DISCUSSION PAPER SERIES

IZA DP No. 523

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Josef Falkinger
Volker Grossmann

July 2002

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

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Josef Falkinger
University of Zurich

Volker Grossmann
University of Zurich and IZA Bonn

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IZA

P.O. Box 7240
D-53072 Bonn
Germany

Tel.: +49-228-3894-0
Fax: +49-228-3894-210
Email: iza@iza.org

IZA Discussion Paper No. 523
July 2002

ABSTRACT

Workplaces in the Primary Economy and Wage Pressure in the Secondary Labor Market*

This paper develops a two-sector general equilibrium model in which firms in the primary economy have to create workplaces prior to production and product market competition. For this, we introduce the endogenous sunk cost approach with two-stage decisions of firms from IO in the macro-labor literature. By hypothesizing that technological change has lowered marginal costs but has raised organizational requirements for installing workplaces, we are capable to explain downsizing of low-skilled jobs in the primary economy despite wage flexibility ex ante. This leads to more accentuated labor market segmentation, i.e. an increase in wage pressure in the secondary economy.

JEL Classification: J26, C23, C25

Keywords: dual labor market, endogenous sunk costs, organizational labor, segregation, workplace

Volker Grossmann
Department of Economics
University of Zurich
Raemistrasse 62
CH-8001 Zurich
Switzerland
Tel.: +41 1 634 22 88
Fax: +41 1 634 49 96
Email: volker.grossmann@wwi.unizh.ch

* We are grateful to Johannes Binswanger, Jim Malley and two anonymous referees for valuable comments. Moreover, we are indebted to Dennis Snower, seminar participants at the University of Zurich, the CESifo workshop on “Employment and Social Protection” in Munich 2001, the European Economic Association Annual Meeting (EEA) and the European Meeting of the Econometric Society (ESEM), both held in Lausanne 2001, for helpful discussions and comments.

1 Introduction

The goal of the present paper is to propose a general equilibrium model with dual labor markets which allows us to identify economic (rather than institutional) forces of downsizing of low-skilled jobs in the primary economy, implying a higher wage pressure in the secondary economy.

In the last years, an extensive literature on the relationship between wage inequality and technological change has been developed (e.g. Gregg and Manning, 1997; Galor and Tssidon, 1997; Acemoglu, 1998; Caselli, 1999; Lloyd-Ellis, 1999; Galor and Moav, 2000).[1] However, increasing wage inequality is not the only symptom of declining demand for low-skilled labor, and is largely confined to the U.S. and the UK (e.g. Gottschalk and Smeeding, 1997). The more pervasive characteristic in the last two decades has been substantial downsizing of low-skilled jobs in manufacturing industries in both Anglo-American countries and Continental Europe (e.g. Berman, Bound and Machin, 1998; Machin and van Reenen, 1998). In relatively rigid European labor markets, this has led to dramatic increases in unemployment rates for low-skilled labor. Thus, economists and policy makers more and more stress the need to create low-paid jobs in the service sector, for instance, by lowering minimum wages. In the U.S., real wages at the bottom have already declined sharply in the last decades (Fortin and Lemieux, 1997; Murphy and Topel, 1997). In combination with a considerably larger service sector in the U.S. compared to, say, Germany, this seems to have helped the U.S. economy to avoid the unemployment problems now faced by Continental Europe.[2] This suggests that opening up the secondary labor market may be a successful strategy to reduce unemployment; how-

[1] This literature largely focuses on shifts in relative labor productivity in favor of skilled workers, i.e. on the hypothesis of so-called skill-biased technological change.

[2] According to OECD (2000), in 1998 the total share of service employment has been 73.8 percent in the U.S. and 62.6 percent in Germany. The respective employment shares of personal services (which are characterized by particularly low-paid jobs, on average) are 12.1 compared to 7.1 percent.

ever, at two kinds of costs. First, a more substantial dualization of the labor market for low-skilled workers with well-paid jobs in the primary economy and low-paid jobs in the secondary economy; and second, higher *overall* wage inequality, coming from job rationing in the primary sector rather than from rising wage differentials between skilled and unskilled workers in *this* sector.[3]

We hypothesize that the main difference between the primary and the secondary economy is technological (for instance, due to the different nature of goods produced in these sectors). The primary economy is characterized by firms with an organizational infrastructure in which workers can interact. Thus, a crucial feature of our model is that firms in the primary economy have to create *workplaces* prior to production and product market competition. This is formalized by introducing the idea of *endogenous sunk costs* for capacity-investments of firms from the IO literature in a macro-labor context.[4] More precisely, firms in the primary economy choose their number of (high-skilled and low-skilled) workplaces at a first stage before entering monopolistic competition in a second stage. As known from the IO literature, such a two-stage framework is natural whenever capacity choices of firms are involved. In a macro-labor context, it enables us to take the idea of a workplace serious. By contrast, no ex ante creation of workplaces is needed in the secondary labor market. Those workers for whom no primary jobs are organized offer their labor to the secondary economy.

The endogenous sunk costs for the creation of workplaces in the primary economy are specified as wage costs for high-skilled managers, where managerial requirements

[3] It should be noted that this view is rather different from the now famous "Krugman-hypothesis" (Krugman, 1994), which deals with an overall trade-off between wage inequality and unemployment due to wage differentials in a single-sector framework.

[4] See Sutton (1991, 1998) for a general account of the theory of endogenous sunk costs, which is necessarily characterized by two-stage games among firms in IO contexts, with subgame-perfect equilibria. We adopt this approach to a general equilibrium model by seeking for perfect foresight equilibria without strategic interactions.

and workplace creation are linked according to a linear homogenous technology.[5] It should be noted that the employment share of workers in managerial occupations has substantially increased in the last two decades (e.g. Berman, Bound and Grichilis, 1994).[6] This suggests that organizational (i.e. managerial labor) requirements have increased; for instance, due to increased requirements for human resource development. In fact, this is consistent with another feature of modern economies often discussed in the IO literature: higher fixed costs in favor of lower marginal production costs.

We find that despite flexible wages such a technological change leads to downsizing of low-skilled jobs in the primary economy in a perfect foresight equilibrium. In absence of the usually considered biased changes in the production technology, this leads to a more compressed wage structure between skill groups in the primary sector, but to increased wage pressure in the secondary economy. Under flexible wages (i.e. the U.S. case), this results in higher wage differentiation within the group of low-skilled workers across sectors. Consequently, overall wage inequality between skill groups may increase despite wage compression in the primary economy. With a minimum wage, unemployment of low-skilled labor increases, and wage inequality even declines.

The paper is organized as follows. Section 2 briefly discusses the related literature. Section 3 presents the basic structure of the economy. Section 4 derives the equilibrium in the primary economy, whereas section 5 closes the model by analyzing the equilibrium in the secondary labor market. The last section concludes.

[5] A first analysis of this idea has been provided in Falkinger and Grossmann (2001). However, this work suffers from two important shortcomings. First, only a one-sector framework has been considered, which does neither allow to address labor market segmentation nor to understand the policy debate on opening up the secondary economy. Second, it has been assumed that only low-skilled jobs have to be organized which is implausible.

[6] According to Grossmann (2002), the manager share in U.S. manufacturing, for instance, has increased from 11.3 percent in 1983 to 15.8 percent in 2000.

2 Related literature

Our analysis is related to the literature on segregation and labor market dualization. Segregation of workers can mean that firms consist of relatively homogenous groups with respect to skill levels (Kremer, 1993; Saint-Paul, 2001; Kremer and Maskin, 2002). Whereas in this "assortative matching" literature similarly skilled workers receive the same wages whether working in homogenous or heterogenous groups, in our model some (low-skilled) workers become increasingly marginalized in a segmented labor market.

