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**Wirtschaftswissenschaftliche Fakultät
der Eberhard-Karls-Universität Tübingen**

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Specialisation**

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Local Unemployment and Specialisation

by

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Abstract

Recent empirical work has shown that there exists a negative relation between wages and unemployment estimated across regions. Our model recognises the spatial dimension of the so-called wage curve by using a Hotelling/Salop framework in which a finite number of firms compete for heterogeneous workers. We incorporate this set-up into an efficiency-wage framework. In setting wages firms perceive their influence on the wage-unemployment trade-off, thus taking the employment decisions of their competitors as an externality. The model predicts that in larger local labour markets with firms demanding more specialised labour, workers receive higher wages and face lower unemployment.

Keywords: specialization and heterogeneity of labour, efficiency wages, local unemployment

JEL-Class.: J21, J41, R23

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1 Introduction

Regions differ in unemployment rates and wages. One can try to explain these differences in unemployment as generated by the combination of spatially diverse demand shocks, inflexible wages due to nationwide wage bargaining and immobile labour. This can aggregate to a permanent regional disequilibrium component of nationwide unemployment, for example to regional mismatch when job seekers and vacancies are located in different regions. If, however, at least some part of the wage determination is local, equilibrium unemployment may vary across labour markets. The purpose of this paper is to demonstrate how the structure of the local labour market influences equilibrium unemployment on this level.

This paper aims to link the size of the local labour market with unemployment and specialisation. The size of the market is the number of participants. What do we mean by specialisation? One of the forces that leads to the formation of agglomerations are productivity gains through specialisation. On the one hand, this may comprise improving the quality of labour through deepening the ability to perform a given task (human capital specialisation). This may also comprise specialised labour demand by firms to produce a good more efficiently, i.e. they demand a narrower range of skills of a given quality. Our model employs the latter understanding. In this local labour market skills are differentiated horizontally. Neglecting differences in quality, each skill can perform a different task. This suffices to show that specialisation provides an incentive for workers and firms alike to migrate into that local labour market however large in geographical space it may be.¹

We consider a local labour market to be spatially well demarcated. It is a region of which all workers are residents. Inside this region they are able to locate suitable job opportunities in such a way that they can be reached with reasonable (and thus negligible) commuting costs. This corresponds to regional demarcations such as travel-to-work areas often used in empirical studies.

¹In our model, specialisation is not clashed with an agglomeration disadvantage. This could be easily accomplished, for example, by setting a convex migration cost or rising land prices against firms and workers.

We analyse regional local labour markets as an agglomeration of workers who are endowed with different skills and of specialised firms differing in their requirements of skills available in the market. Unemployment in this local market for skills stems from the workers' distaste for effort as in the shirking model of equilibrium unemployment by Shapiro and Stiglitz (1984). In the local market the small number of firms can use their hiring rates to manipulate the incentive of workers not to shirk. Unemployment rates and wages across the heterogeneous population of workers are derived.

The basic relations we want to capture with our model are following ones. The location of firms is determined by local factor supply. Firms enter a given local labour market in which workers have formed their skills in anticipation of the average firms' choice. Since workers do not know the precise skill requirement we observe a symmetric distribution of (horizontally differentiated) skills. When entering this market firms have to choose their optimal capacities and thus their optimal employment levels. Thereby, firms take into account the effects of their chosen employment level on workers' incentives and behaviour. The larger the number of workers employed by a particular firm the more pronounced the wage pressure in the local labour market. This link just reflects the idea that firms having a large share in a particular segment of the labour market are well aware that their employment choices have an effect on the wage rate. Firms realise that full employment leads to the maximum wage pressure. In our efficiency wage framework this mechanism work such that it influences the incentive of workers to provide effort, i.e. the no-shirking condition.

The link to the labour market size is the following. A larger local market, that is a rise in the number of workers and firms, results in greater specialisation of firms, which demand a smaller portion of the skills available. On average, firms are willing to pay higher wages for – from the firms' perspective – the more productive workers as competition for these workers increases. Hence we find that on average workers receive higher wages. Although a larger labour market leads to more pronounced specialisation, we also show that in larger local labour markets unemployment rates are lower. Thus, our approach extends studies examining the relationship between the size of local (labour) markets and the degree of local specialization to a setting in which labour markets do not clear and (equilibrium) unemployment prevails.

Our model is related to a range of approaches that link local labour markets and skills. All these approaches, however, completely abstract from the issue of unemployment. Becker and Murphy (1992) postulate that the same range of (complementary) skills must be performed in rural as well as in urban areas. Workers who concentrate on a narrower set of tasks raise their productivity but have to rely on the presence of other workers who perform the remaining tasks. This leads to a positive relation between specialisation and size of the labour market, which is limited by the cost of coordinating specialised labour. Kim (1989, 1990) and Hamilton et al. (1997) analysing the spatial equilibrium in a framework with horizontally differentiated workers show that the average match productivity increases with market size leading to firms' specialisation in labour demand and higher wages in larger local labour markets.

Another type of model that generates productivity gains through horizontally different labour input is that of Ethier (1982). A final product is assembled of intermediate firms' output. Intermediate firms' production functions exhibit increasing returns to the variety of labour used. An (exogenous) increase in the variety of skills thus increases intermediate production, leading to a gain in welfare through increased consumption of the final good.² Goodfriend and McDermott (1995) extend this model by showing that investment in human capital (and thus skill formation) leads to an endogenous rise in the variety of skills. These models, however, assume that all firms use the whole range of specialised inputs to produce each a different intermediate good.

Matusz (1996) includes the shirking model into this framework. Productivity gains through increased market size translate into higher wages. This eases the incentive of workers to shirk at a given wage, implying a lower unemployment rate. Firms are still considered small in relation to the labour market although intermediate firms use differentiated labour and thus the labour market for each skill is competitive. Due to symmetry in these models each type of labour is paid the same wage. If labour markets are segmented in regard to space and skill, however, we find this assumption hard to believe. As a novel feature our model makes imperfect competition for differentiated skills explicit.

²A similar mechanism is adopted in endogenous growth theory in order to generate ongoing growth, see e.g. Romer (1990).

In general, there are only few papers dealing with equilibrium unemployment in a regional dimension. One of these is Smith and Zenou (1995) who use a model of bid-rent functions to explain the inner-urban segregation of employed and unemployed workers. To generate unemployment they make use of the shirking version of efficiency wages, with homogeneous workers and a large number of firms in the central business district.

