dehejia (1994, p. 70) show that capital imports can widen the wage gap if the capital-skill complementarity hypothesis (Griliches, 1969) holds. However, their case rests on the assumption of an aggregate production function, so that changes in the production structure between sectors do not influence factor demand. Richardson (1995, p. 42) points out that in a standard 2×2 trade model an increase of an economy's capital stock has no influence on relative factor rewards as long as relative sectoral total factor productivity and relative commodity prices remain constant (Rybczynski theorem). But the validity of the Rybczynski theorem depends critically on the dimensionality of the model (Ethier, 1984, p. 148). It only holds in even frameworks, i.e. when the number of commodities produced equals the number of factors used in production. As we will see, in an uneven 3×2 framework (three factors, two commodities), capital market integration affects both the skill differential as well as the rate of unemployment.

We assume here that capital is perfectly mobile between sectors but, due to transaction costs, only imperfectly mobile between countries. Capital market integration is then modeled

as an exogenous decrease in these capital market transaction costs (Haufler, 1997). We show that the impact of capital market integration on the skill differential and on the rate of unemployment depends on whether capital is being exported or whether it is being imported. As industrialized countries differ greatly with respect to their net capital movements, this result can provide a demand-driven explanation for the contrasting labor market experiences in these countries.

Section 2 sets up the model and explains, in how far the introduction of efficiency wages can capture wage rigidities. The equilibrium is illustrated in section 3. In sections 4-6 we conduct a comparative-static analysis to derive the impact of international trade, biased technological progress, and capital market integration on the skill differential and the unemployment rate. Section 7 summarizes these results and concludes the paper.

2. The Model

We assume a traditional 3×2 model of international trade. Three factors of production, physical capital (K), skilled labor (H), and unskilled labor (L), are used to produce two homogeneous goods (X and Y) using a constant returns to scale technology. Both goods are traded and the respective commodity prices are given by the world markets (small country case). All factors of production are perfectly mobile between sectors. Additionally, physical capital is mobile across countries, while a country's endowments with both types of labor are exogenously given.

In order to explain unemployment we introduce efficiency wages into the model. The efficiency wage theory postulates a positive relationship between wages paid and the rate of unemployment on one side and workers' effort on the other side. This correlation can be attributed to a number of reasons (Akerlof and Yellen, 1986):

1. *Shirking* (Bowles, 1985; Calvo, 1979; Eaton and White, 1982; Foster and Wan, 1984; Miyazaki, 1984; Shapiro and Stiglitz, 1984): If all firms pay identical wages and if there is full employment, workers who like to loaf on the job do so, because they do not have to carry the cost of their shirking. If they get caught and they are fired, they simply find a new job that is equally well paid. In order to prevent shirking, companies have to create an extra penalty for those being fired. Therefore, it can pay for companies to raise their wages, so that workers cannot find equally well paid jobs as easily. However, if all companies do this, an economy's wage level rises above market-clearing levels, thereby creating involuntary unemployment. In equilibrium, all firms pay efficiency wages and workers reduce shirking, because if they get caught, they are faced with unemployment.

2. *Labor Turnover* (Salop, 1979; Schlicht, 1978; Stiglitz, 1974): Firms may raise wages above market-clearing levels to prevent costly labor turnover. The underlying idea is very similar to the shirking idea: Workers are more reluctant to quit the higher the relative wage of the current firm and the higher the rate of unemployment.

3. *Adverse Selection* (Malcomson, 1981; Weiss, 1980): If workers are heterogeneous in their abilities, and firms are unable to measure a job candidates true abilities, they will have to rely on other means to distinguish able candidates from lemons. If ability and workers' reservation wages are positively correlated, a higher wage offer can attract more able candidates. In this case, higher wages do not exactly raise an individual worker's effort but they attract more productive workers. Thus, adverse selection yields a further explanation for a positive correlation between productivity and wages.

4. *Sociology* (Akerlof, 1982, 1984; Solow, 1980): Sociological studies have provided evidence that workers' effort depends on the work norms of their groups. If firms can raise these norms by paying higher wages, they can also raise average effort in these groups. This "partial gift exchange" (Akerlof, 1982) provides a non-neoclassical explanation for the relationship between wages and workers' effort.

In addition to these standard assumptions we assume further that this relationship between wages, unemployment, and productivity is not independent of a worker's education. Many high-skilled jobs open up opportunities for careers for those who hold these jobs, either within the same company or outside. Thus, a skilled worker's lifetime earnings do not depend on his education only, but also on his reputation (Holmström, 1999). It is his reputation that decides over his career opportunities. Therefore, a skilled worker striving for promotion has an additional incentive to increase his effort without receiving wages above market clearing levels. Moreover, as Akerlof and Yellen (1986, p. 16) remark, high-skill workers may have a different utility function than low-skill workers. If a positive correlation exists between

education and motivation, then highly educated workers will get less utility from shirking than low-skill workers.