For instance, firm-size wage differentials (controlling for all individually observable characteristics of workers) have been attributed to the complexity of the firm organization (Abowd, Kramarz, and Margolis, 1999; Bayard and Troske, 1999). Moreover, using Swiss data Ramirez (2000) finds that the share of skilled, white-collar workers within a firm (which, in line with our model, is used as proxy for a firm's organizational complexity) positively affects wages. Thus, it is plausible to hypothesize that the primary and secondary labor market differ in the organization of firms, with more complex firms paying higher wages. This is exactly what our model predicts.[7]

Other dual labor market models which attempt to explain the decline of (relative) earning opportunities for low-skilled labor rely on the notion of so-called skill-biased technological change, i.e. a biased shift in the relative productivity towards high-skilled workers. Agénor and Aizenman (1997) study the impact of biased technology shocks on the structure of wages, when sectorial differences in

[7] In our model, as in the story suggested by Abowd, Kramarz, and Margolis (1999) to explain employer-size wage differentials, high-paying firms have market power. However, in contrast to their story, in our model equilibrium profits are zero and their is no rent-sharing of employers with workers. In our model, market power is implied by the costs to install workplaces ex ante which are fixed costs ex post (i.e. at the production stage). For an alternative theory on size-wage differentials, focusing on coordination failures with search in both the product and the labor market, see Shi (2002).

monitoring technologies (and thus in efficiency wages) lead to a segmentation into primary and secondary jobs. As in our model, this implies job rationing in the sense of involuntary non-employment in the primary labor market. (See also Saint-Paul (1996a) for an extensive study of labor market segmentation in the presence of efficiency wage payments.) By contrast, in our model the primary and secondary labor market differ in the need to organize workplaces. Thus, we provide a different source of job rationing in the primary economy, related to the necessity to create workplaces ex ante. Finally, Saint-Paul (1996b) analyzes a search model with only high-skilled labor in the primary labor market and only low-skilled labor in the secondary labor market.[8] Skill-biased technological change reduces employment of low-skilled labor, as firms have a higher incentive to wait for more productive, high-skilled workers. This incentive is stronger when more high-skilled workers are available. In our model, also low-skilled workers can be employed in the primary labor market, and high-skilled and low-skilled labor are technological complements in production. Moreover, we analyze a general equilibrium model which emphasizes the structure of goods demand. In contrast, the analysis of Saint-Paul (1996a,b) is partial equilibrium.

3 The structure of the dual economy

There are two sectors in the economy, a so-called x-sector with (an exogenous number of) n firms which produces a differentiated good and a y-sector with a representative firm which produces a homogenous good. In both sectors, labor is the only input and firms take wages as given in their employment decisions. Technologically, the sectors differ in two characteristics. First, whereas in the x-sector the production process and thus employment requires an organization in firms (e.g. Weitzman, 1982), in

[8] Recently, Gautier (2002) has extended this framework of Saint-Paul (1996b) by allowing for free entry of vacancies and the possibility of high-skilled workers to occupy simple jobs.

the y-sector, no organization of work is required. Second, whereas the x-sector employs both high-skilled and low-skilled labor, low-skilled labor is the only input in the y-sector. These characteristics are supposed to represent crucial technological features of the "primary" economy (x-sector) and the "secondary" economy (y-sector). Examples of firms in the x-sector include firms like General Motors and IBM. Such firms are characterized by complex organizational structures, high degree of interaction among employees and a substantial share of high-skilled workers. An extreme example of the secondary labor market would be self-employment of low-skilled workers. Realistically, one may also think of (low-paid) services like cleaning or newspaper selling as activities in the y-sector, which barely involve interaction among employees.

The requirement of an organization in the x-sector *implies* that firms have to decide ex ante (i.e. before production starts) the design of workplaces. This encompasses two dimensions: the number of workplaces and the wage structure. In our model, this is reflected by two assumptions.

First, firms have to choose the amount of *non-production* (i.e. managerial) labor which is necessary to create the desired capacity of workplaces. The non-production labor requirements in a firm positively depend on the amounts of organized high-skilled and low-skilled production labor, respectively. It is assumed that only high-skilled labor can be employed for the creation of workplaces.[9] A natural set-up of a model which reflects the idea that designing workplaces is necessarily an ex ante decision is a two-stage framework. This follows the IO literature which hypothesizes endogenous sunk costs for capacity investments. In our model, at stage 1, firms in the x-sector set up workplaces under perfect foresight about the ex post situation (i.e. about both wages and the nature of product market competition). At stage

[9] See also Das (2001) for a model in which high-skilled workers have a double role as production and non-production workers. In his model, the non-production activity is specified as supervising in the presence of shirking of production workers.

2 (i.e. ex post) firms produce and supply their output on the goods market. Since the costs for non-production workers to set up workplaces are sunk when firms enter stage 2, imperfect competition in the goods market is implied. In our model, we assume monopolistic competition among firms in the x-sector (in stage 2). In contrast, there is perfect competition in the y-sector.

Second, firms have to choose the wage offers for the provided workplaces. It is assumed that the provision of workplaces is accompanied by hiring activities. That means firms announce vacancies, including wage offers. In standard models (like in the secondary labor market in our model), this assumption is consistent with the notion of a Walrasian auctioneer, by letting firms announce the equilibrium wage rates. In our sunk cost approach for workplace creation in the primary economy, the assumption of the announcement of wage offers has to be spelled out explicitly. It implies that wages in the primary labor market are fixed at the equilibrium wage level anticipated by firms under perfect foresight of aggregate employment levels in the primary economy.[10]

Labor markets for high-skilled and low-skilled labor are segmented, where labor supply is inelastically given by N_H and N_L, respectively.

3.1 Technology

Output x_i of firm i in the x-sector is produced according to the constant-returns-to-scale production technology

$$x_i = aF(h_i, l_i) \equiv al_i f(\chi_i), \quad \chi_i \equiv h_i/l_i, \tag{1}$$

[10] This assumption precludes that, at the production stage 2, firms in the x-sector substitute workers employed at the offered wage by workers who underbid prevailing wage rates, i.e. no arbitrage possibilities exist ex post. Ex ante wages can freely be chosen. Rational firms choose the anticipated equilibrium wage structure.

where h_i and l_i denote the amounts of high-skilled and low-skilled production labor in firm i, respectively; $a > 0$. $f(\cdot)$ is a strictly monotonic increasing and strictly concave function which fulfills the Inada conditions and $f(0) = 0$. Before production starts, workplaces $\bar{h}_i$ and $\bar{l}_i$ for high-skilled and low-skilled labor, respectively, have to be created. Employment in production is limited by the provided workplaces, that is: $h_i \leq \bar{h}_i$ and $l_i \leq \bar{l}_i$. The organizational (non-production) high-skilled labor requirement m_i to create production workplaces for $\bar{h}_i$ and $\bar{l}_i$ production workers in firm i is given by

$$m_i = G(\bar{h}_i, \bar{l}_i; \gamma) \equiv \bar{l}_i g(\bar{\chi}_i; \gamma), \quad \bar{\chi}_i \equiv \bar{h}_i / \bar{l}_i, \tag{2}$$

where G is linear homogenous and $g(\cdot; \gamma)$ is monotonic increasing in $\bar{\chi}_i$. γ is a shift parameter. We make the convention that the impact of an increase in γ on g is positive. Moreover, following the common hypothesis in the IO literature that fixed costs and marginal production costs are negatively related, we assume that γ and the productivity parameter a are positively correlated. Then an increase in γ can be interpreted as a kind of technological change which is associated with an increase in total factor productivity a but rising job creation costs in the primary sector. (As shown below, a change in a does not have an independent effect on the key variables in equilibrium.) Abstracting from endogenous technology choice of firms,[11] we hypothesize that fixed managerial labor requirements per unit of workplace capacity have indeed increased. Intuitively, such a shift is plausible in view of the recent internationalization of production, customer orientation and quality improvements of goods in the primary economy (Snower, 1999).[12] Moreover, an increase in γ is consistent with increased requirements for human resource development due to changes in skill-requirements of workers (e.g. Lloyd-Ellis, 1999).

Production in the y-sector is unsophisticated. Low-skilled labor is the only input.

[11] See Falkinger (2002) for an analysis of endogenous adoption of the organization technology g.

[12] Note that an increase in γ is also in line with the evidence on increasing non-production employment shares in general, and employment shares in managerial occupations in particular.

Output y of the representative unit in the y-sector is given by

$$y = L_y, \tag{3}$$

where L_y is the employment level in the y-sector.