This paper is also intended to add to the discussion of the so-called wage curve. In a recent monograph, Blanchflower and Oswald (1994) present empirical evidence of a negative wage-unemployment relation across regions. Their claim is that the level of regional unemployment has an effect on the regional wage level, after controlling for region and industry specific effects. They try to rationalise their findings with the help of an efficiency wage model. Their model, however, assumes homogeneity of workers and perfect competition among firms, thereby abstracting from specialization issues within a region as well as from the effects of imperfect competition among firms in the input market. By focussing on specialisation effects and local market size, we extend Blanchflower/Oswald by providing a wage-curve across regions as well as in a particular region. Larger local labour markets with more specialised labour demand experience lower average unemployment and higher wages. Thus the simple shift in demand that causes the regional variation in unemployment in Blanchflower/Oswald's theoretical model gets its foundation laid in explicit microeconomics in a particular local labour market.³

We believe that the oligopsonistic structure of the labour market in our model is justified if labour markets are segmented. In an investigation of the wage curve in a cross-section of German labour market regions Büttner (1997) has shown that unemployment in neighbouring regions has only a small influence on wage determination in a local labour market. Furthermore, unemployment differences across regions are very persistent and migration across regions is small and a long-run phenomenon. To cap-

³Glaeser and Maré (1994) investigate empirically the urban wage premium in trying to discriminate between omitted variable bias in measuring urban skills, productivity spillovers and faster skill accumulation in cities. The latter is found to have the biggest impact on the urban wage premium. It is interesting to note that they do not add the local level of unemployment to their wage equations.

ture spatial segmentation in our model the wage is determined locally after migration has taken place. Specialised employers are located in horizontal segments of the local labour market. Given education (see above) we assume away labour mobility across professions in our model. Thus in a small area firms demanding a specific skill may be sparse and the supply of skill limited (but large enough not to engage in bilateral bargaining).

A local labour market in our model consists of a given pool of workers with heterogeneous skills and firms with specialised labour demand. Workers differ by type of their skill, not by quality, given the skill. Skills are continuously distributed among the population with each skill having the same probability of occurrence. This is to capture unlimited divisibility of skills. Hence the density of workers endowed with the same skill is constant across skills. As in Kim (1989, 1991) and Hamilton et al. (1997) the circle model of product differentiation (Salop 1979; Anderson, de Palma, Thisse 1992) is adapted to represent a labour market. The finite range of skills is captured by a circle of given circumference. In this model there are two dimensions to "market size." The first is to extend the range of skills, i.e. to enlarge the circumference of the circle. This can be interpreted as an increase in knowledge, so that more skills are developed. The second dimension is growth in the availability of skills, that is, an increase in the density of workers of a given skill. This may help to understand why workers in some locations are better off than in others without resorting to natural resources or determinants of this kind. We focus exclusively on the second dimension. In what follows, an increase in the size of a local labour market means better availability of skill types. This prompts firms to locate in this location and to demand more specialised labour.

This paper is organised as follows. In section 2 the basic set-up is described. As a benchmark, the case of monopsonistic labour demand is presented in section 3. The labour market interaction of two firms with overlapping skill demand is analysed in section 4. Section 5 deals with size effects of local labour markets. Section 6 sums up.

2 The Basic Set-Up

We consider a local labour market with \bar{L} workers of a given skill and N firms. Firms produce a homogenous good which is sold on a competitive outside market with price normalised to unity.⁴

Workers possess (horizontally) differentiated skills which are distributed continuously along a unit circle. The type of skill of each worker is given by his or her address on the circle. In the following subsections we characterize the decision problems of workers and firms before considering a benchmark case for a spatial equilibrium in the following section.

2.1 Workers

Each worker has a particular skill and supplies one unit of labour per period. A particular worker is described by his/her address in skill space, indexed by x . The density of workers of any x on the unit circle is given by \bar{L} . The worker is fully informed about his position on the circle relative to the other workers' skills and to the firms' skill requirements (i.e. their addresses). Workers are assumed to find work distasteful so that they prefer to shirk while at work. A shirking worker does not supply any output. Thus to model the supply side of the labour market we adopt Shapiro/Stiglitz' (1984) model of efficiency wages. An employee's per period utility is his net wage w_x , if he does work he incurs a disutility of e . As his labour supply is inelastic it is sensible to assume that the disutility from work does not vary with wage.

Firms, however, have command over a monitoring technology designed to detect shirking workers. The probability of a shirker being indicted for lazing follows a Poisson process and is denoted q' per unit time. This monitoring technology is imperfect in two ways. First, q' is strictly smaller than one, and second, non-shirking workers

⁴In order to focus most clearly on the implications of labor market structure we abstract from differences among firms in the output market. Allowing for firm heterogeneity on the output side would leave our results unchanged if these differences among firms had no repercussions on input decisions of firms. By introducing a third market on which firms sell their products enables us to neglect income and Ford effects which we consider to have no impact on firms' input decisions.

are mistakenly accused of shirking with probability b per unit time. For reasons of notation, we redefine $q' = q + b$.

Workers have no means of committing themselves to effort (by bonds, for example). In the absence of bonds the loss of wage income from a spell of unemployment is the maximum penalty that the firm can lay upon a shirker. In addition, there are no training costs for newly hired workers. Thus the firm weakly prefers to fire an indicted worker knowing it is making Type II errors. As all workers are alike in their distaste for labour, the firm should not have any preconception against an indicted worker. For this reason indictment does not hamper employment prospects.

Workers maximise utility over an infinite horizon. The discount rate r is common to all workers and firms. The expected present value of utility in steady-state for shirkers and non-shirkers of type x being employed at firm $j = 1, \dots, N$ at the wage rate w_{jx} are, respectively

$$\begin{aligned} E_{jx}^{NS} &= w_{jx} - e + \frac{1}{1+r} \{bU_x + (1-b)E_{jx}^{NS}\} \\ E_{jx}^S &= w_{jx} + \frac{1}{1+r} \{(b+q)U_x + [1-(b+q)]E_{jx}^S\}, \end{aligned}$$

where U_x denotes the present discounted value of utility for an unemployed worker. A worker will exert effort if and only if $E_{jx}^{NS} \geq E_{jx}^S$, that is, if the wage is such that

$$w_{jx} \leq \left(\frac{r}{1+r}\right) U_x + \frac{e(r+b+q)}{q}. \quad (1)$$

Workers are hired randomly from the pool of unemployed, thus unemployed can only form an expectation about future their future utility E_x^e since wages may differ across firms. Hence

$$U_x = B + \frac{1}{1+r} \{a_x E_x^e + (1-a_x)U_x\} \quad (2)$$

$$E_x^e = w_x + \frac{1}{1+r} \{(1-b)E_x^e + bU_x\}, \quad (3)$$

B denotes the unemployment benefit, a_x is the probability to be randomly picked from the pool of unemployed. Of course, an unemployed person can only expect to find employment at those firms at which his productivity is positive. Given this, the firm must in addition be willing to take him. w_x is the expected wage in that case. a_x

and w_x will be determined later. Note that this utility flow is independent of the firm at which the unemployed previously worked.