These hypotheses suggest that the need to pay efficiency wages in order to boost workers' productivity is stronger for unskilled workers than for skilled workers. It seems to be in line with empirical evidence on unemployment rates, too: Unemployment rates of skilled workers are significantly lower than those of unskilled workers in almost all industrialized countries across both sexes and all ages (OECD, 1994, chart 7.1, pp. 120-121). This indicates that skilled workers receive wages closer to market clearing levels than unskilled workers. To simplify the analysis, we assume in our model that skilled workers receive market-clearing wages.

Thus, dual cost functions x and y per unit of output for the two sectors (X and Y) are given by

$$x(r, \omega, w) = \pi, \tag{1}$$

$$y(r, \omega, w) = 1. \tag{2}$$

In equilibrium, costs per unit of output equal product prices. Here, commodity Y is taken as numeraire, so that π is the relative price of X. Additionally, r denotes the real rental rate for capital (in terms of units of good Y), ω denotes the real wage rate for skilled workers, and w denotes the effective wage rate for unskilled workers. It is defined as

$$w = \frac{\ell}{e}, \tag{3}$$

where ℓ is the real wage paid and e is workers' effort. According to the efficiency-wage theory workers' effort is a positive function of both wages paid and the rate of unemployment. Here, we assume that

$$e = \alpha \ln \ell + \beta \ln u . \qquad \alpha,\beta>0 \tag{4}$$

The effort function is specified so that the effort raising effect of a wage increase (a rise in the rate of unemployment) is positive, but decreasing in ℓ (u). α and β are positive parameters denoting the weight of the two influences on workers' effort.

In this setting, companies raise wages above market clearing levels until the additional effort triggered by the wage increase equals the increase in production cost. Thus, an equilibrium is reached when the Solow (1979) condition is satisfied, i.e. when the elasticity of effort with respect to the wage rate $\left(\varepsilon_{e,\ell}\right)$ is one:

$$\varepsilon_{e,\ell} = \frac{\alpha}{e} = 1 . \tag{5}$$

Furthermore, we suppose that capital is only imperfectly mobile across countries. If capital was perfectly mobile, rental rates would be equalized across countries, so that $r = r^*$. However, if mobility restrictions exist, either due to market imperfections or due to deliberate policies, international rental rate differentials can persist. Here, we assume that international capital movements bring about transaction costs and that these transaction costs are proportional in the volume of these transfers. International capital market equilibrium is reached when marginal productivity of capital in the capital exporting country equals marginal productivity of capital in the capital importing country minus marginal transaction costs τ.

In the small country case, where the world market rental rate is exogenously given, the domestic rental rate is determined by the world market rental rate and the transaction costs. If the small country is a capital exporting country, the domestic rental rate is determined by

(6a) $$r = r^* - \tau .$$

If, on the other hand, the small country is a capital importing country, this condition changes to

(6b) $$r = r^* + \tau .$$

If transaction costs fall, international rental rate differentials decline. When τ approaches zero, international rental rates equalize.

In rates of change, (1)-(6) yield

(7) $$a^{Kx}\hat{r} + a^{Hx}\hat{\omega} + a^{Lx}\hat{w} = \hat{\pi},$$

(8) $$a^{Ky}\hat{r} + a^{Hy}\hat{\omega} + a^{Ly}\hat{w} = 0,$$

(9) $$\hat{w} = \hat{\ell} - \hat{e},$$

(10) $$\hat{e} = \frac{\alpha}{e}\hat{\ell} + \frac{\beta}{e}\hat{u},$$

(11) $$\hat{e} = 0,$$

(12) $$\hat{r} = \hat{\phi},$$

where $\hat{\phi} = \begin{cases} \frac{r^*}{r}\hat{r}^* - \frac{\tau}{r}\hat{\tau} & (\text{capital export case}) \\ \frac{r^*}{r}\hat{r}^* + \frac{\tau}{r}\hat{\tau} & (\text{capital import case}) \end{cases}$.

A circumflex denotes relative changes and a^{ij} represent cost shares of factor i in the production of commodity j, e.g. $a^{Kx} = \frac{rK^X}{\pi X}$. With constant returns to scale, the adding up theorem holds, so that $\sum_i a^{ij} = 1$.

