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WORK ORGANIZATION, WAGE PRESSURE IN THE SECONDARY LABOR MARKET, AND THE GREEN CARD*

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Abstract

Two trends have marked the politico-economic discussion in many industrialized countries in recent years. On the one hand, international production, workplace decentralization, shareholder orientation and generous manager remuneration have changed the face of firms in the primary economy. On the other hand, there is increased pressure on the secondary labor market revealed by unemployment or declining wages of low-skilled workers. This paper establishes a causal relationship between the two trends by developing a model in which labor market segmentation stems from the fact that organizational labor (management) is a key element in the primary, but not in the secondary economy. We also evaluate the effectiveness of selective immigration policies for high-skilled workers (green card).

JEL Classification: D20, J31

Keywords: Dual labor market; reorganization of work, organizational labor, international competition, green card

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1 Introduction

Two features are typical for recent economic development in industrialized countries: Increasing wage pressure in the secondary labor market on the one hand, and substantial reorganization processes of primary jobs on the other hand (Lindbeck and Snower, 1996, 2000; OECD, 1999). This has provoked two strands of policy debate: Job creation in low-paid work, in particular in the service sector, and selective immigration licenses ("greed cards").

The present paper evaluates this policy debate by showing how the increasing wage pressure in the secondary labor market and organizational changes in primary jobs are related to each other. Moreover, the paper shows how this debate may be related to other important trends in recent years; namely shareholder orientation and a sharp rise in manager remuneration. The idea is that primary jobs need the organizational infrastructure of a firm in which workers can interact. The provision of this organizational infrastructure requires high-skilled non-production workers (e.g. in managerial occupations). We find that increases in organizational labor requirements, e.g. due to decentralized information-processing, customer-orientation and international production, raise the need for high skills. In addition, any power of shareholders or managers to extract rents from their firms exerts pressure to improve the skill structure of jobs organized in a firm. Total employment in the primary economy is limited by the amount of high-skilled non-production workers and the employed organization technology. By contrast, no organized workplaces are needed in the secondary labor market. Thus, those workers for whom no primary jobs are organized offer their labor to the secondary labor market. As a result, workplace decentralization, increased

international competition, shareholder orientation and manager rents in the primary economy imply for the secondary labor market that either wages fall and employment expands or, if there are minimum wages, part of the low-skilled labor force is unemployed.

Indeed, in the U.S. real wages at the bottom declined sharply in the last decades (Fortin and Lemieux, 1997; Murphy and Topel, 1997). Due to dramatic increases in unemployment rates for low-skilled labor also in Europe 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. At the same time we observe an increasing emphasis of the need for selective immigration. There is an ongoing debate about policies to attract immigration of high-skilled labor in Germany. Other developed countries, like Canada, Australia and the U.S. already select immigrants on the basis of their qualification.

This paper argues that wage pressure in the secondary labor market and demand for selective immigration are closely connected. In the present model, an increase in the supply of high-skilled workers helps to expand the primary economy and to loose wage pressure in the secondary labor market. Immigration of high-skilled labor is thus welcome both for achieving a more attractive sectoral structure and for dampening the need of lowering wages for low-skilled labor.

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 sectoral differences in monitoring technologies (and thus in efficiency wages) lead to a segmentation into primary and secondary jobs. (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. 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 of our model predicts.[1]

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. 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. Thus, he finds that an increase in the supply of high-skilled

[1] 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).

labor has adverse effects on employment opportunities of low-skilled workers, which is the opposite of our result. 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.[2] 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.

The paper is organized as follows. Section 2 presents the basic structure of the economy. Section 3 derives the equilibrium in the primary economy, whereas section 4 closes the model by analyzing the equilibrium in the secondary labor market. Section 5 discusses our comparative-static results in the light of stylized labor market facts. The last section concludes.

2 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 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

[2] Our model extends the single-sector framework of Falkinger (2000) and Falkinger and Grossmann (2001) to a dual economy.

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 (requiring a substantial amount of coordinating activities) 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 different characteristics of the two sectors have several implications.

First, the requirement of an organization in the x-sector *implies* that firms have to decide ex ante (i.e. before production starts) how many workplaces to create. In our model, this is reflected by the assumption that ex ante firms have to choose the amount of *non-production* (i.e. managerial) labor which is necessary to coordinate the interactions among production workers. Thus, non-production labor requirements in a firm positively depend on the amounts of high-skilled and low-skilled production labor, respectively. It is assumed that only high-skilled labor can be employed for organizational activities.[3] A natural set-up of a model which reflects the idea that organizing work is necessarily an ex ante decision is a two-stage framework. In our model, at stage 1, firms in the x-sector set up workplaces under prefect fore-

[3]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.

sight about the ex post situation. At stage 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, as employment there does not need to be organized in the above sense.

Second, in the equilibrium analyzed below, the amount of primary jobs is limited by the firms' job provision decisions at stage 1. The following assumption ensures that there can be job rationing in the sense of involuntary non-employment in the *primary* labor market.

Assumption (A): Wage contracts for primary jobs are fixed at the wage level anticipated by firms under perfect foresight of aggregate employment levels in the primary labor market.