Combining (1), (2) and (3) we get the incentive compatibility constraint of a worker of type x at a given firm j :

$$w_{jx} \geq \frac{b+r}{a_x+b+r}B + \frac{a_x}{a_x+b+r}(w_x - e) + \frac{e(r+b+q)}{q}. \quad (4)$$

2.2 Firms

The finite number N of firms⁵ are equidistantly spaced around the circle with distance $d = 1/N$.⁶ A firm's address on the circle defines its most desired type of skill as the worker endowed with it is most productive to the firm. Workers' productivity decreases with distance from the firm's address. Firms are fully informed about all parameters of the market, except that they cannot observe the work effort of workers at zero cost.

Let g be a worker's productivity at a given firm's address. His skill x is put in relation to his "skill position" vis-à-vis a firm. It is assumed that a worker's productivity decreases (for simplicity) linearly with distance x from some firm that acts as a reference point in skill space. Thus if a worker meets exactly this firm's skill requirement, his productivity is g and $x = 0$; if his skill is such that he meets that of a neighbouring firm ($x = d$), his productivity is also g . How productive he is at the respective other firm depends on parameters (g, s) .

Across skill types, the technology is $g - sx$ and is of decreasing returns to scale (output increases less than proportional with the number of workers as firms hire workers with less and less optimal skills). Each skill type, however, has constant returns to scale. As the firm can discriminate between skills this choice of technology avoids that the last worker hired of one skill will have a lower marginal productivity than the first hired of a skill with a lower productivity (i.e. larger x). Thus if the firm can get a type of worker for a wage that is at least repaid by the type's productivity,

⁵To avoid integer problems, N is assumed to be any nonnegative real number.

⁶See Economides (1989) for an explicit treatment of the choice of technology in the Salop-framework. He shows that an equidistant distribution of firms displays a Nash equilibrium.

the firm would want to get all workers of this type. This leaves the focus on the firm's hiring decision bringing about unemployment of a fraction of a skill type, as will be seen.

The firm can employ a variety of skills over the unit circle, i.e. $x = 0, \dots, 1$. The focus of this paper is on firms' competition for skills in the input market and not on one firm's optimal skill mix in order to do best on the product market. Hence the technology is such that skills are perfect substitutes given the firms address on the circle. A firm is, in principle, interested in a worker of given skill as long as

$$g - sx - r(1 + r)c - B \geq 0,$$

where s measures the marginal loss of productivity and $r(1 + r)c$ the worker's capacity cost (see below). Without the shirking problem and inelastic labour supply, the firm would set wages just equal to the common reservation wage, assumed to be the unemployment benefit, B . We will later show that the firm, due to the existence of the moral hazard problem, will stop hiring even if a worker has strictly positive productivity.

2.3 The Sequence of Decisions

The time structure of firms' and workers' decisions is as follows. When setting up its premises the firm incurs a cost that depends on the size of capacity it needs for operation. In $t = 0$ the firm decides whether to enter and builds capacity K_{jx} (for each type of skill) for starting production next period. Thereby, firms determine their employment levels for the remaining periods of the game, $(1 - u_{jx}^t)\bar{L}$, where $u_x^t = 1 - \sum_j (1 - u_{jx}^t)$ is the unemployment rate at time t . In the following periods ($t = 1, \dots, \infty$) firms decide simultaneously over wages w_{jx}^t . Observing initial capacity choice as well as the current level of wages, an employee calculates at each period in time ($t = 1, \dots, \infty$) whether it is worthwhile to provide effort or not. Those workers not employed at time t will of course remain unemployed until time $t + 1$. The firm applies its shirker detection technology and, at the end of the day, decides whom to lay off. For simplicity, it is assumed that hirings are made randomly from the pool of

unemployed before newly laid-off workers enter this pool. Note that at any point in time workers are free to reject any wage offer, irrespective of their employment status.

The firm must make sure that its employment decision at t determines future unemployment in order to influence workers' beliefs about future unemployment and hence to be also able to influence the NSC. In the absence of capacity choice firms cannot credibly announce that they will hire only part of the existing work force in future periods. Workers rationally foresee that with wages being set at or below productivity firms have an incentive to hire all workers (setting wages above productivity is not optimal). Then, workers do not face a credible threat of unemployment, implying that all workers will shirk. If, however, firms have to install capacity before production and workers observe this, the firm is able to commit to a hiring policy which is accompanied by less than full employment. Consequently, workers face an unemployment threat and can be induced to work (by setting the wage rate accordingly).

We solve the model backwards by first looking at the choice of wages and effort levels for a given level of capacities. This, however, turns out to be straightforward. Firms will always set wages just satisfying the no-shirking condition in order to induce effort of workers. Setting wages below the no-shirking wage implies that workers shirk and leads to zero productivity and non-positive profits. Wages above the no-shirking wage do not pay either since these higher wages are only higher costs as initial capacity choice hinders the firm from expanding the workforce.

Thus (4) will hold with equality, implying that $w_{jx} = w_x = \tilde{w}_x$, whereby \tilde{w}_x denotes the no-shirking wage rate given in eq. (4). This implies that workers will never shirk in equilibrium. It also implies that a worker never rejects a wage offer. In equilibrium aggregate hirings must equal aggregate lay-offs

$$a_x u_x \bar{L} = b(1 - u_x) \bar{L}.$$

Combining all of this, we get the "aggregate No Shirking Condition" (NSC)⁷:

$$\tilde{w}_x = e + B + \frac{e}{q} \left(\frac{b}{u_x} + r \right). \quad (5)$$

The NSC is also called the wage-setting curve. The wage rate of a given type is connected to the unemployment rate. The longer the spell of unemployment, the

⁷Note that this condition is time-independent. Therefore, we drop the time index.

larger is the loss of utility for the laid-off worker at given wages. It follows that given a high unemployment level, the worker must be paid a relatively low wage to be deterred from shirking and, likewise, low unemployment necessitates high wages. This is the well-known negative wage-unemployment relation in Shapiro/Stiglitz.