Substituting (5) and (11) into (10) yields

(13) $$\hat{\ell} = -\frac{\beta}{\alpha}\hat{u}.$$

(13) indicates a negative relationship between the rate of unemployment and the wage rate. This relationship is known as the *wage curve*. Blanchflower and Oswald (1994, 1995) provide empirical evidence for the existence of the wage curve from a number of countries. As the elasticity of the wage curve $\varepsilon_{\ell,u} = -\beta/\alpha$ measures the responsiveness of the wage rate to the amount of access supply in the labor market, it can be viewed as an index of wage rigidity. The lower the elasticity of the wage rate with respect to the rate of unemployment, the "stickier" the wage rate.

The skill differential is defined as the wage rate of skilled workers over the wage rate of unskilled workers, i.e. $\theta=\omega/\ell$. Therefore, $\hat{\theta} = \hat{\omega} - \hat{\ell}$. Now, after rearranging, (7) and (8) yield

(14) $$a^{Hx}\hat{\theta} - \frac{\beta}{\alpha}\left(a^{Hx} + a^{Lx}\right)\hat{u} = \hat{\pi} - a^{Kx}\hat{\phi},$$

(15) $$a^{Hy}\hat{\theta} - \frac{\beta}{\alpha}\left(a^{Hy} + a^{Ly}\right)\hat{u} = -a^{Ky}\hat{\phi}.$$

3. Equilibrium

(14) and (15) provide the elasticities of the two sectors' isocost curves in a θ-u space. C.p. these elasticities are given by

$$\frac{\hat{\theta}}{\hat{u}} = \frac{\beta}{\alpha}\left(1 + \frac{a^{Li}}{a^{Hi}}\right) > 0, \qquad \forall\ i=x,y. \tag{16}$$

(16) shows that these isocost curves are upward sloping. In the area to the left of or above these curves production cost exceed the product price, whereas in the area to the right of or underneath these curves, companies in this sector are making profits. To illustrate the influence of the unemployment rate on production cost assume that the unemployment rate falls. As workers associate a lower rate of unemployment with a lower disutility from being fired, their effort decreases and effective production cost rises. In this case, companies have two options to lower production cost: either lower the wage rate of the skilled, or increase the wage rate of the unskilled in order to boost productivity and lower effective production cost. Both ways, the skill differential decreases.

(16) also shows that as long as α and β are identical across sectors, the slopes of the two isocost curves differ only with respect to the skill intensities of the two sectors $\left(a^{Li}/a^{Hi}\right)$: The higher the skill intensity, the flatter the slope of the respective isocost curve. We will assume now that X is the skill intensive good and that Y uses unskilled workers intensively in its production. Therefore, capital is left as the "middle factor", so that factor intensities yield the following inequality:

$$\frac{a^{Hx}}{a^{Hy}} > \frac{a^{Kx}}{a^{Ky}} > \frac{a^{Lx}}{a^{Ly}}. \tag{17}$$

Additionally, let the high-skill sector also have a higher capital intensity (in the sense that total labor cost constitute a lower proportion of the value of its output) than the low-skill sector:

(18) $$a^{Kx} > a^{Ky}.$$

Wood (1994, p. 79f.) provides evidence for a positive correlation between a sector's skill intensity and its capital intensity. His results are supported by an earlier study by Forstner and Ballance (1990, p. 98). According to Wood, a possible explanation for this collinearity could be the empirically observed complementarity between capital and skill in manufacturing (capital-skill complementarity hypothesis, Griliches, 1969). If relative demand for skilled labor rises as the capital intensity of a sector increases, skill intensive industries also have a higher capital intensity.

[INSERT figure 2 here]

The equilibrium is illustrated in figure 2 (linearity was assumed for simplification). The intersection of the two isocost curves explicitly yields the equilibrium values for the relative wage of skilled workers (θ) and for the rate of unemployment of unskilled workers (u). The equilibrium values for ℓ, w, and ω are implicitly given by this solution. As e is generally determined by (5), (4) can be solved for ℓ when u and e are given as $\ell = E \times \exp\left(1 - \frac{\beta}{\alpha} \ln u\right)$, with E as the base of the natural logarithm. Effective wages of unskilled workers are then given by (3), and the wage rate of skilled workers can be determined by $\omega=\theta\ell$. These solutions are obtained for given values of the relative commodity price (π), the world rental rate (r^*), and capital market transaction costs (τ). The latter two also determine the domestic rental rate (6a/b).

4. International Trade

If our country is relatively skilled labor abundant compared to the rest of the world, it will export the skill intensive good X and import the low-skill intensive good Y (Heckscher-Ohlin theorem; see Hoon, 1991, for the validity of the Heckscher-Ohlin theorem with efficiency wages). As a result of international trade, its terms of trade, given by the relative product price π, will rise.