Assumption (A) means that there are no arbitrage possibilities for firms at the production stage 2. That is, *ex post*, firms in the x-sector cannot employ workers who underbid prevailing wage rates. This is consistent with several sources of wage rigidities identified in the labor market literature, such as insider-outsider theories (Lindbeck and Snower, 1988). As shown in section 4, under assumption (A) low-skilled workers in the primary labor market typically earn higher wages than in the secondary labor market. Such a wage gap is one (and maybe the most important) distinction between primary and secondary jobs in the literature on dual labor markets.[4]

[4]Other characteristics of primary jobs in the literature on dual labor markets include low labor turnover and high costs of adjustment of a firms' labor force. Ultimately, differences between primary and secondary jobs must stem from technological (including

It is assumed that labor markets for high-skilled and low-skilled labor are segmented, where labor supply is inelastically given by N_H and N_L, respectively. In the basic model, there is perfect wage flexibility in the y-sector. In the x-sector, according to assumption (A), wages are flexible only as long as there are unoccupied workplaces (organized at stage 1).

2.1 Technology

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

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

where h_i and l_i denote the amounts of high-skilled and low-skilled production labor in firm i, respectively. $f(\cdot)$ 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 organized. 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 and coordinate production workplaces for $\bar{h}_i$ and $\bar{l}_i$ workers in firm i is given by

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

where G is linear homogenous and $g(\cdot)$ is monotonic increasing.

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

organizational) differences.

only input. 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.

2.2 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 the 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.

2.3 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 3), 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 $\mu \equiv \frac{\sigma}{\sigma-1} > 1$ denotes the mark-up factor.[5] 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 (in production) 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

$$\begin{aligned} c &= \frac{w_H h_i + w_{L,x} l_i}{x_i} \\ &= \frac{w_{L,x}}{f(\chi) - \chi f'(\chi)}, \end{aligned} \tag{8}$$

according to (1) and (7). Moreover, note that in a perfect foresight equilibrium, it is optimal to utilize capacity fully (at stage 2); i.e. to choose employment according to $h_i = \bar{h}_i$ and $l_i = \bar{l}_i$.[6] Finally, symmetry implies

[5] The two-stage decision process of firms in the primary economy implies that organizational (labor) 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 (labor) 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.

[6] Note that in a perfect foresight equilibrium the installed skill-intensity in production $\bar{\chi}$ 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.

$h_i = h$, $l_i = l$ and thus $x_i = x = lf(\chi)$ in equilibrium.

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

$$MRS(Q,y) = \frac{w_{L,x}}{w_{L,y}} \frac{\mu}{f(\chi) - \chi f'(\chi)} \left(= \frac{p}{q} \right), \tag{10}$$

where $Q \equiv nx$ denotes total output in the primary economy and $MRS \equiv \frac{\partial U/\partial X}{\partial U/\partial y}$ is the marginal rate of substitution between the differentiated good of the x-sector and the homogenous good of the y-sector. Note that, for all i, $mrs_i = MRS(Q,y) = \frac{\alpha}{1-\alpha}\frac{y}{Q}$ in a symmetric equilibrium in the primary economy.[7]

3 Equilibrium number of primary jobs

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 $w_M m_i$, where w_M denotes the nominal wage rate of (high-skilled) non-production

[7] 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 $\frac{\partial u}{\partial y} = (1-\alpha)\left(\frac{x}{y}\right)^{\alpha} n^{\alpha/\rho}$.

workers. Of course, with flexible wages, $w_M = w_H$ must hold in equilibrium. However, allowing for rents of non-production workers, we write

$$w_M = (1+\theta)w_H, \quad \theta \geq 0. \tag{11}$$

Note that $\theta > 0$ can have many reasons, treated as exogenously in our model. For instance, principal-agent theory tells us that incentive problems may lead to a deviation of wages for managers from perfectly competitve rates. Moreover, there may be sources of insider power since managers and other (non-production) workers who oversee the organizational structure have firm-specific knowledge. Although both kinds of arguments are standard in the microeconomic theory of the firm, the macroeconomic effects of such power on behalf of organizational labor have not been studied yet.

We also allow for rents of firm owners in the x-sector (e.g. due to shareholder power). It is assumed that firm owners can appropriate a share R of the revenue p per unit of sold output x. In sum, a firm's profits after accounting for possible rents are given by $\pi_i = (p(1-R)-c)x_i - (1+\theta)w_H m_i$. 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

$$\pi_i = \left[(\tilde{\mu}-1)cf(\bar{\chi}) - (1+\theta)w_H g(\bar{\chi})\right]\bar{l}_i, \tag{12}$$

where

$$\tilde{\mu} = \mu(1-R) > 1, \; 0 \leq R < 1 - \frac{1}{\mu}. \tag{13}$$

If in (12) the term in square brackets (and thus profit) is zero, then $\frac{\partial \pi_i}{\partial l_i} = 0$ and firms do not want to provide further workplaces for low-skilled workers.

This is equivalent to

$$\underbrace{(\mu(1-R)-1)f(\bar{\chi})}_{\equiv APL(\mu,R,\bar{\chi})} = \underbrace{(1+\theta)f'(\bar{\chi})g(\bar{\chi})}_{\equiv ACL(\theta,\bar{\chi})}, \tag{14}$$

where we used

$$\frac{w_H}{c} = f'(\bar{\chi}), \tag{15}$$

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.[8] This is the equilibrium at which employment in the

[8] 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.

primary labor market reaches the highest possible level.[9] Because of assumption (A), there is generally a wage gap between the primary and secondary labor market (i.e. $w_{L,x} > w_{L,y}$) in equilibrium.[10] Workers in the secondary labor market would like to work in the primary economy. However, firms provide no workplaces for them. Thus, 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 $\bar{\chi} = \chi^*(z)$ is given by (14), where z is a vector of the parameters μ, R and θ. Moreover, χ^* depends on the technologies f and g. $\chi^*(z)$ can be determined in a familiar return-cost diagram. The left-hand side of (14) 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 (14) 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 work places for low-skilled labor. 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 $\bar{\chi}$. Hence, the intersection between

[9] 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.