The crucial difference of this model to Shapiro/Stiglitz' formulation is the following: In their model the labour market is large in relation to firms which ignore their influence of their hirings on the unemployment rate. Hence, by taking unemployment as aggregate and the NSC as given, they act as *wage-takers*. In a small local labour market with a small number of firms, firms perceive that their hiring affects unemployment. Although workers are deterred from shirking by unemployment, which is the aggregation of single firms' hirings, firms do not take unemployment and thus the NSC as given. By setting their hiring rate, hence by influencing unemployment, they become *wage-setters*. A firm deciding how many workers to hire will implicitly take into consideration how many workers are hired by rival firms.

Setting wages is thus equivalent to setting hiring rates, given hiring rates of firms competing for the same workers. As discussed above, firms implicitly decide about hirings when making their capacity choice. Hence we can focus our analysis on the choice of capacity. The firm j maximises present discounted profit at period 0

$$\max_{u_{jx}} \Pi_j^M = \sum_{t=1}^{\infty} (1+r)^{-t} \int_x \{(g - sx - \tilde{w}_x)(1 - u_{jx})\bar{L} - cK_{jx}\} dx \quad (6)$$

subject to

$$\tilde{w}_x = w(u_x)$$

$$K_{jx} \geq (1 - u_{jx})\bar{L}$$

The first constraint is the NSC (5), the second constraint is the capacity choice in $t = 0$.

3 Monopsony

In the following we analyse the monopsony case as a benchmark case. As said in the introduction, monopsony is a category in the (horizontal) skill space in this model, a region can well have a few monopsonists.

Inserting the first two constraints into the objective function in eq. (6) and maximising piecewise for each x over u_x , the firm's hiring and hence the unemployment rate u_x is the solution to

$$\Pi_{u_x}^M : g - sx - r(1+r)c - \tilde{w}(u_x) - \frac{\partial \tilde{w}_x}{\partial u_x}(1 - u_x) = 0. \quad (7)$$

This resembles the profit maximisation of a "conventional" monopsonist with upward sloping labour supply. Although each worker supplies effort inelastically (in the no shirking region) in this model, labour supply becomes elastic over all workers of the same skill through the interdependence of hiring and unemployment. The monopsonist has to pay \tilde{w} to the each worker and to raise the wages of all intramarginal workers. Hence the assumption of one skill's constant returns to scale is innocuous.⁸

In steady-state, inflows into unemployment must equal outflows from unemployment

$$b(1 - u_x)\bar{L} = \alpha_x u_x \bar{L},$$

implying that the unemployed worker's probability to find a job is

$$\alpha_x = \frac{b(1 - u_x)}{u_x}.$$

Inserting this into (2) and (1) yields the monopsony no-shirking-constraint (MNSC)

$$\tilde{w}_x = e + B + \frac{e}{q} \left(\frac{b}{u_x} + r \right). \quad (8)$$

The monopsonist perceives this negative wage-unemployment relation as manipulable. Inserting the MNSC and its partial derivative with respect to u_x into (7) yields the profit maximising wage-unemployment combination for workers of type x

$$\Pi_{u_x}^M : g - sx - r(1+r)c - B - e - \frac{e}{q} \left(\frac{b}{u_x^2} + r \right) = 0. \quad (9)$$

The second order condition is

$$\Pi_{u_x u_x}^M = -\frac{2eb}{qu_x^3} < 0.$$

⁸Rebitzer and Taylor (1995) show that even in a market with a large number of firms (and thus exogenous unemployment) a single firm acts as if it were a monopsonist under the assumption that detection probability decreases with firm size. Hence, in contrast to our model, firm size is independent of how many firms compete on the labour market, provided there are many.

All skill types face unemployment. Letting $u_x \rightarrow 0$ in (9) shows that even the best suited type's productivity cannot compensate for the wage that would have to be paid to deter shirking.

If (9) is totally differentiated to give

$$\frac{du_x}{dx} = -s(\Pi_{u_x u_x}^M)^{-1} > 0, \quad (10)$$

it is seen that the further a worker's skill is away from the monopsonist's most desired skill ($x = 0$), the fewer workers of this type he will employ.

Also, the resulting higher unemployment enables the monopsonist to decrease the wage of the less productive workers while still keeping them labouring. This follows from (10) and $(\partial \tilde{w}_x / \partial u_x) < 0$.

The shirking problem is severe in two dimensions. First, it was shown that not all workers of a given type are employed, although the firm would want to from a pure productivity perspective (in the absence of asymmetric information). Second, in the horizontal dimension, the monopsonist does not employ all types of workers that he would want to employ did the worker moral hazard not exist. In that case, the firm demands types until $\bar{x} = (g - r(1+r)c - B)/s$. Setting $u_x = 1$ in (9) and solving for x yields $x^M = (g - r(1+r)c - B - e - (e/q)(b+r))/s$ when there is a shirking problem. It is immediate that the monopsonist stops hiring at $x^M < \bar{x}$. Each type of worker is employable by at most one firm. The monopsony case occurs if $x^M \leq 1/2N$, that is, if the range of skills demanded by one firm does not interfere with the range of skills demanded by another.

The interpretation is straightforward. In principle, the firm would want to utilise the whole pool of workers of a given type, provided $x \leq \bar{x}$. However, workers have to be paid a premium as effort is distasteful and monitoring imperfect. Very productive workers can compensate the firm by their high productivity for the high premium they must get if the firm employs most of them. If the firm were to employ the same portion of a low productive type, it would have to pay the same high wage because low productive workers have the same distaste for effort as any other type. But for their low productivity they are paid a low wage in order to be employed at all, hence they must be deterred by high unemployment rates. Were workers able to commit

to effort, the firm would not hesitate to employ all of a given type plus more types. It is also important to note that the firm does not trade off more productive workers against less productive ones.

4 Duopsony

We extend now our analysis by looking at situations in which at least some skill types are employed in equilibrium by more than one firm. It is clear that more than one firm can compete for the same type of worker if their most desired type of skills lie each sufficiently close on the skill circle. In this section it is shown how the unemployment rate of a given type varies with its productivity position relative to the firms at which his skill is potentially in demand. For the sake of simple exposition, only the case of at most two firms $j = 1, 2$ competing for a worker's type is considered.

A duopsonistic labour market is still easily overlooked by the firms. Firms remain fully aware of their own influence on the incentive constraint of the workers. A given type's unemployment is thus determined by the individual hiring decisions of the duopsonists. We also continue to assume that hirings are made randomly by each firm from the pool of unemployed. This is innocuous, it was already discussed in section 2 that a worker of a given type earns the same wage irrespective of which of the two firms employs him. The reason for this is that a worker only cares about aggregate hirings of his type to weigh against his current wage since his distaste for effort is the same at any job. This indifference in relation to firms prompts him to accept the first job offer he gets. On the other hand, firms do not have an incentive to bid wages up as long as there are some unemployed of the same type.