Proposition 1: *An increase in the terms of trade leads to an increase of the skill differential and drives up unemployment of unskilled workers.*

Proof: An increase of π leads to an upward shift of the X sector's isocost curve. The new intersection of the two curves yields a higher skill differential and a higher rate of unemployment. The new equilibrium is illustrated in figure 3.

[INSERT figure 3 here]

Mathematically, solving (14) and (15) for $\hat{\theta}/\hat{\pi}$ and for $\hat{u}/\hat{\pi}$ yield the following results:

$$\frac{\hat{\theta}}{\hat{\pi}} = -\frac{1}{\Delta}\frac{\beta}{\alpha}\left(a^{Hy} + a^{Ly}\right), \tag{19}$$

$$\frac{\hat{u}}{\hat{\pi}} = -\frac{1}{\Delta}a^{Hy}, \tag{20}$$

where $\Delta = \frac{\beta}{\alpha}\left(a^{Hy}a^{Lx} - a^{Hx}a^{Ly}\right)$. If (17) holds, $\Delta < 0$. Then, $\hat{\theta}/\hat{\pi} > 0$ and $\hat{u}/\hat{\pi} > 0$.

The reason for the rise of the skill differential is very much what the Stolper-Samuelson theorem predicts and what the *Trade and Wages* literature emphasizes: Because of a rise of

the relative price of the skill intensive commodity X, this industry expands and relative demand for skilled labor increases. This drives up the skill differential. What is new in this model is that the unemployment rate also adjusts to changes of the terms of trade. As companies pay wages above the market clearing level for unskilled labor (and thus create unemployment), changes in the demand for low-skill workers lead to both changes of the wage rate and changes of employment [see (13)]. In the case of an increase of the relative price of the skill intensive good X, relative demand for unskilled labor falls and unemployment rises.

(19) can be rearranged, so that

$$\frac{\hat{\theta}}{\hat{\pi}} = -\frac{\left(a^{Hy} + a^{Ly}\right)}{\left(a^{Hy}a^{Lx} - a^{Hx}a^{Ly}\right)}. \tag{21}$$

Interestingly, (21) is independent of α and β. Thus, the elasticity of the wage curve has no effect on the impact of product price shocks on relative wages. In fact, (21) is identical to the result obtained with no labor market rigidities (see appendix). This leads to proposition 2:

Proposition 2: *Labor market rigidities have no impact on the rate of change of relative wages.*

Let us first clarify what proposition 2 does *not* say: Proposition 2 does not say that wage rigidities have no impact at all on relative wages. Labor market rigidities do have an influence on the *scale* of wage dispersion. The larger these rigidities in the market for unskilled workers, the lower the skill premium. However, proposition 2 does have something to say about the *change* of relative wages: According to proposition 2, relative change of the skill premium is independent of the degree of inflexibility of the labor market. This result sharply contradicts the popular view that different developments of the skill differential in various industrialized countries can be explained by different labor market institutions. No matter

how rigid wages are (as long as they are not fixed), a rise of the relative product price of the skill intensive good leads to a respective increase in the skill differential.

The reason for this result is tied to the logic of competitive pricing. To illustrate the underlying mechanism suppose that the commodity price in the import competing industry falls. If factor prices did not adjust, firms in this sector could no more compete with foreign competitors. The respective industry would disappear and classical (Ricardian) specialization would follow. However, the rise in unemployment relaxes the rigidity constraint because it raises workers' efforts and allows firms to reduce wages. A diversified equilibrium is thus feasible. The extent to which firms have to adjust wages in order to stay competitive is no different to the case where wages are market clearing: it depends on the commodity price constraint and on technology, i.e. factor intensities.

It should also be pointed out that proposition 2 applies only to the impact on relative wages. The change in the rate of unemployment is not independent of the degree of wage stickiness. As (20) shows, $\partial(\hat{u}/\hat{\pi})/\partial\varepsilon_{\ell,u} < 0$, so that the larger wage rigidities are (the lower the elasticity of the wage curve), the greater is the impact on the rate of unemployment.

5. Biased Technological Progress

Proposition 2 holds for biased technological progress, too. In general, we have to distinguish between factor bias and sector bias in technological progress. The applicability of proposition 2 for sector-biased technological progress is straightforward because the mechanism that leads to changes in factor prices is the same. Jones (2000) has shown that the mathematical solutions for the impact on relative factor rewards are even identical between a one percent increase in the relative product price of X (international trade) and a one percent increase in relative productivity of X (sector-biased technological progress). Therefore, our irrelevance theorem can be transferred one-to-one to the case of sector-biased technological progress.