3.2 Preferences

There is a representative consumer, deriving utility from the consumption of the differentiated good produced by the x-sector and the homogenous good produced by the y-sector. Preferences are represented by a utility function u which is weakly separable in these two types of goods:

$$u(x_1, ..., x_n, y) = U(X, y) = X^{\alpha} y^{1-\alpha}, \tag{4}$$

$0 < \alpha < 1$, where X is a quantity index of the differentiated good given by the CES-index $X = (\sum_i x_i^{\rho})^{1/\rho}$, $0 < \rho < 1$. Thus, the elasticity of demand for each variety i produced by firm i in the x-sector is constant and given by $\sigma \equiv \frac{1}{1-\rho}$. Denoting the price of variety i in the x-sector by p_i and the price for the homogenous good in the y-sector by q, we have for the optimal consumption structure

$$mrs_i = \frac{p_i}{q}, \ i = 1, ..., n, \tag{5}$$

where $mrs_i \equiv \frac{\partial u/\partial x_i}{\partial u/\partial y}$ is the marginal rate of substitution between x_i and y.

3.3 Prices and wages

After each firm in the x-sector has chosen the number of production workplaces $\bar{h}_i$ and $\bar{l}_i$ (at stage 1; see section 4), in stage 2, firms enter monopolistic competition. Thus, as in Dixit and Stiglitz (1977), prices are set as (constant) mark-up over marginal costs c, i.e.

$$p_i = \mu c = p, \tag{6}$$

where $\mu \equiv \frac{\sigma}{\sigma-1} > 1$ is the mark-up factor.[13] Denote nominal wage rates for high-skilled and low-skilled production workers in the primary labor market by w_H and $w_{L,x}$, respectively. Cost minimization implies that relative wages $\frac{w_H}{w_{L,x}}$ of high-skilled labor and the skill-intensity in production χ_i are related by the equation

$$\omega_x \equiv \frac{w_H}{w_{L,x}} = \frac{f'(\chi_i)}{f(\chi_i) - \chi_i f'(\chi_i)} \left(= \frac{F_1}{F_2}\right). \tag{7}$$

Note that this implies $\chi_i = \chi$. Marginal costs are given by

$$c = \frac{w_{L,x}}{a\left[f(\chi) - \chi f'(\chi)\right]}, \tag{8}$$

according to (1) and (7). Moreover, note that at stage 2, it is optimal to utilize capacity fully; i.e. to choose employment according to $h_i = \bar{h}_i$ and $l_i = \bar{l}_i$. Finally, symmetry implies $h_i = h$, $l_i = l$ and thus $x_i = x = lf(\chi)$ in equilibrium.[14]

In the y-sector we have perfect competition. This implies

$$q = w_{L,y}, \tag{9}$$

where $w_{L,y}$ denotes the nominal wage rate (for low-skilled labor) in this sector.

In sum, according to (5), (6), (8) and (9), we obtain

$$mrs_i = \frac{w_{L,x}}{w_{L,y}} \frac{\mu}{a\left[f(\chi) - \chi f'(\chi)\right]} \left(= \frac{p}{q}\right). \tag{10}$$

Note that in a symmetric equilibrium in the primary economy, for all i, we have[15]

$$mrs_i = \frac{\alpha}{1-\alpha} \frac{y}{Q}, \tag{11}$$

[13] The two-stage decision process of firms in the primary economy implies that sunk non-production costs are not passed on to output prices. As argued above, the organizational capacity has to be determined by firms before production starts and thus organizational costs are fixed costs at the production stage. See Blanchard and Giavazzi (2000) for a one-sector monopolistic competiton model in which entry costs are proportional to output like the organizational costs in our model. They also are not reflected in output prices.

[14] Note that in a perfect foresight equilibrium the installed skill-intensity in production $\bar{\chi} = \bar{h}/\bar{l}$ coincides with the skill-intensity χ implied by the costs minimization condition (7). Moreover, firms will not install capacity for producing output which cannot be sold.

[15] According to (4), for $x_i = x$, $\frac{\partial u}{\partial x_i} = \alpha \left(\frac{x}{y}\right)^{\alpha-1} n^{(\alpha/\rho)-1}$ and $\frac{\partial u}{\partial y} = (1-\alpha) \left(\frac{x}{y}\right)^{\alpha} n^{\alpha/\rho}$.

where $Q \equiv nx$ denotes total output in the primary economy.

4 Equilibrium number of primary jobs

In our two-stage framework, the perfect foresight equilibrium is derived by backwards induction.

In the preceding section the (profit maximizing) behavior of firms in the x-sector at stage 2 (i.e. for a given work place capacity) has been analyzed. At stage 1, firms in the x-sector choose their profit maximizing number of workplaces $\bar{h}_i$ and $\bar{l}_i$, perfectly foreseeing the equilibrium at stage 2 (taking aggregate levels as given). Profits in firm i are earnings at stage 2 minus the non-production costs incurred at stage 1. The latter are given by $w_H m_i$. Thus, profits of firm i are given by $\pi_i = (p-c)x_i - w_H m_i$, where p is the equilibrium price determined in section 3.3, and x_i and m_i are given by the technology functions f and g, respectively.

Using (1), (2), (6), $\chi_i = \chi$ and the fact that all workplaces installed at stage 1 will indeed be occupied at stage 2 (i.e. $h_i = \bar{h}_i$, $l_i = \bar{l}_i$, $\chi = \bar{\chi}$), we can write this in the form

$$\pi_i = \left[(\mu - 1)caf(\bar{\chi}) - w_H g(\bar{\chi};\gamma)\right]\bar{l}_i. \tag{12}$$

An equilibrium in the primary economy is reached when, under the anticipation of the price-setting behavior of firms and the expectations of aggregate variables at stage 2, firms have no incentive to change the structure or the amount of provided workplaces at stage 1. Note that with linear homogenous technologies $F(\cdot)$ and $G(\cdot)$, this implies zero-profits, according to (12).[16] If and only if in (12) the term in square brackets is zero, then $\frac{\partial \pi_i}{\partial l_i} = 0$ and firms do not want to provide further

[16] Thus, our equilibrium concept allows for zero profits of monopolistically competitive firms in the x-sector, despite an exogenous number of firms n. In contrast to the free-entry equilibrium of e.g. Dixit and Stiglitz (1977), employment levels rather than the number of firms adjust such that profits are driven to zero.

workplaces. The condition for such a zero-profit equilibrium is thus given by

$$\underbrace{(\mu-1)f(\bar{\chi})}_{\equiv APL(\bar{\chi})} = \underbrace{f'(\bar{\chi})g(\bar{\chi};\gamma)}_{\equiv ACL(\bar{\chi};\gamma)}, \tag{13}$$

where we used

$$\frac{w_H}{c} = af'(\bar{\chi}), \tag{14}$$

according to (7) and (8).

As shown in full detail in the appendix, there are multiple (perfect foresight) equilibria in the model. First, if firms expect relatively high wages of low-skilled production workers they wish to provide a high proportion of workplaces for skilled workers so that the expansion of employment may be constrained by skilled labor supply *before* the zero-profit condition is reached. Second, if firms have pessimistic expectations, zero-profit equilibria with unemployment of both low-skilled and high-skilled workers result. In order to point out that job rationing (i.e. involuntary non-employment of low-skilled labor in the primary labor market) is not the result of unfavorable expectations, we focus on the zero-profit equilibrium with full employment of high-skilled labor.[17] This is the equilibrium at which employment in the primary labor market reaches the highest possible level.[18]

As shown below, there is generally a wage gap between the primary and secondary labor market (i.e. $w_{L,x} > w_{L,y}$) in equilibrium.[19] Thus, workers in the secondary labor market would like to work in the primary economy. However, firms

[17] This may be compared to Weitzman (1982), who also analyzes a monopolistic competition model where multiple (rational expectations) equilibria exist. As in the primary labor market in our model, in his model employment requires an organization in firms. (Unlike our model, his model neither allows for another sector where no organization of work is necessary nor for heterogeneity among workers.) However, in his model involuntary unemployment is due to pessimistic expectations. In contrast, in our model due to its two-stage nature involuntary non-employment (in the primary labor market) may occur even with the most optimistic expectations.