The utility flow of an unemployed (2) becomes

$$U_x = B + \frac{1}{1+r} \{(\alpha_{1x} + \alpha_{2x})E_x^e + [1 - (\alpha_{1x} + \alpha_{2x})]U_x\},$$

where α_{jx} is the probability to be hired by firm j . Let us denote firm j 's hiring rate by $(1 - u_{jx})$, thus type x 's unemployment rate is $u_x = u_{1x} + u_{2x} - 1$. With the same reasoning as in the monopsony case, it must be that $u_{1x} + u_{2x} > 1$, otherwise workers would shirk at any wage. As in no-shirking steady-state any firm replaces just those

mistakenly fired, the probability to be hired from the pool of unemployed by firm j is

$$\alpha_{jx} = \frac{b(1 - u_{jx})}{u_x}.$$

The duopsonistic no-shirking-condition (DNSC) thus becomes⁹

$$\tilde{w}_x = e + B + \frac{e}{q} \left(\frac{b}{u_{1x} + u_{2x} - 1} + r \right). \quad (11)$$

Imagine the distance $d = 1/N$ on the circle between firms is such that their skill demands overlap over some range. x is the distance of this skill type viewed from firm 1's perspective, which corresponds to $d - x$ viewed from firm 2's perspective. Note that there are N potential duopsonistic markets in the local labour market.

In order to analyse the duopsonistic case, we proceed as follows. First, we look at the first-order conditions of the firms for the different types of skills. Then, we prove that there exists a range in which some skill types are indeed employed by just two firms. On this basis, we ask for the employment level of different skill types in each firm and for their total levels of employment. Finally, we turn to the address of the critical skill type on either side of the range, lying between the optimal skills of either firm. This critical skill type is the "last" being demanded by both firms. Thereby, we deduce the borderline between the duopsony and monopsony case.

The present discounted value of a firm's profit looks very similar to that of the monopsonist. The firms choose their capacities simultaneously. In maximising profits

⁹Hamilton et al. (1997) have discussed in depth the case of duopsony when there is full employment. The duopsonist tries to keep the worker of a given skill at his reservation utility, the same way as the monopsonist wants to keep the worker at B . A worker can choose his employer. If the worker's skill is in positive demand from both firms, the firms bid for the worker's labour as long as the worker's productivity pays for the wage. Hence the reservation wage relevant for firm 1 is no longer B for a given skill type, but its productivity at firm 2, which is a rising function of the workers distance to firm 1. In their model those workers earn the highest wages whose outside option is best, that is the case for the worker whose skill is in equal demand. With unemployment, however, and given the skill, the wage competition between firms disappears. This is so because wages are set via the DNSC which is an aggregate condition. Even though a skill type is still free to choose firms, he is indifferent. This is the case for all types in the duopsony range, although wages might differ between types.

the duopsonists take each other's hiring decisions as given. Hence $w_{jx} = w(u_{1x}, u_{2x})$. The associated first order conditions derived from (6) are

$$\begin{aligned}\Pi_{u_1}^{D1} &: g - sx - r(1+r)c - w(u_x) - \frac{\partial \tilde{w}_x}{\partial u_{1x}}(1 - u_{1x}) = 0 \\ \Pi_{u_2}^{D2} &: g - s(d-x) - r(1+r)c - w(u_x) - \frac{\partial \tilde{w}_x}{\partial u_{2x}}(1 - u_{2x}) = 0\end{aligned}$$

for firm 1 and firm 2, respectively. Inserting the DNSC and its partial derivative with respect to u_{1x} and u_{2x} , respectively, and keeping the hiring of the other firm constant yields

$$\Pi_{u_1}^{D1} : g - sx - r(1+r)c - B - e - \frac{e}{q} \left(\frac{b}{u_{1x} + u_{2x} - 1} + r \right) - \frac{eb(1 - u_{1x})}{q(u_{1x} + u_{2x} - 1)^2} = 0, \quad (12)$$

$$\Pi_{u_2}^{D2} : g - s(d-x) - r(1+r)c - B - e - \frac{e}{q} \left(\frac{b}{u_{1x} + u_{2x} - 1} + r \right) - \frac{eb(1 - u_{2x})}{q(u_{1x} + u_{2x} - 1)^2} = 0. \quad (13)$$

The last term on the LHS is the effect that the firm's own hiring decision has on total unemployment.

The second order condition is

$$\Pi_{u_{jx}u_{jx}}^{Dj} = -\frac{2eb(1 - u_{jx})}{qu_x^3} - \frac{2eb}{qu_x^2} < 0.$$

There exists a Nash equilibrium if neither firm has an incentive to deviate from its hiring decision, given the hiring rate of the other duopsonist, i.e. when (12) and (13) are fulfilled with strict equality or if the LHS is strictly positive given a corner solution ($u_{jx} = 1$).

The slope of the reaction functions for a given type (the subscripts here refer to firms) must satisfy

$$R'_j(u_x) = -\frac{\Pi_{u_j u_j}^{Dj}}{\Pi_{u_j u_i}^{Dj}} < 0$$

and $|R'_j(u_x)| < 1$ for stability and uniqueness. As the numerator in $R'_j(u_x)$ is the second order condition, it suffices that the denominator is negative. This is clearly the case since it only differs from the second order condition by keeping $(1 - u_{1x})$ constant

in the last term while differentiating (12). As u_{1x} enters this term negatively, the stability condition is also satisfied. The hiring decisions $(1 - u_{1x})$ and $(1 - u_{2x})$ are strategic substitutes. This is the above mentioned first dimension of firm behaviour, that is, in regard to for a given skill type.

The less attractive a given skill is for one firm, the more of this type the other firm wants to hire. As workers only care about the unemployment rate when deciding whether to shirk, the competitor's hiring decision is an externality to either firm. If firm 2 decides to hire a small share of a given type of worker, it decreases the rehiring probability of its own employees but also of firm 1's current employees of the same type. This allows firm 1 to lower the wage for these employees without inducing them to shirk or to hire more workers of the same type or do both. Given a low hiring rate for a skill being rather unproductive for firm 2, firm 1 knows that this increases the deterrence effect of unemployment. Firm 1 can thus hire more of this given skill. This is the meaning of the hiring rates being strategic substitutes.

We now proceed by showing that there indeed exists a range of skill types at which some workers of a given type work for firm 1, some workers of the same type work for firm 2 and some workers of the same type are unemployed, i.e., for which the first-order conditions ((12) and (13)) are fulfilled with equality. This range will be termed duopsony range.