But what about factor-biased technological progress? Xu (2001) has shown that the factor bias of technological progress is irrelevant in a small open economy when the technological progress is confined to one sector (local technical progress). In this case, it is only the sector bias that matters: If technological progress occurs in the skill intensive sector, it will lead to an increase of the skill differential, independent of whether it is skill-biased or unskilled-biased.

But if the technological progress is economy wide and occurs in both sectors, factor bias matters again (Jones, 2000). In how far does skill-augmenting technological progress in the whole economy affect relative wages and unemployment, and what role do wage rigidities play in this? To answer this question we introduce a new technological parameter t so that ω/t denotes the effective wage rate of skilled workers. The impact of skill-augmenting technological progress on the skill differential and on the rate of unemployment can then be analyzed explicitly by an increase in t.

(1) and (2) convert to

(1') $$x\left(r, \frac{\omega}{t}, w\right) = \pi,$$

(2') $$y\left(r, \frac{\omega}{t}, w\right) = 1.$$

Proposition 3: *(i) Skill-augmenting technological progress leads to an increase in the skill differential. The rate of unemployment of unskilled workers is unaffected. (ii) This result is independent of wage rigidities.*

Proof: The introduction of t changes (14) and (15) so that

(14') $$a^{Hx}\hat{\theta} - \frac{\beta}{\alpha}\left(a^{Hx} + a^{Lx}\right)\hat{u} = \hat{\pi} - a^{Kx}\hat{\phi} + a^{Hx}\hat{t},$$

(15') $$a^{Hy}\hat{\theta} - \frac{\beta}{\alpha}\left(a^{Hy} + a^{Ly}\right)\hat{u} = -a^{Ky}\hat{\phi} + a^{Hy}\hat{t}.$$

As a result of an exogenous increase in the productivity of skilled workers, the two isocost curves are shifted upwards. (14') and (15') reveal that the extent of the upward shift is identical for both curves $\left(\hat{\theta}/\hat{t}\Big|_{\hat{u}=0}^{X/Y} = 1\right)$. Therefore, the new equilibrium is characterized by a higher skill differential, whereas the rate of unemployment of unskilled workers has remained constant. Figure 4 illustrates the adjustment to skill-augmenting technological progress.

[INSERT figure 4 here]

The mathematical solution proves proposition 3(ii). The results are independent of the wage curve:

(22) $$\frac{\hat{\theta}}{\hat{t}} = 1,$$

(23) $$\frac{\hat{u}}{\hat{t}} = 0.$$

The mechanisms at work here are very similar to the ones described in the well-known Rybczynski theorem. The rise in productivity of skilled workers initially lowers relative production costs in the skill intensive industry X. With commodity prices remaining constant, relative demand for X increases. Therefore, resources are shifted away from the production of Y towards the production of X. The output expansion of X and the output contraction of Y induced by these structural adjustments lead to an increase in the relative demand for skilled labor, thus pushing up the skill differential [see (22)].

On the other hand, (23) might come as a surprise. One could expect that a decline of the relative demand for unskilled workers also leads to an increase in the rate of unemployment. However, relative demand for labor changes only if measured in physical units. Effective demand for either skill group remains unchanged. In analogy to Rybczynski, effective wage rates do not change, either. Therefore, the rate of unemployment of unskilled workers remains unaffected by these adjustment processes.

It is also obvious from (22) and (23) that wage rigidities play absolutely no role in this result. As effective demand for unskilled workers does not change, neither the wage of unskilled workers nor the unemployment rate is affected.

6. Capital Market Integration

Capital market integration is modeled as an exogenous decrease in marginal transaction costs τ (Haufler, 1997). When transaction costs fall, additional capital movements reduce international rental rate differentials. In the small country case, this leads to a move of the domestic rental rate towards the world rental rate. As the world rental rate is exogenously given $\left(\hat{r}^* = 0\right)$, the sign of the rate of change of the domestic rental rate depends on whether the small country is a capital exporting country or whether it is a capital importing country. According to (12), if $\hat{r}^* = 0$ and $\hat{\tau} < 0$, then $\hat{r} = \hat{\phi} < 0$ in the capital importing case, whereas $\hat{r} = \hat{\phi} > 0$ in the capital exporting case. The impact of the adjustment processes in the labor market is summarized in proposition 4:

Proposition 4: *(i) Capital market integration leads to an increase of the skill differential and a fall of the rate of unemployment of unskilled workers, if the home country is a capital importing country. The results are reversed, if the home country is a capital exporting country. (ii) The irrelevance of wage rigidities for the determination of changes in relative wages holds.*