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

the APL- and ACL-curve determines $\chi^*(z)$ 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 $\bar{H} = \chi^*(z)\bar{L}_x$. Full employment of high-skilled labor implies $\bar{H} + M = \chi^*(z)\bar{L}_x + M = N_H$, where $M(= nm)$ is the aggregate amount of organizational labor. Using $M = \bar{L}_x g(\bar{\chi})$ from (2), this implies that the employment level of primary jobs for low-skilled workers is given by

$$L_x^*(N_H, z) = \frac{N_H}{\chi^*(z) + g(\chi^*(z))}. \tag{16}$$

L_x^*, as given by (16), is the maximal zero-profit equilibrium employment level of low-skilled labor in the primary labor market (corresponding to optimistic expectations and thus full employment of high-skilled labor).[11] Note that L_x^* does not depend on the number of firms n in the x-sector.

Proposition 1 *Under assumption (A), in the zero-profit equilibrium with full employment of high-skilled labor, an increase in the supply of high-skilled labor N_H: (i) Raises the equilibrium employment level of low-skilled labor in the primary labor market L_x^*. (ii) Neither affects the equilibrium skill-intensity in production $\chi^*(z)$ nor the relative equilibrium wage ω_x^* in the x-sector.*

[11] In a zero-profit equilibrium with pessimistic expectations we would have H^e instead of N_H in (16), where $H^e < N_H$ is the aggregate level of employment of high-skilled labor which is expected by pessimistic firms.

Proof. Directly follows from (16), (14) and (7). ■

If N_H rises and firms in the x-sector expect full employment of high-skilled labor, firms find it profitable to install more workplaces for low-skilled workers. This is because (all other things equal) a higher skill-intensity χ would mean that the real profit margin per low-skilled worker increases and the real average costs for organizational labor may decrease. Thus, $\frac{\partial \pi_i}{\partial l_i} > 0$ would hold, according to (12) and (14), such that L_x^* rises until zero-profits are restored. 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. 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.[12] This is consistent with the stylized fact that wage inequality in the last, say, two decades did not decline despite a substantial increase in the relative supply of skilled labor (e.g. Gottschalk and Smeeding, 1997). Note that this result is not due to the common notion of skill-biased technological change, i.e. to an increase in the relative marginal productivity of skilled labor (for a given skill-intensity).

[12] 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 fact, skill-biased technological change has played a major role in the economic literature of the 1990s.[13] However, while 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 it more difficult to organize jobs for low-skilled workers. Formally, this means that the g-curve and thus the ACL-curve shifts upwards. This increases average costs of providing workplaces for low-skilled workers relative to their profit yield.[14] For a more formal analysis, include a parameter γ in the vector of exogenous changes z representing increasing costs of organizing low-skilled labor, i.e. consider instead of $g(\chi)$ a family of functions $\tilde{g}(\chi, \gamma)$ with $\frac{\partial \tilde{g}}{\partial \gamma} > 0$. The following proposition summarizes the impact of parameter changes in $z = (\mu, R, \theta, \gamma)$ on L_x^* and ω_x^*.[15]

Proposition 2 *Under assumption (A), in any zero-profit equilibrium, both*

[13] 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 vector of exogenous changes z representing skill-biased technological change, i.e. define a function $v(\chi, \zeta) \equiv \frac{f'(\chi)}{f(\chi)}$ with $\frac{\partial v}{\partial \zeta} > 0$. For the impact of ζ, rewrite (14) as $\frac{\mu(1-R)-1}{1+\theta} = v(\chi^*, \zeta) g(\chi^*)$ to confirm $\frac{\partial \chi^*}{\partial \zeta} > 0$ (note that the term $v(\chi^*, \zeta) g(\chi^*)$ is decreasing in χ^*). Thus, L_x^* decreases with ζ, according to (16). Moreover, it is straightforward but tedious to show that $\frac{\partial \omega_x^*}{\partial \zeta} > 0$ if and only if $f'/f > g'/g$ holds at $\bar{\chi} = \chi^*(z)$.

[14] See Falkinger (2000) for an extensive discussion and an endogenous shift in the g-function.

[15] 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.

the equilibrium employment level of low-skilled labor in the primary labor market L_x^* and the relative equilibrium wage ω_x^* increase with μ and decline with R, θ and γ.

Proof. Apply the implicit function theorem to (14) to obtain the impacts on χ^*. Then use (16) 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. An increase in θ has a similar effect, since an increased wage for *non*-production workers makes it less attractive to organize work places. This also means that the ACL-curve in figure 1 shifts upwards. Employment of low-skilled labor in the primary economy is reduced and high-skilled production workers lose relative to low-skilled workers since the skill-intensity in production increases. A change in $\tilde{\mu} = \mu(1 - R)$ positively affects the profit-margin per low-skilled worker, shifting up the APL-curve. Thus, the equilibrium number of primary jobs rises and, due to the declining skill-intensity in production, wage inequality increases as well. Note, that one has to distinguish carefully between market power of firms in the goods market arising from the fact that the non-production wage costs are sunk from the perspective of stage 2 and the power of firm owners to extract rents from their firms. Whereas an increased mark-up μ on marginal costs allows to finance more non-production work and thus has a positive impact on the equilibrium number of primary jobs, the opposite is true for increased shareholder claims R.