To characterise this range, we first show the parameter constellation for the case that at least one skill is in positive demand by at least two firms. By the symmetry of the firms' demands, if the skill $x = d/2$ is not demanded by both firms, that is if $u_{1x} = u_{2x} = 1$ at this particular skill, a duopsony range does not exist. Conversely, there exists at least a duopsony point if

$$\Pi_u^{Dj} = g - s\frac{d}{2} - r(1+r)c - B - e - \frac{e}{q}(b+r) < 0.$$

From the DNSC it is apparent that like in the duopsony case the unemployment rate is strictly positive for any skill type. Furthermore, a sufficient condition is that any firm's skill demand does not span a range larger than its distance to the neighbouring firm. A third firm does not interfere with the skill demands of firm 1 and 2 if $g - sd - r(1+r)c - B \leq 0$. It was discussed above that this would be the shape of the

skill demand if the shirking problem was absent; its presence, however, decreases the range of skills demanded. Adding the shirking problem, a positive term containing the unemployment rate would have to be subtracted from this skill demand, hence this condition is only sufficient.

The second dimension of firm behaviour is across skill types. A duopsonist's most desired skill is $x = 0$ and $d - x = 0$, respectively. The further a worker's skill is away from a firm, the fewer workers of this type this firm will employ. This is seen by totally differentiating (12), taking u_{2x} as given, to get

$$\frac{du_{1x}}{dx} = -s \left(\prod_{u_{1x} u_{1x}}^{D_1} \right)^{-1} > 0.$$

The result for firm 2 looks exactly the same, except that one has to differentiate with respect to $(-x)$ to move away from the firm. By symmetry of the firms' skill demands, the type whose skill is located half-way between firm's addresses ($x = d/2$) has the same probability to be hired by either firm.

Across skills, firms decrease their demand for workers the further a skill is away from the firms' most preferred one. It was shown already very early in this paper that a given type is offered the same wage by either firm, hence *any* type is indifferent between firms. Firms might thus hire even those unemployed whose skills would far better fit the other firm, and the unemployed would accept the offer.

In models with full employment, a "critical" type whose productivity is equal at both firms defines the boundary between firms. Skill types to either side of this type uniquely attach themselves to one particular firm. In Hamilton et al. (1997) there is exactly one type of worker that is indifferent between the two firms. In Kim (1990) workers can play off firms against each other in the wage bargain. The symmetrical productivity loss leads to an equilibrium wage equal across skill types. A firm is only capable of paying that wage up to the minimum productivity of this critical type, leading to a clear divide of skills at that type whose wage equals his productivity at both firms alike.

This need not be the case here. There is constant turnover on the labour market, and workers who have lost their job with one firm must enter unemployment before they are rehired. They are then drawn randomly from the unemployment pool of their

own kind. As seen, firms maximise profits by accounting for each type separately, thus hiring decisions are independent across skill types. All skill types in the duopsony range are in positive demand by firms. Hence an "equal-productivity-divide" between firms does not exist when there is unemployment.

The range of skills over which firm 1 enjoys monopsony power is the distance from firm 2 at which firm 2 does not want to hire skills anymore, i.e. $u_{2x} = 1$. Inserting this into firm 2's first order condition (13), yields u_{1x} as a function of x_M^1 , the skill which is away furthest from firm 1 but still not demanded by firm 2. Given $u_{1x}(x_M^1)$, firm 1's first order condition can be solved for x_M^1 . Firm 1's total range of skills demanded is by symmetry $x_T^1 \equiv d - x_M^1$. As the analytical solution is not easily interpretable, we give a numerical example. For the following parameter values

g	B	s	e	q	b	c	r	d
1	0	2	0.4	0.8	0.1	0.5	0.1	0.25

we get

x_M^1	x_T^1	x^M
0.07	0.18	0.23

This example demonstrates that the duopsonists' skill demands overlap, so that firm 1 still demands skills beyond the "equal-productivity-divide" of $d/2 = 0.125$. The example further shows that the firm's range of skills demanded is smaller in duopsony than in (here fictitious) monopsony. That is, a duopsonist is more specialised. The intuition for this is that for skill types that are of low productivity to firm 1 though still employed under monopsony, rival firm 2 wants to set high hiring rates because these types are very productive to it. This raises the wage through lower aggregate unemployment, and because of their low productivity, these types are no longer interesting to firm 1 in duopsony.

How does unemployment vary between types? For the monopsony range the hiring is independent of the other firm's presence. For the workers in the duopsony range, the following proposition states to what level of unemployment the non-cooperative setting of the hiring rates leads.

Proposition 1 *Those workers whose skill is in demand from both firms face the same rate of unemployment and get the same wage. A skill's location closer to one firm increases the probability of being hired there, but reduces to an equal degree the employment prospect with the other firm.*

Proof: Both $\Pi_{u_j}^D$ hold with equality in the duopsony range. Firm j 's hiring rate $(1 - u_j)$ enters its first-order-condition linearly in the numerator, while firm k 's hiring rate is only implicit in the unemployment rate in the denominator. The worker's type as measured as the distance from the firms' addresses, i.e. x and $(d - x)$, simply shifts the first-order-conditions. Hence (12) and (13) can be added to give

$$\Pi_u^D = g - s\frac{d}{2} - r(1+r)c - B - e - \frac{e}{q} \left(\frac{b}{u} + r \right) - \frac{e b(1-u)}{2u^2}. \quad (14)$$

u is the solution to $\Pi_u^D = 0$. It does not depend on the workers' individual skill distance from the firms, provided a worker's skill falls under duopsony (thus the x -subscripts on u are erased). Hence all workers in the duopsony range have the same unemployment rate. From the DNSC it is apparent, that their wage depends only on the unemployment rate. Thus all workers in the duopsony range earn the same wage. (14) also shows that the worker whose skill is hired in the same portion by both firms, i.e. $x = d/2$, is decisive for the level of wages and the unemployment rate. Q.e.d..