Proof: Mathematically, we obtain

$$\frac{\hat{\theta}}{\hat{\phi}} = \frac{\left(a^{Kx} - a^{Ky}\right)}{\left(a^{Hy}a^{Lx} - a^{Hx}a^{Ly}\right)}, \tag{24}$$

$$\frac{\hat{u}}{\hat{\phi}} = \frac{1}{\Delta}\left(a^{Kx}a^{Hy} - a^{Ky}a^{Hx}\right). \tag{25}$$

If (17) and (18) hold, $\hat{\theta}/\hat{\phi} < 0$ and $\hat{u}/\hat{\phi} > 0$. Thus, changes in the skill differential and the unemployment rate triggered by an increase of capital mobility depend on whether ϕ rises

or falls as a consequence of the declining transaction costs. As $\hat{\phi} = -\frac{\tau}{r}\hat{\tau} > 0$ when the home country is a capital exporting country, this country is faced with a declining skill differential and a rising rate of unemployment. On the other hand, in a capital importing country the skill differential rises $\left(\hat{\phi} = \frac{\tau}{r}\hat{\tau} < 0\right)$ whereas the unemployment rate falls.

In our graphical analysis an increase of capital mobility $(\tau \to 0)$ leads to a shift of both sectoral isocost curves. If the domestic rental rate is lower than the world rental rate, so that the home country is a capital exporting country, a fall of capital market transaction costs will be followed by an increase in the domestic rental rate. Thus, production costs increase in both sectors and the sectoral isocost curves are shifted downwards (to the right). A closer look at the extent of the two shifts reveals that the downward shift of the Y sector's isocost curve exceeds the downward shift of the X sector's isocost curve, whereas X's isocost curve is shifted more to the right than Y's isocost curve:

(26) $$\left.\frac{\hat{\theta}}{\hat{\phi}}\right|_{\hat{u}=0} = -\frac{a^{Ki}}{a^{Hi}}, \qquad \forall \text{ i=x,y,}$$

(27) $$\left.\frac{\hat{u}}{\hat{\phi}}\right|_{\hat{\theta}=0} = \frac{a^{Ki}}{\frac{\beta}{\alpha}\left(a^{Hi} + a^{Li}\right)}, \qquad \forall \text{ i=x,y.}$$

If (17) and (18) hold, $\left(\hat{\theta}/\hat{\phi}\right)^{X}_{\hat{u}=0} < \left(\hat{\theta}/\hat{\phi}\right)^{Y}_{\hat{u}=0}$ and $\left(\hat{u}/\hat{\phi}\right)^{X}_{\hat{\theta}=0} > \left(\hat{u}/\hat{\phi}\right)^{Y}_{\hat{\theta}=0}$. The shifts of the two curves and the new equilibrium are illustrated in figure 5. Suppose that the initial equilibrium was at point A. The new equilibrium is then given by point B. From A to B, the skill differential has fallen and the rate of unemployment of unskilled workers has risen.

[INSERT figure 5 here]

The reason for these adjustments is straightforward: When the domestic rental rate is pushed up by capital outflows, production cost rise in both sectors. If commodity prices remain constant, companies have to downscale their activities in order to prevent losses. This reduces demand for labor of both skill groups, putting downward pressure on both wages. However, as low-skill wages are somewhat rigid, part of the adjustment pressure has to be carried by employment, resulting in a higher rate of unemployment and a lower skill differential.

The opposite case, where the home country is a capital importing country, can be described as a movement from B to A. In this case, a rise of capital mobility reduces the domestic rental rate, so that production costs in both sectors fall. As a result, the two isocost curves shift upward (to the left). The skill differential increases and the rate of unemployment falls.

Concerning proposition 4(ii), (24) shows that the impact of capital movements on relative wages is again independent of the elasticity of the wage curve (see appendix). Therefore, relative changes of the skill differential triggered by capital movements do not depend on the degree of wage stickiness. This finding underlines the generality of the irrelevance of wage rigidities for relative factor rewards in general equilibrium.

7. Summary and Conclusion

In the previous sections we have made extensive use of the *ceteris paribus* clause. The impact of international trade, technological progress, and capital movements were all analyzed as if they were the only change brought about by globalization. In reality, however, all three changes coincide. So if we are to say something about the impact of globalization as a whole, we have to look at all three changes simultaneously. In this case we have to differentiate between the effects in a capital exporting country and in a capital importing country. Table 1 summarizes our results.