[18] Of course, it is also assumed that firms in the x-sector are not constrained by the supply of low-skilled labor. Otherwise the notion of a dual economy would not make sense.

[19] In a zero-profit equilibrium $w_{L,x} = w_{L,y}$ may only occur as a knife-edge case.

provide no workplaces for them. Hence, they must supply their labor force to the less attractive secondary economy.

In a zero-profit equilibrium, the skill-intensity in production in the x-sector is given by $\bar{\chi} = \chi^*(\gamma)$, where $\chi^*(\gamma)$ is implicitly defined by condition (13). In the comparative-static analysis we concentrate on technological changes reflected in γ. It is important to note that productivity parameter a does not affect the equilibrium skill intensity $\chi^*(\gamma)$. Therefore, our comparative-static results regarding γ apply also if a varies simultaneously with γ as discussed in the introduction.

$\chi^*(\gamma)$ can be determined in a familiar return-cost diagram. The left-hand side of (13) equals the "real" average profit margin per low-skilled worker (in terms of unit costs) whereas the right-hand side equals "real" average non-production labor costs per low-skilled worker. (In the following we use the short-cuts APL and ACL, respectively). APL is an increasing function of $\bar{\chi}$ (starting at zero for $\bar{\chi} = 0$), since output per low-skilled worker is raised by a higher skill-intensity in production. As far as the right-hand side of (13) is concerned, a marginal increase in $\bar{\chi}$ has two effects on ACL. First, the "real" wage rate for high-skilled workers $\frac{w_H}{c} = f'(\bar{\chi})$ declines from infinity at $\bar{\chi} = 0$, lowering average costs to organize workplaces. Second, the average non-production labor requirement $g(\bar{\chi})$ per low-skilled job may increase. It is assumed that the latter effect does not outweigh the former. Thus, ACL is a non-increasing function of $\bar{\chi}$. In sum, the intersection between the APL- and ACL-curve determines $\chi^*(\gamma)$ as depicted in figure 1.

Figure 1

Denoting the aggregate employment level of high-skilled and low-skilled labor in production as $\bar{H}(= n\bar{h})$ and $\bar{L}_x(= n\bar{l})$, respectively, we have $\bar{H} = \chi^*(\gamma)\bar{L}_x$. Full employment of high-skilled labor implies $\bar{H} + M = \chi^*(\gamma)\bar{L}_x + M = N_H$, where $M(= nm)$ is the aggregate amount of organizational labor. Note that $M = \bar{L}_x g(\chi^*(\gamma); \gamma)$, according to (2). This implies the following.

Proposition 1 *In any zero-profit equilibrium, there is job-rationing of low-skilled labor in the primary economy. The maximal equilibrium employment level is given by*

$$L_x^*(N_H, \gamma) = \frac{N_H}{\chi^*(\gamma) + g(\chi^*(\gamma); \gamma)}. \tag{15}$$

Proof. Follows immediately from the full employment constraint $\bar{H} + M = N_H$, i.e. $\chi^*(\gamma)\bar{L}_x + \bar{L}_x g(\chi^*(\gamma); \gamma) = N_H$. ■

Note that the maximal zero-profit equilibrium employment level of low-skilled labor in the primary labor market L_x^* corresponds to optimistic expectations and thus to full employment of high-skilled labor.[20] Also note that neither χ^* nor L_x^* depend on the number of firms n or the productivity parameter a in the x-sector, respectively.

As can immediately be seen from (15), L_x^* increases with N_H. This reduces wage pressure in the secondary labor, as is discussed in section 5. The further analysis concentrates on the role of technological change.

The notion of skill-biased technological change has played a major role in the economic literature of the 1990s.[21] However, focusing on mere changes in the production technology has been strongly criticized (e.g. DiNardo and Pischke, 1997). Changes in the way how firms organize work seem more relevant in practice. Decentralized communication, international production and customer-orientation makes

[20] In a zero-profit equilibrium with pessimistic expectations we would have H^e instead of N_H in (15), where $H^e < N_H$ is the aggregate level of employment of high-skilled labor which is expected by pessimistic firms.

[21] The impact of skill-biased technological change on L_x^* and ω_x^* can be derived as follows. Note that, according to (7), an increase in the relative marginal productivity F_1/F_2 (for any given skill-intensity in production χ) is equivalent to an increase in $\frac{f'(\chi)}{f(\chi)}$. Include a parameter ζ in the production function, i.e. write $f(\cdot) = \tilde{f}(\chi; \zeta)$, representing skill-biased technological change.Then define a function $v(\chi, \zeta) \equiv \frac{\partial \tilde{f}(\chi;\zeta)/\partial \chi}{\tilde{f}(\chi;\zeta)}$ with $\frac{\partial v(\chi,\zeta)}{\partial \zeta} > 0$. For the impact of ζ, rewrite (13) as $\mu - 1 = v(\chi^*, \zeta) g(\chi^*; \gamma)$ to confirm $\frac{\partial \chi^*}{\partial \zeta} > 0$ (note that the term $v(\chi^*, \zeta) g(\chi^*; \gamma)$ is decreasing in χ^*). Thus, L_x^* decreases with ζ, according to (15). Moreover, it is straightforward but tedious to show that $\frac{\partial \omega_x^*}{\partial \zeta} > 0$ if and only if $v(\chi^*, \zeta) > \frac{\partial g(\chi^*;\gamma)\partial \chi}{g(\chi^*;\gamma)}$ holds.

it more difficult to organize jobs for low-skilled workers. Formally, this means that γ increases, shifting both the g-curve and thus the ACL-curve upwards. This increases average costs of providing workplaces for low-skilled workers relative to their profit yield, implying the following.[22]

Proposition 2 *In any zero-profit equilibrium, if γ increases, then both the equilibrium employment level of low-skilled labor in the primary labor market L_x^* and the relative equilibrium wage ω_x^* decline.*

Proof. Apply the implicit function theorem to condition (13) to show that χ^* increases with γ. Then use (15) and (7). ■

An increase in γ means that, for any skill-intensity in production χ, the ACL-curve shifts upwards, as depicted in figure 1. As non-production requirements for low-skilled labor rise, firms in the primary economy have a disincentive to create jobs for the low-skilled. Note that, in contrast to the skill-bias literature, wage inequality decreases rather than increases in the primary economy. As will be seen in the next section, the sign of the overall change in wage inequality depends on institutional barriers for a secondary labor market.[23]

[22] Note that proposition 2 holds in any zero-profit equilibrium, not just in one with full employment of high-skilled labor. We focus on optimistic expectations in order to discuss changes in the *maximal* (possible) equilibrium employment level in the primary labor market.

[23] Interestingly, wage inequality between skill groups in the primary labor market (ω_x^*) is not affected by an increase in high-skilled labor supply N_H, according to (7) and (13). This is due to the following opposing effects. First, as in conventional models with a segmented labor market for different skill groups, an increased availability of high-skilled labor reduces wage inequality, given that the skill-intensity in production increases. Second, however, if N_H increases, firms have an incentive to install more workplaces which raises the demand for (high-skilled) organizational labor. (This reduces the skill-intensity in production and raises relative wages). In our model, both effects exactly cancel. (Formally, this is due to the linear homogeneity of both $F(\cdot)$ and $G(\cdot)$, which implies that the (zero-profit) equilibrium skill-intensity χ^* does not depend on N_H. See Egger and Grossmann (2000) for a similar result in a different context.)

5 Equilibrium in the secondary labor market

In this section, we derive the number of secondary jobs and the equilibrium wage differentiation for low-skilled labor between sectors.