4 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.

Having determined the equilibrium number of primary jobs for the low-skilled L_x^*, "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.

$$L_y^S = N_L - L_x^*(N_H, z). \tag{17}$$

Labor demand in the y-sector L_y^D is given by goods demand in this sector, implied by (10). Using (3) and substituting both $\chi = \chi^*(z)$ and $Q = Q^* = L_x^*(N_H, z)f(\chi^*(z))$ into (10) we obtain the following relationship between labor demand L_y^D in the y-sector and the wage differential of low-skilled labor across sectors:

$$\begin{aligned} \frac{w_{L,y}}{w_{L,x}} &= B(L_y^D, N_H, z), \text{ where} \qquad (18) \\ B(L_y^D, N_H, z) &\equiv \frac{\mu}{MRS\left[L_x^*(N_H, z)f(\chi^*(z)), L_y^D\right]\left[f(\chi^*(z)) - \chi^*(z)f'(\chi^*(z))\right]} \end{aligned}$$

Note that, according to (8), the term $[f(\chi^*(z)) - \chi^*(z)f'(\chi^*(z))]$ equals the "real" equilibrium wage rate $\left(\frac{w_{L,x}}{c}\right)^*$ of low-skilled labor in the primary economy. It unambiguously increases with χ^*.

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 (17) and (18), 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 $\frac{w_{L,y}}{w_{L,x}} \leq 1$ the amount of low-skilled labor which is left over from the primary economy does not depend on the secondary labor market. For all $\frac{w_{L,y}}{w_{L,x}} > 1$ everybody would prefer to work in the secondary labor market.[16] But the number of jobs provided in the primary economy is limited and arbitrage is excluded, according to assumption (A). Thus, $w_{L,x} > w_{L,y}$ can (and generally does) hold in equilibrium (see section 2). Moreover, the B-curve shifts upwards if N_H increases, since in equilibrium MRS is decreasing in $Q^* = L_x^* f(\chi^*)$ and thus in L_x^*. (Remember that χ^* does not depend on N_H.)

How is the B-curve affected by parameter changes in $z = (\mu, R, \theta, \gamma)$? Consider a change in z which leads to downsizing of low-skilled labor L_x^* in the primary economy. Such downsizing goes hand in hand with a rise in the skill-intensity χ^* (see (16)) and thus with a rise in the real wage $\left(\frac{w_{L,x}}{c}\right)^*$ of low-skilled workers who keep their primary jobs. This has a direct negative effect on $B(L_y^D, N_H, z)$ $\left[= \frac{\mu}{MRS(Q^*,y)(w_{L,x}/c)^*}\right]$. But χ^* also affects the aggregate output $Q^* = L_x^* f(\chi^*)$ of the primary economy. If Q^* declines with the downsizing of L_x^* and the rise in χ^*,[17] then MRS, representing the relative marginal willingness to pay for the differentiated good, rises and reinforces the negative effect of $\left(\frac{w_{L,x}}{c}\right)^*$ on the B-curve. The B-curve is definitely shifted downwards in this case. By contrast, if Q^* rises with χ^* (i.e. if downsizing of L_x^* leads to rising equilibrium output in the primary economy), then MRS declines. Only if this decline in the relative willingness

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

[17] It can be shown that this is always the case if $\frac{1+g'(\chi^*)}{1+g(\chi^*)/\chi^*} \geq \frac{f'(\chi^*)\chi^*}{f(\chi^*)}$ holds.

to pay for the differentiated good is so strong that it outweighs the positive impact of the rise in χ^* on $\left(\frac{w_{L,x}}{c}\right)^*$, the B-curve shifts upwards. However, this would be an implausible case: First, Q^* would have to increase strongly despite downsizing of low-skilled labor L_x^* in the primary economy. Second, output y of the secondary economy (say, cleaning services) would have to be a good substitute for the differentiated good (say, cars). The following assumption excludes such an implausible demand reaction.[18]

Assumption (B): If change in z induces a decline (rise) in L_x^*, the B-curve does not shift up (down).

For instance, if $f(\cdot)$ is isoelastic, then assumption (B) always holds with the Cobb-Douglas utility function (4).[19] Trivially, assumption (B) is also fulfilled if preferences are quasi-linear (such that MRS does not depend on Q).

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 other parameters z.[20] Thus, we can write

$$\left(\frac{w_{L,y}}{w_{L,x}}\right)^* = B(L_y^*(N_H, N_L, z), N_H, z) \equiv b(N_H, N_L, z). \tag{19}$$

[18] The following argument analoguously applies for changes in z which increase L_x^* and decrease χ^*.

[19] Substituting $MRS(L_x^* f(\chi^*), L_y^D) = \frac{\alpha L_y^D}{(1-\alpha)L_x^* f(\chi^*)}$ into (18) and using (16), we find $B(\cdot) = \frac{(1-\alpha)\mu N_H}{\alpha[\chi^* + g(\chi^*)][1-\eta(\chi^*)]L_y^D}$, where $\eta(\chi) \equiv \frac{\chi f'(\chi)}{f(\chi)}$. For $\eta(\chi) = \eta < 1$ (i.e. $f(\chi) = a\chi^\eta$), then the B-curve unambiguously decreases if χ^* rises. More generally, assumption (B) holds if $\eta'(\chi^*)$ is not too high ($\eta'(\chi^*) \leq 0$ would be sufficient).