[INSERT table 1 here]

Table 1 shows that capital importing countries can expect to see their skill differential rise, whereas the impact on the rate of unemployment is somewhat ambiguous in these countries. Capital exporting countries, on the other hand, should experience a sharp rise of unemployment, while the reaction of relative wages is not as clearly determined.

Most interestingly, the total impact of globalization is either largely skill differential increasing or largely unemployment increasing. However, it is not wage rigidities that decide whether relative wages or unemployment rates adjust. We showed that wage rigidities are rather irrelevant in that respect. It is the directions of capital flows that make the difference.

It is almost always impossible to break down a real phenomenon to one single cause. This is especially true for the many complex changes that are brought about by what is called globalization. So far, the debate about the impact of globalization on relative wages has centered around international trade and technological progress. This paper showed that capital market integration might play a role as well.

Appendix

Proof of Proposition 2 and 4(ii):

Without efficiency wages, (14) and (15) change to

$$a^{Hx}\hat{\theta} + \left(a^{Hx} + a^{Lx}\right)\hat{\ell} = \hat{\pi} - a^{Kx}\hat{\phi},$$

$$a^{Hy}\hat{\theta} + \left(a^{Hy} + a^{Ly}\right)\hat{\ell} = -a^{Ky}\hat{\phi}.$$

Concerning changes in relative wages $\left(\hat{\theta}\right)$, these two equations yield the following solutions:

$$\frac{\hat{\theta}}{\hat{\pi}} = -\frac{\left(a^{Hy} + a^{Ly}\right)}{\left(a^{Hy}a^{Lx} - a^{Hx}a^{Ly}\right)}$$

$$\frac{\hat{\theta}}{\hat{\phi}} = \frac{\left(a^{Kx} - a^{Ky}\right)}{\left(a^{Hy}a^{Lx} - a^{Hx}a^{Ly}\right)}$$

For the derivation of the latter result remember that $\sum_i a^{ij} = 1$.

Comparing these solutions with the solutions in (21) and (24) proves the irrelevance of wage rigidities.

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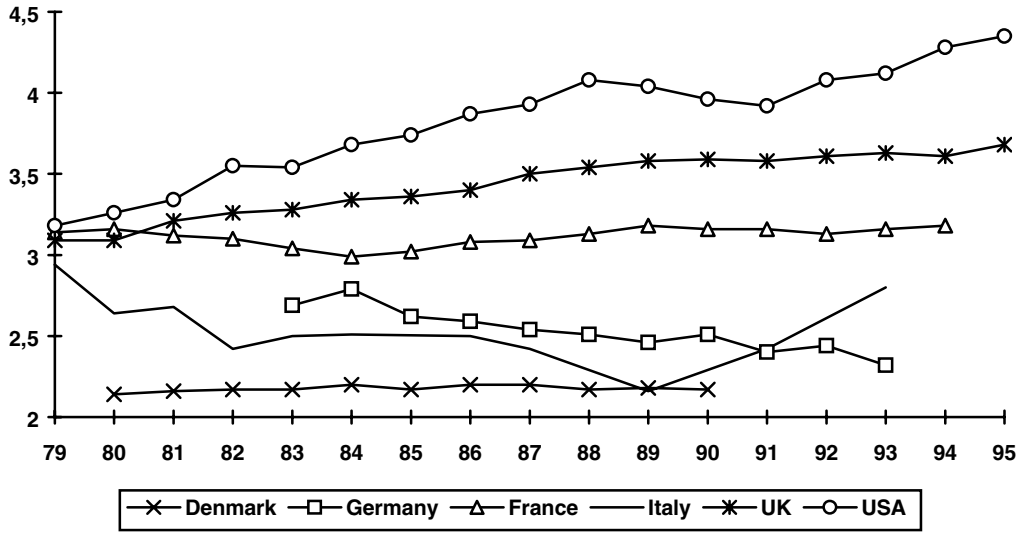
Figures and Tables

Figure 1:
Trends in Earnings Inequality, Deciles D9/D1



Notes: Both sexes for all countries except USA (males only). To improve readability, 0.3 has been added to the ratio of the UK, while 0.1 has been subtracted from the ratio of France.

Source: Table 3.1 in OECD (1996, p. 61f.).