"Labor supply" in the secondary labor market L_y^S equals the amount of low-skilled labor which is not employed in the primary labor market, i.e.

$$L_y^S = N_L - L_x^*(N_H, \gamma). \tag{16}$$

Labor demand in the y-sector L_y^D is given by goods demand in this sector, implied by (10). Using (10) with $mrs_i = mrs$ for all i, the wage differential of low-skilled labor across sectors is given by

$$\frac{w_{L,y}}{w_{L,x}} = \frac{1}{mrs} \cdot \frac{\mu}{a\left[f(\chi^*(\gamma)) - \chi^*(\gamma) f'(\chi^*(\gamma))\right]}. \tag{17}$$

Note that, according to (8), the term $a\left[f(\chi^*) - \chi^* f'(\chi^*)\right]$ equals the "real" equilibrium wage rate $\left(\frac{w_{L,x}}{c}\right)^*$ of low-skilled labor in the primary economy. For calculating mrs note that total output $Q = nx$ in the primary economy is given by $Q^* = nx^* = aL_x^*(N_H, \gamma) f(\chi^*(\gamma))$ in equilibrium. Using this together with (3) in equation (11), we get

$$mrs = \frac{\alpha}{1-\alpha} \cdot \frac{L_y^D}{aL_x^*(N_H, \gamma) f(\chi^*(\gamma))}. \tag{18}$$

Combining (17) and (18), we obtain the following relationship between labor demand L_y^D in the y-sector and the wage differential of low-skilled labor:

$$\frac{w_{L,y}}{w_{L,x}} = B(L_y^D, N_H, \gamma) \equiv \frac{1-\alpha}{\alpha} \cdot \frac{L_x^*(N_H, \gamma)}{L_y^D} \cdot \frac{\mu}{1 - \eta(\chi^*(\gamma))}, \tag{19}$$

where $\eta(\chi) \equiv \frac{\chi f'(\chi)}{f(\chi)} < 1$. For the comparative-static analysis it is important to note that a cancels in (19) because of two opposing effects. On the one hand, mrs decreases with a; on the other hand, the "real" equilibrium wage rate $\left(\frac{w_{L,x}}{c}\right)^* = a\left[f(\chi^*) - \chi^* f'(\chi^*)\right]$ of low-skilled labor in the primary economy increases with a.

In sum, variations in a do not affect the relationship between labor demand and relative wages in the secondary economy.

With flexible wages, both the equilibrium number of secondary jobs L_y^* and the equilibrium wage for low-skilled workers in the secondary economy relative to those in the primary economy $\left(\frac{w_{L,y}}{w_{L,x}}\right)^*$ are given by the intersection of the curves defined by (16) and (19), as depicted in figure 2.

Figure 2

B is negatively sloped in L_y^D since mrs increases in $y = L_y$. By contrast, the supply curve L_y^S is vertical. For all $\frac{w_{L,y}}{w_{L,x}} > 1$ everybody would prefer to work in the secondary labor market.[24] For $\frac{w_{L,y}}{w_{L,x}} \leq 1$ the amount of low-skilled labor which is left over from the primary economy does not depend on the secondary labor market. Since the number of workplaces provided in the primary economy is limited and wages are fixed at the level offered in the announcement of vacancies, in general, we have $w_{L,x} > w_{L,y}$ in equilibrium.

The intersection point in figure 2 defines L_y^* as a function of labor supply of both skill groups N_H and N_L, respectively, and the shift parameter γ.[25] Thus, we can write

$$\left(\frac{w_{L,y}}{w_{L,x}}\right)^* = B(L_y^*(N_H, N_L, \gamma), N_H, \gamma) \equiv b(N_H, N_L, \gamma). \tag{20}$$

where $\left(\frac{w_{L,y}}{w_{L,x}}\right)^* \leq 1$ must hold in such an equilibrium.

There may be limits to wage differentiation across sectors due to union power, fairness considerations among low-skilled workers across sectors, minimum wages, and the like. As figure 2 reveals, if for some reason the sectorial wage gap $\frac{w_{L,y}}{w_{L,x}}$ cannot

[24] Of course, this can never be an equilibrium situation. Again, we refer to the appendix for a detailed discussion of possible equilibria.

[25] Substituting (15) into (16) reveals that relative employment of low-skilled labor in the secondary labor market $\frac{L_y^*}{N_L}$ is a function of relative skill supply $\frac{N_H}{N_L}$ and γ. The same is true for $\frac{L_x^*}{L_y^*}$.

fall below a bound $\hat{b} > b(N_H, N_L, \gamma)$ (with $\hat{b} \leq 1$), there is unemployment of low-skilled labor. Note that such a lower bound is equivalent to a real minimum wage for low-skilled labor.[26] Clearly, if $\hat{b} > b(N_H, N_L, \gamma)$, the equilibrium unemployment rate

$$\hat{u}_L = 1 - \frac{\hat{L}_y}{N_L} \tag{21}$$

is a function of $\hat{b}$, N_H, N_L and γ, where $\hat{L}_y$ denotes equilibrium employment level in the y-sector in this case.

Note that the B-curve shifts upwards if N_H increases, according to (15) and (19). (Remember that χ^* does not depend on N_H.) Moreover, the L_y^S-curve shifts leftwards if N_H increases (or N_L decreases, respectively). Thus, an increase in N_H (or a decrease in N_L) softens wage pressure in the secondary labor market.

How is the B-curve affected by an increase in γ? Remember that an increase in γ leads to downsizing of low-skilled labor L_x^* in the primary economy, according to proposition 2. Such downsizing goes hand in hand with a rise in the skill-intensity χ^* (see (15)). Thus, according to (19), the condition that $\eta(\chi)$ is a non-increasing function of χ is sufficient for the B-curve not to shift upwards when γ increases. For instance, this is fulfilled if $f(\cdot)$ is isoelastic, which implies that $\eta(\cdot)$ is a constant.[27]

[26] Formally, this can be seen as follows. Denote the aggregate price index by Γ, which should be an increasing and linear homogenous function in output prices. We can write $\Gamma = \tilde{\Gamma}(p, q) \equiv q\beta(p/q)$ with $\beta' > 0$. Thus, using $p = \frac{\mu w_{L,x}}{a[f(\chi^*) - \chi^* f'(\chi^*)]}$ and $q = w_{L,y}$, the real wage in the secondary labor market is given by $\frac{w_{L,y}}{\Gamma} = \left[\beta\left(\frac{\mu}{a[f(\chi^*) - \chi^* f'(\chi^*)]}\frac{w_{L,x}}{w_{L,y}}\right)\right]^{-1}$. Thus, imposing $\frac{w_{L,y}}{w_{L,x}} > \hat{b}$ puts a lower bound on the real wage in the y-sector.

[27] It should be noted that our Cobb-Douglas utility-specification (4), although simplifying the analysis, implies a rather strong substitutability between output y of the secondary economy (say, cleaning services) and the differentiated good (say, cars). If, for instance, instead of (4) we would have assumed quasi-linear preferences, then mrs would not depend on total output Q in the primary economy. Thus, mrs would also be independent of χ^* in this case. Since, the real wage rate of low-skilled labor in the primary economy $\left(\frac{w_{L,x}}{c}\right)^* = a\left[f(\chi^*) - \chi^* f'(\chi^*)\right]$ unambiguously increases with χ^* and thus also with γ, the B-curve would then unambiguously shift downwards if γ increases, according to (17).

Proposition 3 *Suppose the B-curve does not shift up if γ increases. In any zero-profit equilibrium we have the following. (i) If wages are flexible, L_y^* increases and $\left(\frac{w_{L,y}}{w_{L,x}}\right)^*$ decreases with γ. (ii) If there is a lower bound $\hat{b} > b(N_H, N_L, z)$ on $\frac{w_{L,y}}{w_{L,x}}$, the equilibrium unemployment rate $\hat{u}_L$ increases with γ.*

Proof. Use (15)-(21) and proposition 2. ■

Thus, an increase in γ is capable to account for increasing labor market segmentation which is revealed by both downsizing of low-skilled labor in the primary labor market and rising wage pressure for already low-paid work in the secondary labor market. Productivity changes which may accompany the variations in γ do not affect this result.

As pointed out above, an increase in skill supply N_H shifts up the B-function, and thus is a possible mean to counteract the effect of γ towards segmentation and rising inequality. These opposing effects of N_H and γ reminds one of the the old debate on the race between education and technological change (see Tinbergen, 1975). Also recent discussions to promote immigration of high-skilled labor ("green card") can be interpreted as an attempt to accommodate technological changes. However, the implied reduction of N_H in the source countries has of course corresponding adverse effects.