Hence, we can divide the area between two firms in two ranges. At either side we may find a monopsonistic range, whereas in the middle a duopsonistic range prevails. In the duopsonistic range, wages and unemployment rates are equal across all types. In the monopsonistic range wage rates (unemployment rates) are higher (lower) and increase (decrease) towards the respective ends (i.e. by moving towards $x = 0$ and $x = d$). In order to show this, we rely on our above discussion. Let us concentrate on the monopsonistic range of firm 1 only (the one of firm 2 is just symmetric). Starting from x_M^1 and lowering x we know by definition and from our above discussion that $u_{2x} = 1$ with u_{1x} shrinking. The second firm will find the respective type of skill already so little interesting that it will not employ these workers while the reverse is true for firm 1. Firm 1's employment rate rises with a declining x (for $x < x_M^1$). With the help of the DNSC we find that the wage rises accordingly. Since the first-order

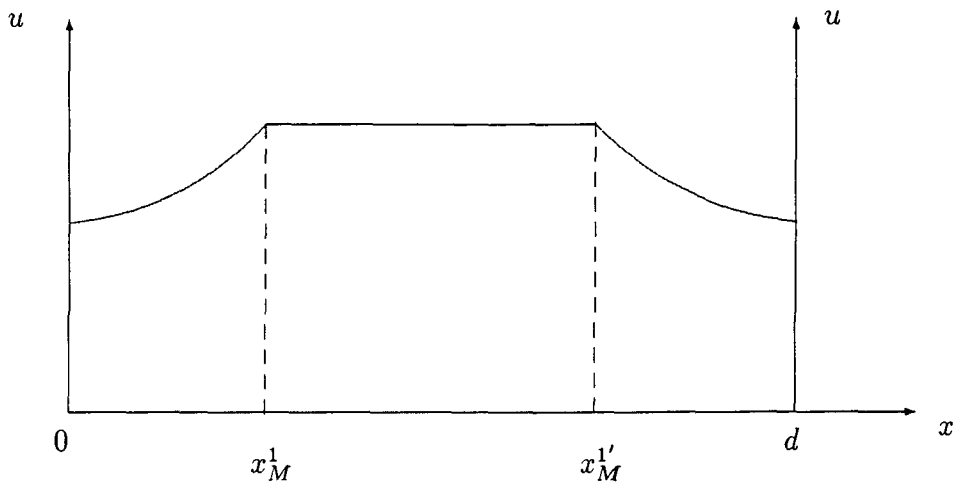


Figure 1: Equilibrium unemployment levels in skill space

condition of firm 1 is continuous in u_{1x} and u_{2x} there is no jump in total unemployment rates. The overall unemployment patterns are depicted in Figure 1.

Thus our result is to some extent in line with the existing literature using the Hotelling/Salop set-up. In the present model a "critical" skill type in equal demand from both firms also plays an important role. However, the addition of unemployment changes the results of the above cited class of horizontal labour specialisation models considerably. Although the "critical" skill type determines aggregate employment and wages, it does so for a whole range of skill types. Contrary to duopsony with full employment, the skill type with equal productivity to both firms does no longer constitute the boundary between firms.

5 Comparative Statics

5.1 The Effects of Local Labour Market Size

The "size of a local labour market" in this paper is synonymous to the number of workers and the number of firms as it was emphasised in the introduction. We limit our discussion to a variation of an exogenously given number of firms. The relation between growth of the labour force, that is a rise in the density of workers of a skill type, and the number of firms is straightforward. A rise in density increases the number

of productive workers at a firm, wages and unemployment unchanged. If firms enter the local labour market until their profits are zero (given some additional fixed cost), a rising density of workers increases the number of firms.

In the following two propositions we show how the growth of the local labour market affects specialisation, the wage level and the unemployment rate.¹⁰ As $d = 1/N$, a rise in the number of firms is equivalent to a fall in d .

Proposition 2 *In a larger region, firms become more specialised. The range of skills they demand $x_T^j = (d - x_M^j)$ declines with the size of the local labour market.*

Proof: In the numerical example we have described how in the case of duopsony the firms' boundaries are determined. Here we reiterate part of it more formally. Firm 2 stops hiring in setting $u_2 = 1$ (omitting the worker's type subscripts). Then $u = u_1$ in firm 1's monopsony range. Inserting this into firm 1's first order condition (12) and solving for u gives

$$u_M^1 = \sqrt{\frac{eb/q}{g - sx - B - e - r(1+r)c - er/q}}$$

It follows that $\partial u_M^1 / \partial x > 0$. Firm 2's first order condition becomes for the critical $x_T^2 = x_M^1$:

$$\Pi_u^D |_{u_2=1} = g - s(d - x_T^2) - r(1+r)c - B - e - \frac{e}{q} \left(\frac{b}{u} + r \right) = 0.$$

Differentiating this expression totally yields

$$\frac{dx_T^2}{dd} = \frac{s}{s - \frac{\partial \Pi_u^D}{\partial u} \frac{\partial u}{\partial x}} > 0.$$

Firm 1's level of specialisation is the range of skills demanded, $x_T^1 = d - x_M^1 = d - x_T^2$. This shrinks as the number of firms in the market rises,

$$\frac{d(d - x_T^2)}{dd} = 1 - \frac{dx_T^2}{dd} > 0. \quad \text{Q.e.d.}$$

¹⁰The analysis is restricted to comparing equilibria. Frictions that certainly arise from raising and shutting down plants are ignored. The behaviour of a particular firm, which has entered in previous periods, in response to changes in local factor supply is not modelled. Rather, each equilibrium is a separate market configuration.

The intuition is similar to the discussion above when the monopsony and duopsony cases were compared. As firms move closer in skill space but with hiring rates and wages given, workers in firm 1's previous monopsony range now become productive for firm 2. Firm 1, which previously had single command over these types' unemployment, is now confronted with hiring by its rival. This lowers the unemployment rate and firm 1's optimal response is to lower its hiring as well. In response to this, the monopsonistic range declines to a lesser extent than d . Hence firms become more specialised.

This result is in line with the full employment literature, where the firm's boundary was $d/2$ and thus the range of skills employed at a firms shrinks with market size. Thus growing availability of workers leads to specialised production.

In this partial equilibrium model, workers benefit from specialisation. This is formalised in the following proposition.

Proposition 3 *The the average wage is increasing and the average unemployment is decreasing with the size of the labour market.*

Proof: For the duopsony region, this follows from proposition 1. Totally differentiate (14) to get

$$\frac{du}{dd} = -s \left(\Pi_{uu}^D \right)^{-1} > 0.$$

From the DNSC we know that the wage for skill types in the duopsony region must rise with market size. Q.e.d..

The intuition behind this proposition is the following. Enhanced specialization leads to higher productivity of workers. Hence, firms are more inclined to hire more workers of each type. This, in turn, requires, however, a higher wage rate in order to meet the DNSC.