[20] Substituting (16) into (17) 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 z. The same is true for $\frac{L_x^*}{L_y^*}$.

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 sectoral wage gap $\frac{w_{L,y}}{w_{L,x}}$ cannot fall below a bound $\hat{b} > b(N_H, N_L, z)$ (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.[21] Clearly, if $\hat{b} > b(N_H, N_L, z)$, the equilibrium unemployment rate

$$\hat{u}_L = 1 - \frac{\hat{L}_y}{N_L} \tag{20}$$

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

Proposition 3 *Under assumption (A), in the zero-profit equilibrium with full employment of high-skilled labor: (i) If wages are flexible, the equilibrium employment level in the secondary labor market L_y^* decreases in N_H and increases in N_L. The opposite results hold for $\left(\frac{w_{L,y}}{w_{L,x}}\right)^*$. (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 $\hat{u}_L$ decreases in N_H and increases in N_L.*

Proof. Use (16)-(20) and proposition 1. ■

[21] 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 $p = \frac{\mu w_{L,x}}{f(\chi^*) - \chi^* f'(\chi^*)}$ and $q = w_{L,y}$, the real wage in the secondary labor market is given by $\frac{w_{L,y}}{\Gamma} = \left[\beta\left(\frac{\mu}{f(\chi^*) - \chi^* f'(\chi^*)} \frac{w_{L,x}}{w_{L,y}}\right)\right]^{-1}$. Thus, imposing $\frac{w_{L,y}}{w_{L,x}} > \hat{b}$ puts a lower bound on the real wage in the y-sector.

Thus, wage pressure in the secondary labor market can unambiguously be softened by an increase in the supply of skilled labor by education or selective immigration policy.

Proposition 4 *Under assumptions (A) and (B), in any zero-profit equilibrium: (i) If wages are flexible, L_y^* decreases in μ and increases in R, θ and γ. The opposite results hold for $\left(\frac{w_{L,y}}{w_{L,x}}\right)^*$. (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 $\hat{u}_L$ decreases in μ, and increases in R, θ and γ.*

Proof. Use (16)-(20) and proposition 2. ■

According to proposition 4, there are essentially three candidates for explaining the rising wage pressure for already low-paid work: Changes in the competitive pressure of firms (reflected by a decrease in μ), increasing rents of firm owners and organizational labor (reflected by an increase in R and θ, respectively), and changes in methods of organizing work (reflected by an increase in γ). Note that all these forces are changes in the primary economy. In the following, we will summarize the mechanisms and intuitions behind propositions 3 and 4 and discuss their implications.

5 Discussion

5.1 Increased competitive pressure (Globalization)

The competitive pressure in the goods markets of the primary economy in our model is represented by the mark-up factor μ which is inversely related to the price elasticity of demand faced by firms. A decline in this mark-up,

for instance, due to international competition, forces firms to cut overhead costs. This can be done by reducing workplaces for low-skilled workers whose return is relatively low compared to the organizational costs they cause. Formally, improving the skill-structure in production, i.e. raising the skill-intensity of organized jobs, increases the profit margin (APL) and decreases non-production costs (ACL), so that the decline in μ can be compensated, according to (14). This downsizing of low-skilled jobs in the primary economy increases labor supply in the secondary labor market. Under the plausible assumption that the goods produced in the secondary market are not a very good substitute for the goods in the primary economy (assumption (B)), this supply effect either depresses wages in the secondary economy or leads to higher unemployment of low-skilled labor.

5.2 Changes in production and organization methods

Firm-level evidence suggests that skill-upgrading, computerization and work-place decentralization are strongly related (For an excellent survey of this evidence, see Bryanjolffson and Hitt, 2000.) That is, rising labor demand for high-skilled workers seems to be due to changes in methods to organize work, rather than mere (biased) changes in the production technology.[22] 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. Formally, the method of organization is captured by the parameter γ, which affects the g-function. New methods of organization like customer orientation, international production or decentralized information-

[22] See also Bresnahan (1999) and Snower (1999) for illuminating discussions.

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.[23] In our model, this is reflected by an upward shift of the g-function and thus of the firms' costs ACL of arranging workplaces for low-skilled workers. This induces 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. Again, under the weak assumption (B), with flexible wages the secondary economy expands and wages go down; with rigid wages unemployment is raised.

5.3 Changes in rents for the key factors of the primary economy

Production in the primary economy is complex and requires interaction within the infrastructure provided by firms. This interaction within firms requires an organization. Thus, both the owners of the firms and organizational workers (managers) are in a powerful position. Their power may allow them to extract rents. Actually, the fact that shareholder orientation has become such an important issue during the last decade may be interpreted in two ways: Either, others (some stake holders) had appropriated rents before

[23] For simplicity, we neglected the productivity gains which presumably result by such organizational changes. Formally, increases in total factor productivity would reduce unit costs c and would increase output per low-skilled worker $f(\cdot)$. As a result, profits and thus the skill-intensity χ^* in the zero-profit equilibrium are not affected by productivity increases, according to (12).

and shareholder-oriented management has to cut these rents and bring them back to the owners of the firms; or shareholders have become so powerful that they can appropriate a rent that they could not appropriate before. In our model, this means an increase in R. At the same time we have recently seen a sharp, many would say an extreme rise in manager salaries also compared to the rise of the wages of high-skilled workers in general. In our model, this is reflected by an increase in θ. Now, a rise in R decreases the profit margin (APL) that can be retained per low-skilled worker. And a rise in θ increases the costs (ACL) of organization. Both effects can only be counteracted by firms of the primary economy if they improve their skill structure (i.e. increase χ) by cutting workplaces of low-skilled workers. Under the assumption of a plausible demand reaction (assumption (B)) the consequences for the secondary labor market are a depression of wages or an increase in unemployment.