6 Conclusion

Firm-level evidence suggests that skill-upgrading, computerization and workplace decentralization are strongly related (For an excellent survey of this evidence, see Bryanjolffson and Hitt, 2000.) Moreover, the evidence suggests that skill-upgrading in manufacturing firms is the result of downsizing of low-skilled labor, rather than increases in high-skilled employment (e.g. Berman, Bound and Grichilis, 1994). That is, declining earning opportunities for low-skilled workers seem to be due to changes in methods to organize work, rather than mere (biased) changes in the

production technology.[28] In our model, changes in the organization of work have a very natural place, since organization of production by non-production workers is the central building block of the model.

Our model has formalized the idea that firms (in the primary economy) have to create workplaces by using the endogenous sunk cost approach from the IO literature. We have shown that the incentive of firms to create workplaces depends on the organizational technology. New methods of organization like customer orientation, international production or decentralized information-processing and decision-making requires relatively high abilities of workers. In other words, the costs of organizing jobs for low-skilled workers rises under new organization methods. This has been shown to induce firms in the primary economy to an upgrading of the skill-structure by downsizing their low-skilled work force. The workers who are set free from the primary economy constitute additional supply of low-skilled workers in the secondary labor market. Typically, with flexible wages the secondary economy expands and wages for low-skilled labor go down. This is not only consistent with the evidence of rising overall wage inequality in Anglo-American countries, but also with the expansion of a low-paid service sector. In contrast, with rigid wages unemployment is raised and wage inequality may even decrease, which may be viewed as the European case. Thus, in contrast to the one-sector models in the skill-bias literature, we can deal with the phenomena of rising segregation, even in combination with decreases in wage inequality. Regarding the effects of a deregulation of the labor market, the policy implications are rather negative. Although higher wage differentiation may reduce unemployment of low-skilled workers, it does not help to create jobs in the primary economy. The only remedy in our framework is the increase in the supply of skilled workers relative to the low-skilled.

[28] See also Bresnahan (1999), Snower (1999) and Lindbeck and Snower (2000) for illuminating discussions.

Appendix

In this appendix, we show which kind of (perfect foresight) equilibria can exist in our model.

Expected variables of firms in the x-sector (from the perspective of stage 1) are denoted by superscript "e". $\bar{\chi}^e = \frac{\bar{H}^e}{\bar{L}_x^e}$ and $M^e = \bar{L}_x^e g(\bar{\chi}^e;\gamma)$ imply $H^e = \bar{H}^e + M^e = [\bar{\chi}^e + g(\bar{\chi}^e;\gamma)]\,\bar{L}_x^e$, where H^e denotes aggregate expected employment of high-skilled labor. If $H^e = N_H$ ($H^e < N_H$) we speak of optimistic (pessimistic) expectations. If $\bar{\chi}^e = \chi^*(\gamma)$ (from (13)), we have

$$H^e = [\chi^*(\gamma) + g(\chi^*(\gamma);\gamma)]\,\bar{L}_x^e, \tag{A.1}$$

which relates (expected) aggregate employment levels of high-skilled and low-skilled labor in the x-sector when profits are zero. This "zero-profit line" is depicted in figure 3.

Figure 3

It is easy to see that the area above the zero-profit line in figure 3 corresponds to positive profits, whereas the area below this line means negative profits.

Given expectations $\bar{\chi}^e$ for the aggregate skill-intensity in production in the primary economy, each firm expects a wage differential $\omega_x^e = \Lambda(\bar{\chi}^e)$, where $\Lambda(\bar{\chi}^e) \equiv \frac{f'(\bar{\chi}^e)}{f(\bar{\chi}^e)-\bar{\chi}^e f'(\bar{\chi}^e)}$ (use (7)). Thus, from the perspective of stage 1, the optimal (i.e. cost-minimizing) skill-intensity is given by $\bar{\chi}_i = \Lambda^{-1}(\omega_x^e) = \bar{\chi}^e$. Hence, according to (12), real profits (in terms of unit costs) of firm i in the x-sector from the perspective of stage 1 can be written as

$$\hat{\pi}_i \equiv \frac{\pi_i}{c} = \left[(\mu-1)af(\bar{\chi}^e) - \left(\frac{w_H}{c}\right)^e g(\bar{\chi}^e;\gamma)\right]\bar{l}_i. \tag{A.2}$$

Note that $\left(\frac{w_H}{c}\right)^e = af'(\bar{\chi}^e)$, according to (14). If the term in square brackets in (A.2) is positive (negative) firms want to raise (reduce) $\bar{l}_i$ and at the same time $\bar{h}_i$ according to $\bar{h}_i/\bar{l}_i = \bar{\chi}^e$. If $\hat{\pi}_i = 0$ (i.e. $\bar{\chi}^e = \chi^*(\gamma)$), firms have no incentive to

deviate. Thus, any point on the line between points 0 and A in figure 3 can be an equilibrium.[29] Point A is the zero profit equilibrium with full employment of high-skilled labor (i.e. optimistic expectations) on which we have focused in this paper. Note that points like C, D and E in figure 3 cannot be equilibrium situations. At point C, the term in square brackets of (A.2) is positive such that firms would like to raise the number of workplaces for both high-skilled and low-skilled labor. At points D and E, firms want to reduce capacity. Finally, note that any situation with full employment of high-skilled labor and non-negative profits, i.e. not just point A but any point on the line between B and A in figure 3 can be a perfect foresight equilibrium. Although at such a point (except at A) it would be profitable to raise employment levels $\bar{h}_i$ and $\bar{l}_i$ along $\bar{\chi}^e$, firms have no incentive to do so if high-skilled labor is already fully employed. They obviously cannot expect to be able to fill additional workplaces for high-skilled workers. And deviating from $\bar{\chi}^e$ by extending $\bar{l}_i$ alone would imply losses since $\bar{\chi}^e$ is the cost-minimal choice.

References

Abowd, John M., Francis Kramarz, and David N. Margolis (1999). High Wage Workers and High Wage Firms, *Econometrica* 67, 251-334.

Acemoglu, Daron (1998). Why do New Technologies Complement Skills? Directed Technical Change and Wage Inequality, *Quarterly Journal of Economics* 113, 1055-1089.

Berman, Eli, John Bound and Zvi Grichilis (1994). Changes in the Demand for Skilled Labor within U.S. Manufacturing: Evidence from the Annual Survey of Manufactures, *Quarterly Journal of Economics* 109, 367-397.

[29] Note that in any equilibrium $\left(\frac{w_{L,y}}{w_{L,s}}\right)^* \leq 1$ must hold. It is easy to show that there always exist some points on the line between 0 and A where $w_{L,y} \leq w_{L,x}$ holds (i.e. there always exists a zero-profit equilibrium).

Berman, Eli, John Bound and Stephen Machin (1998). Implications of Skill-biased Technological Change: International Evidence, *Quarterly Journal of Economics* 113, 1245-1279.

Caselli, Francesco (1999). Technological Revolutions, *American Economic Review* 89, 78-102.

Agénor, Pierre-Richard and Joshua Aizenman (1997). Technological Change, Relative Wages, and Unemployment, *European Economic Review* 41, 187-205.

Bayard, Kimberly and Kenneth R. Troske (1999). Examining the Employer-Size Wage Premium in the Manufacturing, Retail Trade, and Service Industries Using Employer-Employee Matched Data, *American Economic Review* 89, 99-103.

Blanchard, Olivier and Francesco Giavazzi (2000). Macroeconomic Effects of Regulation and Deregulation in Goods and Labor Markets, MIT (mimeo).

Bresnahan, Timothy F. (1999). Computerisation and Wage Dispersion: An Analytical Reinterpretation, Economic Journal 109, F390-F415.

Brynjolfsson, Erik and Lorin M. Hitt (2000). Beyond Computation: Information Technology, Organizational Transformation and Business Performance, *Journal of Economic Perspectives* 14, 23-48.

Das, Satya P. (2001). Trade and Relative Wages: The Role of Supervisory Function by Skilled Workers, *European Economic Review* 45, 45-65.

DiNardo, John E. and Jörn-Steffen Pischke (1997). The Returns to Computer Use Revisited: Have Pencils Changed the Wage Structure too?, *Quarterly Journal of Economics* 112, 291-303.

Dixit, Avinash and Joseph E. Stiglitz (1977). Monopolistic Competition and Optimum Product Diversity, *American Economic Review* 67, 297-308.