Figure 2:
Equilibrium

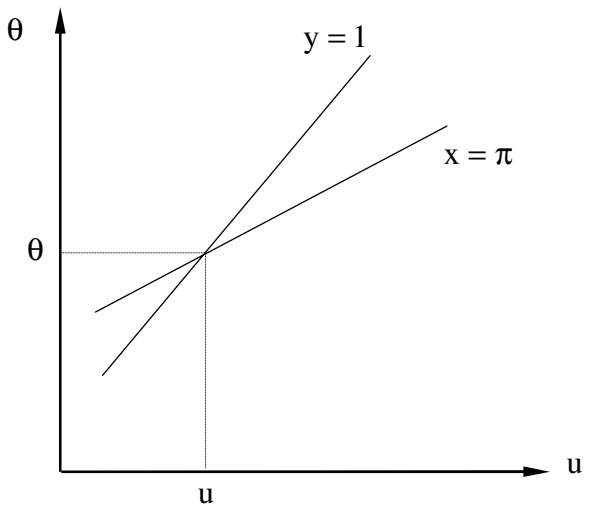


Figure 3:
International Trade

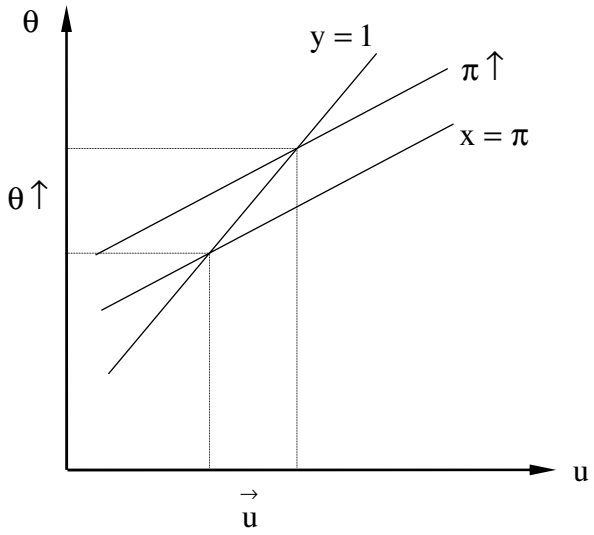


Figure 4:
Skill-Augmenting Technological Progress

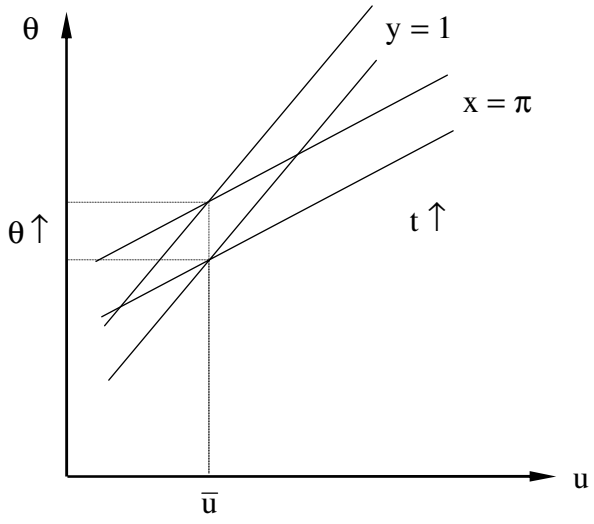


Figure 5:
Capital Movements

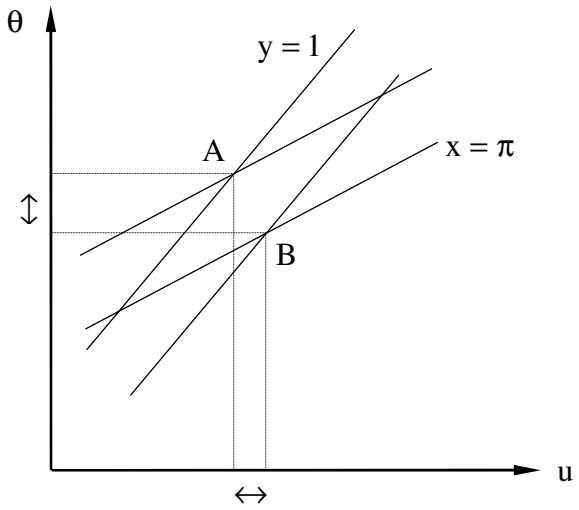


Table 1:

	Capital Movements	Biased Technological Progress	International Trade	Total Impact
Capital Importing Country	$\theta\uparrow$ $u\downarrow$	$\theta\uparrow$ $\bar{u}$	$\theta\uparrow$ $u\uparrow$	$\theta\uparrow\uparrow$ $u\uparrow\downarrow$
Capital Exporting Country	$\theta\downarrow$ $u\uparrow$	$\theta\uparrow$ $\bar{u}$	$\theta\uparrow$ $u\uparrow$	$\theta\uparrow\downarrow$ $u\uparrow\uparrow$