5.4 Immigration of high-skilled labor (Green card)

Having discussed the factors which can explain the increased pressure on the secondary labor market, we turn to the question of whether the (currently in Germany) much discussed green card for high-skilled workers is a possible relieve. Indeed, our analysis predicts that an increase in the supply of high-skilled labor (by education or selective immigration) induces firms in the primary economy to create more jobs for low-skilled workers and reduces the pressure on the secondary labor market. This is because a larger available skilled labor force allows to maintain the skill structure of jobs in the economy despite a higher level of low-skilled employment. There are more high-skilled

workers to accompany low-skilled workers as co-production or as organizing (non-production) workers. Of course, more jobs for low-skilled labor in the primary economy means ceteris paribus less supply of low-skilled labor in the secondary labor market and thus less pressure on wages. There is also a positive demand effect. The fact that the primary sector expands improves the relative price of the goods of the secondary economy. With competitive markets, this shifts the labor demand curve in the secondary labor market upwards and reduces the wage pressure in the secondary economy in addition to the reduction in labor supply.

6 Conclusion

We started out by observing the following trends that have marked the politico-economic discussion in many industrialized countries in recent years: Substantial changes in the primary economy both in the competitive environment and inside firms, in particular in the organization of work. We also observed a widespread shareholder orientation and a rise in wages of high-skilled labor, in particular sharply rising salaries for organizational labor (managers). Moreover, increased pressure on the secondary labor market revealed by unemployment or declining wages of low-skilled workers. Finally, practice or discussion of selective immigration policies for high-skilled workers.

We have presented a model which succeeds to explain these different trends in a coherent and natural way. The central element of the explanation is that, due to its complexity, production in the primary economy requires

organized work. The necessary organizational labor input depends on both the number and the skill structure of organized jobs. Profit-maximizing job provision behavior of firms leads to job rationing in the primary economy. Those low-skilled workers who do not get a work place in the primary economy form labor supply in the secondary labor market.

The common feature of increased competitive pressure in the goods markets of the primary economy, for instance through globalization, of new methods of production, or of rising rents for both firm owners and organizational labor is that they induce firms to improve the skill structure of the provided workplaces by cutting down jobs for low-skilled labor. This downsizing effect raises the pressure on the secondary labor market.

An increase in the supply of high-skilled labor allows firms in the primary labor market to create more jobs for low-skilled labor without reducing the skill-intensity of their job structure. Thus, the primary economy expands and the pressure on the secondary labor market is reduced, all other things equal. Therefore, increasing the supply of high-skilled labor, be it by education or immigration is indeed good also for the secondary labor market in the considered economy. Of course, if the increase of high-skilled labor comes from immigration, there is another economy which loses high-skilled workers. And there we have exactly the opposite effect: The primary economy shrinks and pressure on the secondary economy rises. Only the increase of high-skilled labor supply by education avoids such negative external effects on other countries.

Insofar as the pressure on the secondary labor market comes from increased rents in the primary economy, cutting down these rents is a clear

policy substitute to selective immigration. By definition, such a policy would have negative effects on shareholders and managers but not on other countries.

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 $M^e = \bar{L}_x^e g(\bar{\chi}^e)$ imply $H^e = \bar{H}^e + M^e = [\bar{\chi}^e + g(\bar{\chi}^e)]\,\bar{L}_x^e$, 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 $\bar{\chi}^e = \chi^*(z)$ (from (14)), we have

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

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

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

Note that $\left(\frac{w_H}{c}\right)^e = f'(\bar{\chi}^e)$, according to (15). 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. $\bar{\chi}^e = \chi^*(z)$), firms have no incentive to deviate. Thus, any point on the line between points 0 and A in figure 3 can be an equilibrium.[24] 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-

[24]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).

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.