Egger, Hartmut and Volker Grossmann (2001). The Double Role of Skilled Labor, New Technologies, and Wage Inequality, University of Zurich (mimeo).

Falkinger, Josef (2002). Macroeconomic Equilibrium and the Organization of Work: A New Theory of Employment, Contributions to Economics, Physika, Hei-

delberg, forthcoming.

Falkinger, Josef and Volker Grossmann (2001). Skill Supply, Supervision Requirements, and Unemployment of Low-skilled Labor, *International Journal of Manpower* 22,1-2, 69-82.

Fortin, Nicole M. and Thomas Lemieux (1997). Institutional Changes and Rising Wage Inequality: Is there a Linkage?, *Journal of Economic Perspectives* 11, 75-96.

Galor, Oded and Omer Moav (2000). Ability-Biased Technological Transition, Wage Inequality, and Economic Growth, *Quarterly Journal of Economics* 115, 469-97.

Galor, Oded and Daniel Tsiddon (1997). Technological Progress, Mobility, and Economic Growth, *American Economic Review* 87, 363-82.

Gautier, Pieter A. (2002). Unemployment and Search Externalities in a Model with Heterogenous Jobs and Workers, *Economica* 69, 21-40.

Gottschalk, Peter and Timothy M. Smeeding (1997). Cross-National Comparisons of Earnings and Income Inequality, *Journal of Economic Literature* 35, 633-87.

Gregg, Paul and Alan Manning (1997). Skill-Biassed Change, Unemployment and Wage Inequality, *European Economic Review* 41, 1173-1200.

Grossmann, Volker (2002) Quality Improvements, the Structure of Employment, and the Skill-bias Hypothesis Revisited, *Topics in Macroeconomics* 2 (1), Article 2, http://www.bepress.com/bejm/topics/vol2/iss1/art2.

Kremer, Michael (1993). The O-Ring Theory of Economic Development, *Quarterly Journal of Economics* 108, 551-75.

Kremer, Michael and Erik Maskin (2002). Wage Inequality and Segregation by Skill, *Quarterly Journal of Economics*, forthcoming.

Krugman, Paul (1994). Past and Prospective Causes of High Unemployment, in: Reducing Unemployment. Current Issues and Options, Proceedings of a Symposium in Jackson Hole, Wyoming, Kansas City: Federal Reserve Bank of Kansas, 68-81.

Lindbeck, Assar and Dennis J. Snower (2000). Multitask Learning and the Re-

organization of Work: From Tayloristic to Holistic Organization, *Journal of Labor Economics* 18, 353-376.

Lloyd-Ellis, Huw (1999). Endogenous Technological Change and Wage Inequality, *American Economic Review* 89, 47-77.

Machin, Stephen and John van Reenen (1998). Technology and Changes in Skill Structure: Evidence from Seven OECD Countries, *Quarterly Journal of Economics* 113, 1215-1244.

Murphy, Kevin M. and Robert Topel (1997). Unemployment and Nonemployment, *American Economic Review Papers and Proceedings* 87, 295-300.

OECD (2000). Employment Outlook, Paris.

Ramirez, José V. (2000). Inter-Industry and Inter-Firm Wage and Hours Differentials in Switzerland, *Schweizerische Zeitschrift für Volkswirtschaftslehre und Statistik* 136, 371-395.

Saint-Paul, Gilles (1996a). Dual Labor Markets, MIT Press, Cambridge, MA.

Saint-Paul, Gilles (1996b). Are the Unemployed Unemployable?, *European Economic Review* 40, 1501-1519.

Saint-Paul, Gilles (2001). On the Distribution of Income and Worker Assignment Under Intrafirm Spillovers, with an Application to Ideas and Networks, *Journal of Political Economy* 109, 1-37.

Shi, Shouyong (2002). Product Market and Size-Wage Differential, *International Economic Review* 43, 21-54.

Snower, Dennis J. (1999). The Organizational Revolution and its Labor Market Implications, Keynote address to the European Association of Labour Economists (EALE), Regensburg.

Sutton, John (1991). Sunk Costs and Market Structure: Price Competition, Advertising, and the Evolution of Concentration, MIT Press.

Sutton, John (1998). Technology and Market Structure, MIT Press.

Tinbergen, Jan (1975). Income Distribution: Analysis and Policies, North-

Holland.

Weitzman, Martin L. (1982). Increasing Returns and the Foundations of Unemployment Theory, *Economic Journal* 92, 787-804.

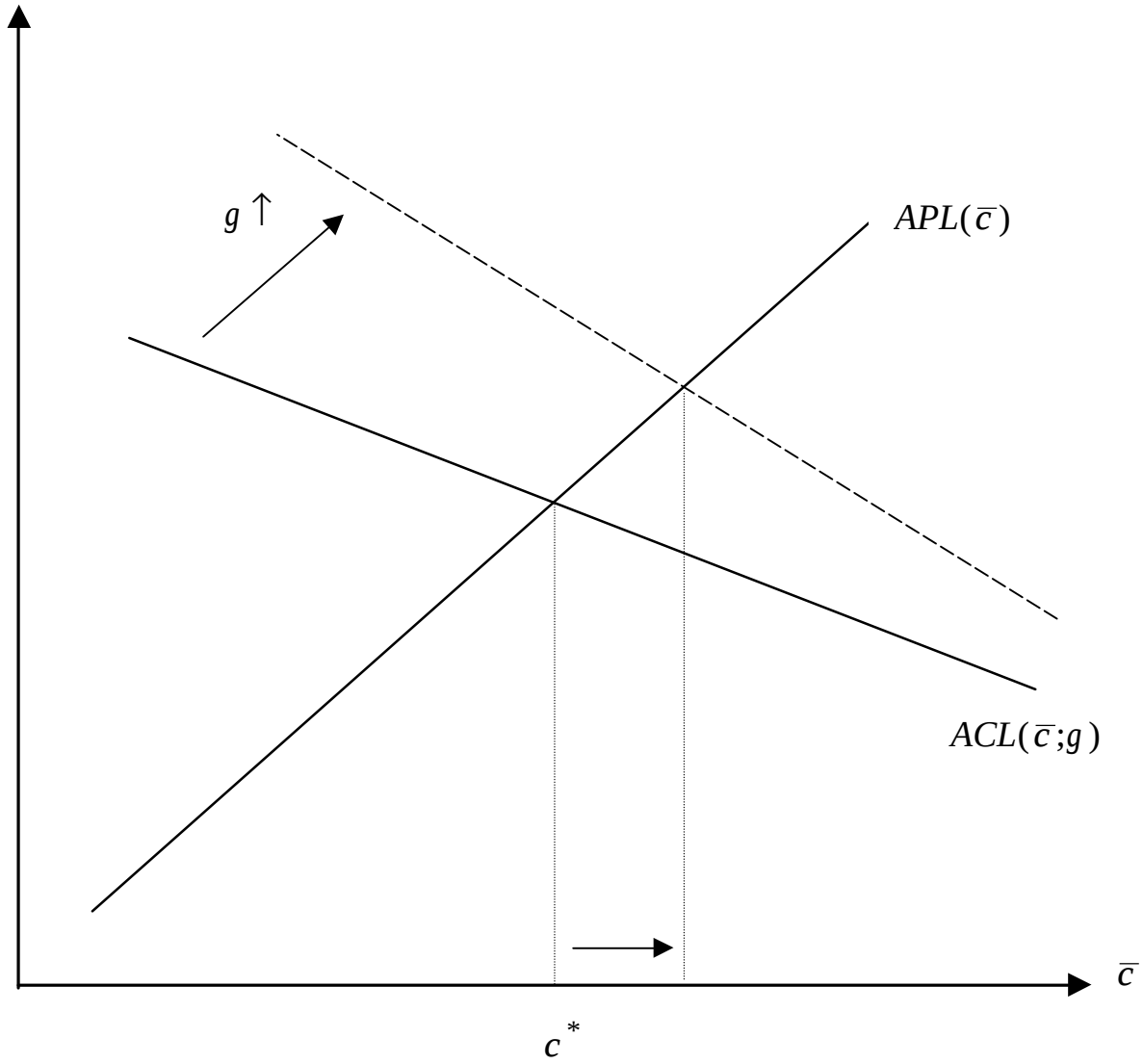

Figure 1: The skill-intensity of production in the primary economy in zero-profit equilibrium and the impact of an increase in g .