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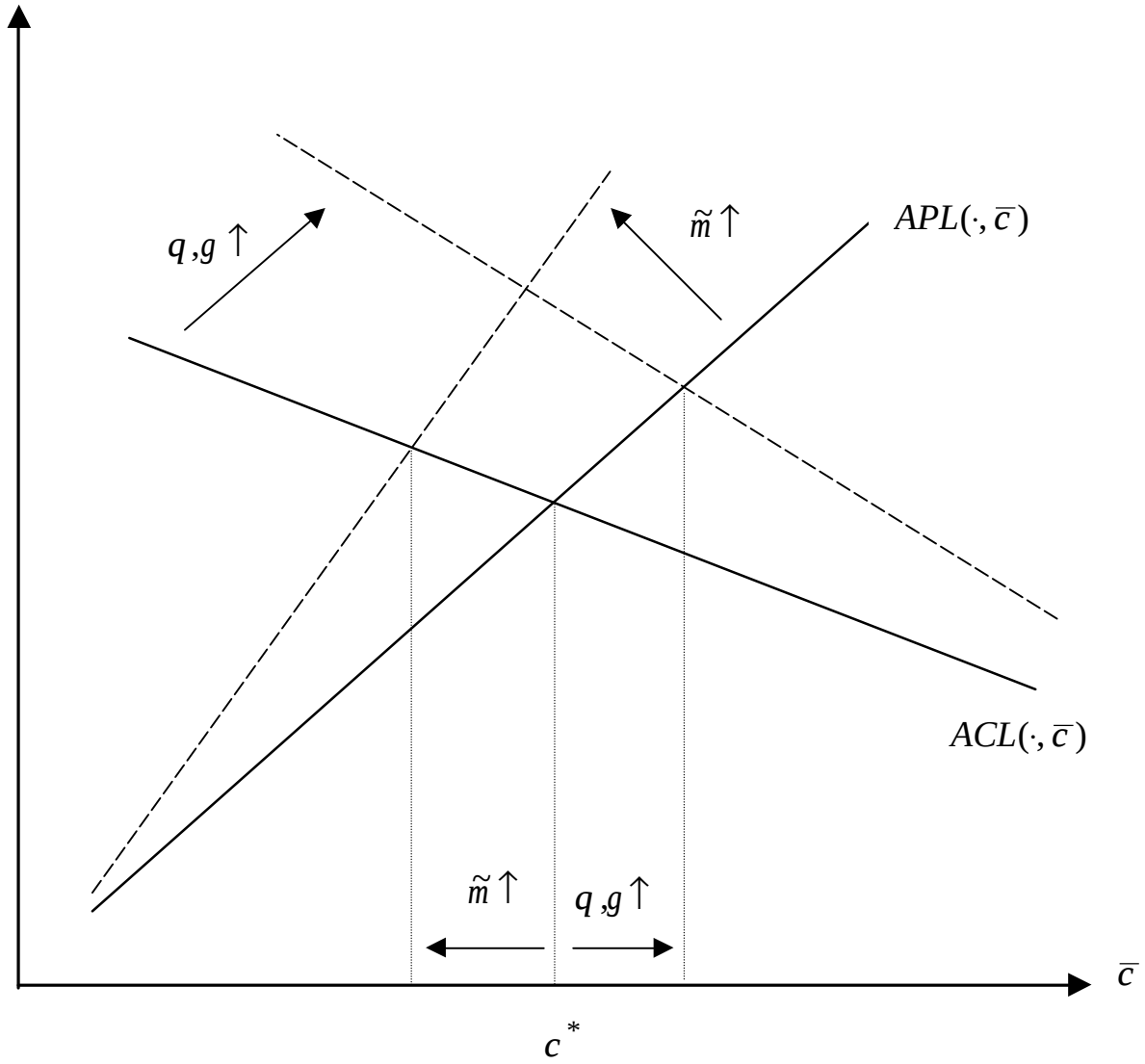

Figure 1: Skill-intensity of production in the primary economy in zero-profit equilibrium.