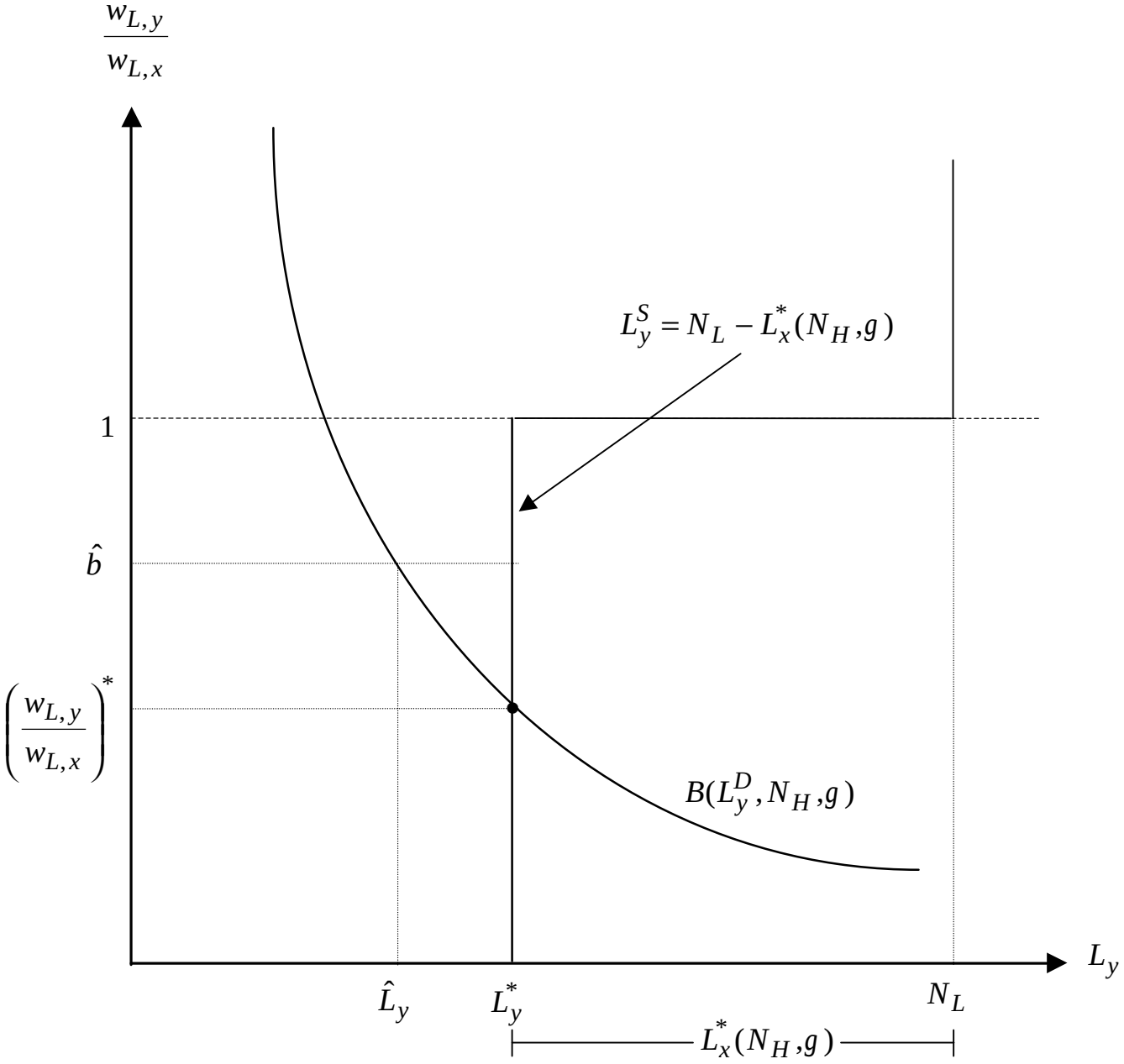

Figure 2: Equilibrium in the secondary labor market.

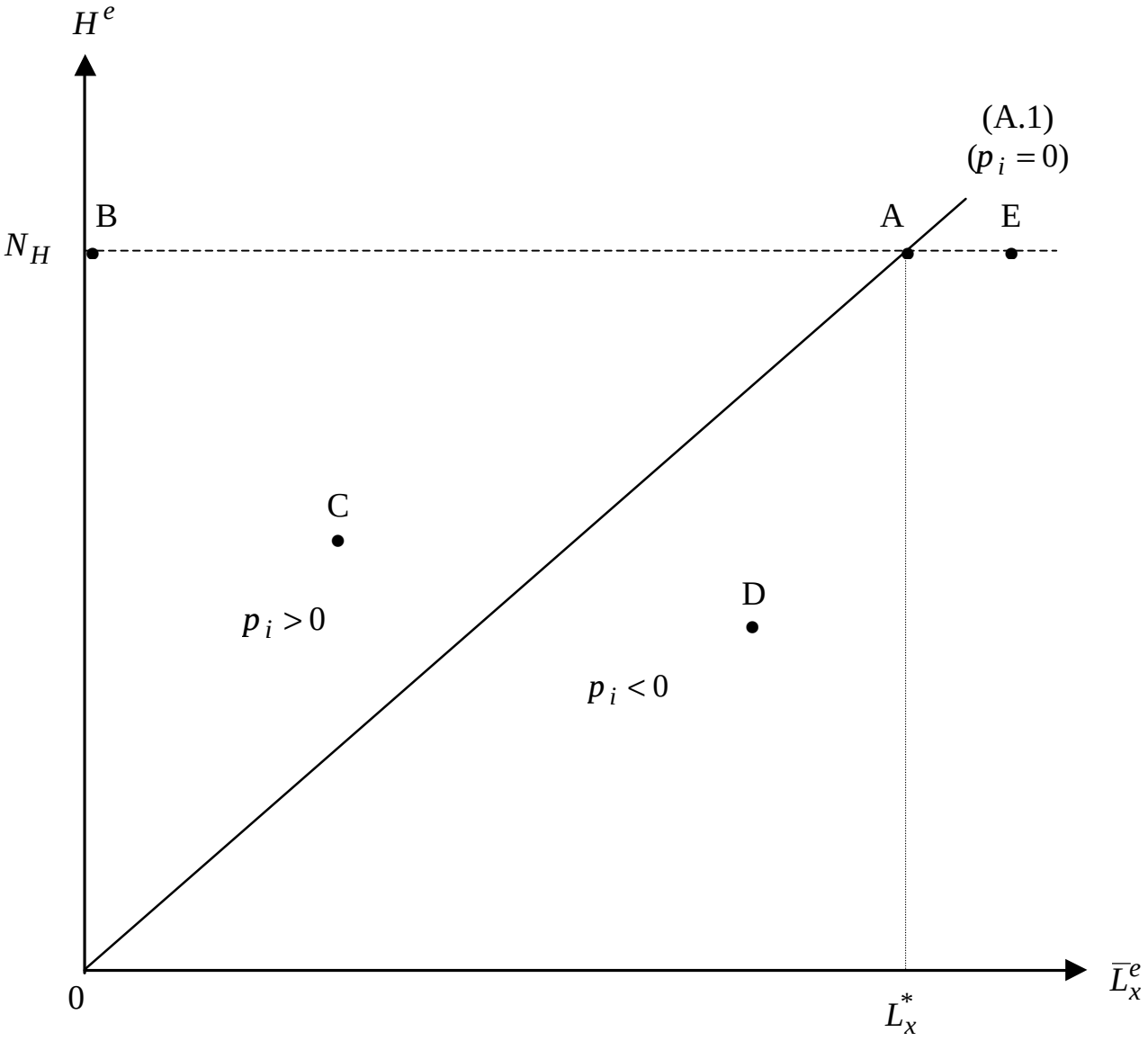

Figure 3: Zero-profit equilibrium (L_x^*, N_H) in the primary economy.

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