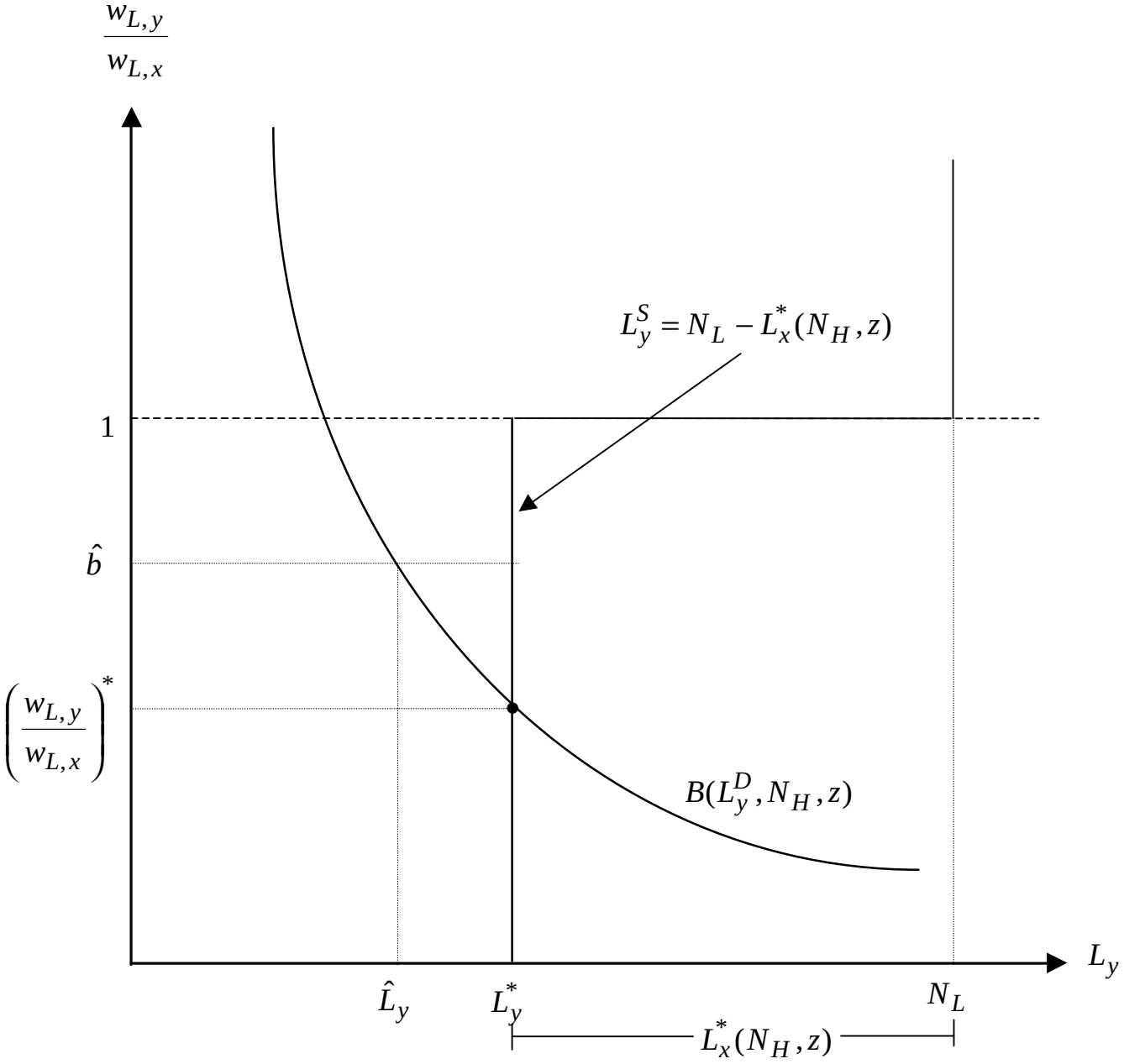

Figure 2: Equilibrium in the secondary labor market.

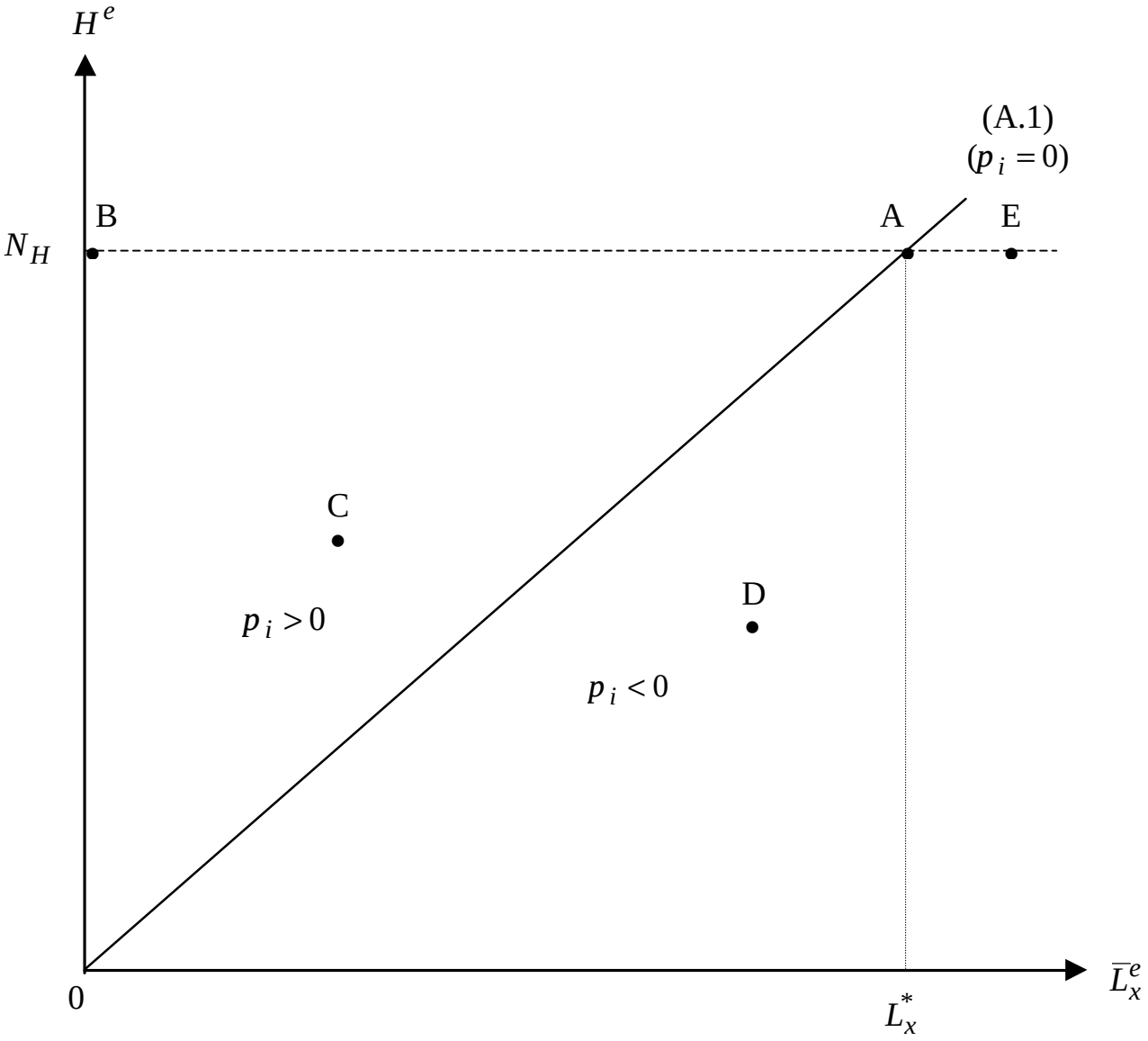

Figure 3: Zero-profit equilibrium (L_x^*, N_H) in the primary economy.