From proposition 2 we know that the duopsony region is enlarged in a larger market. As the unemployment rates are continuous in the transition from duopsony to monopsony, the unemployment rate also falls for those skill types who were previously at the edge of the monopsony regions. They benefit from market size as their employment opportunities grow. Note that they do not benefit from an increased choice between possible employers but from the latter's increased competition for skills. Those

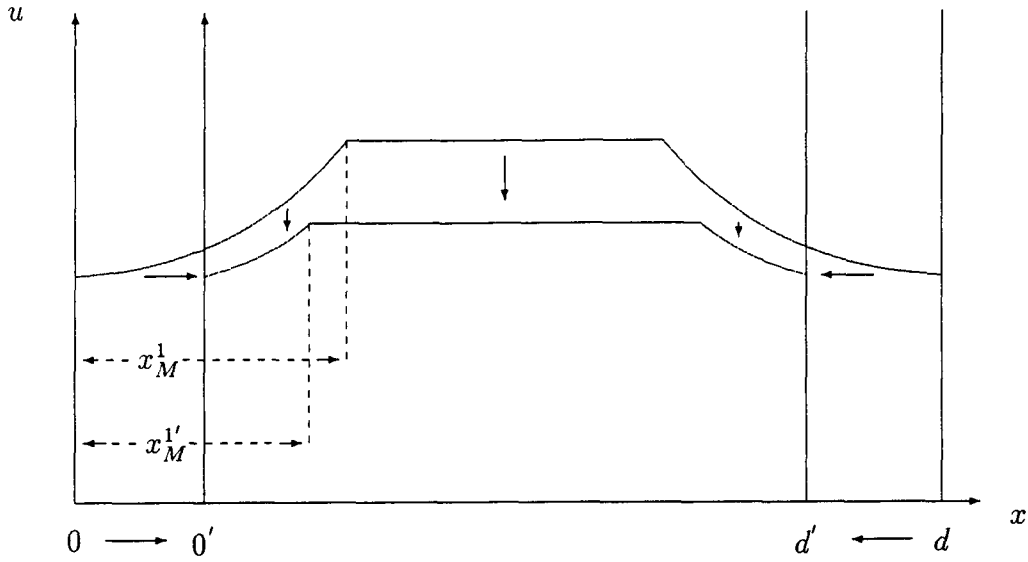


Figure 2: Equilibrium unemployment levels and region size

workers who remain under the monopsonist's regime are not worse off. Their unemployment rate does not depend on the other firm and hence not on the market size. Figure 2 shows the effect of an increase in the number of firms, $N' > N$. The vertical axes move closer, $d' < d$. The behaviour of the firms in their respective monopsony region is unaffected by the increase in the number of firms, hence the slope of the locus relating unemployment to skill is unchanged. The monopsony regions shrink, $\Delta x_M' < \Delta x_M$. The unemployment rate for those workers in the duopsony region falls.

Ultimately, of course, monopsony regions will vanish as the market grows. However, the pattern will not change. There will always be a range in which skill types are demanded by n firms and at the same time a range in which $n - 1$ firms compete for workers of a given skill type.

5.2 Further Comparative Static Effects

The effects of changes in exogenous variables other than labour market size on unemployment are summarised in the following table. The results are valid for both the monopsony and the duopsony region.

	g	B	s	q	b	e
u	-	+	+	-	+	+

With a higher maximal productivity g of a given type of worker, firm's profits rise given wage and employment. It can thus raise the wage and hire more workers. From the DNSC (11) it is apparent that B simply lowers g one-to-one, hence a raise in unemployment compensation just drives out productivity. If the marginal productivity loss across skills, s , rises, the same argument as with g applies (except for the most wanted type). Hence in figure 1, the slope of the unemployment-skill locus steepens in the monopsony region, while unemployment is higher for all types in the duopsony region. A shirker is fired with probability $q' = q + b$. A better monitoring technology thus corresponds to a rise in q , holding b constant. Better monitoring increases the probability of a shirker to be fired, thus the expected loss from shirking. Firms can hire more workers without transcending the DNSC. A rise in turnover b raises unemployment, because laid-off workers have to spend one period unemployed before they can be rehired. If workers find work more distasteful (a rise in e), they must be deterred from shirking by higher unemployment. As the level of u determines the length of the duopsony range, given d , the effects on the length of the monopsony range correspond to the sign on u in the table. Thus the effects on specialisation (x_T^1 for firm 1) carry the reverse sign.

6 Conclusion

By combining an industrial organization framework (Salop's circle model) which allows to model the demand for heterogenous labour with an efficiency wage set-up we were able to investigate the relationship between the structure of the local labour market and equilibrium unemployment. In doing so, our paper extends existing approaches

analyzing local labour markets and the importance of specialization at a regional level to a world with equilibrium unemployment. Furthermore, we introduced aspects of imperfect competition in the input markets to the Shapiro/Stiglitz framework.

This paper is concerned with the labour market within a region. It may be extended by interactions between regions. This necessitates an explicit formulation of how workers in other regions learn of outside job opportunities and under which conditions they migrate. In the context of this model it seems that workers migrate whenever their expected wage differential (including the probability of being unemployed) net of moving costs is positive. Since information about wages presumes some knowledge about employment opportunities (by interregional search to some extent by firms), the demarcation of a local labour market would still be dependent on the residential decision of workers as it was assumed throughout this paper.

This paper has shown that specialisation leads to a lower average unemployment rate and to higher average wages. This result of specialisation, however, depends on the assumption that firms are perfectly informed about a worker's skill. If they had, on the contrary, no such information, they were to form expectations about skill types in the pool of unemployed. This highlights an important aspect in economics of specialisation: If firms demand more specialised labour under ongoing agglomeration, this may lead to a force countervailing agglomeration in regard to the efficiency of matching skills to specialised firms. This matching effect would be akin to Becker and Murphy's co-ordination costs mentioned in the introduction and would bring agglomeration to a halt. On the other hand, it is also conceivable that highly specialised firms invest large amounts into search for the most suited skill types, expecting a high return from specialised labour. To incorporate these important aspects as well as the interaction of imperfect competition of firms in the output as well as input market (arising from firm heterogeneity in the output as well as input side) into the present framework is left for future research.

7 References

- Anderson, S., A de Palma and J.F. Thisse (1992): *Discrete Choice Theory of Product Differentiation*, MIT Press.
- Becker, G. and Murphy, K. (1992): The Division of Labor, Coordination Costs and Knowledge, *Quarterly Journal of Economics*, 107, 1137-60.
- Blanchflower, D. and A. Oswald (1994): *The Wage Curve*, MIT Press.
- Büttner, T. (1997): *Agglomeration, Growth, and Adjustment: A Theoretical and Empirical Study of Regional Labor Markets in Germany*, Ph.D. dissertation, University of Konstanz.
- Economides, N. (1989): Symmetric Equilibrium Existence and Optimality in a Differentiated Product Market, *Journal of Economic Theory*, 47, 178-194.
- Ethier, W. (1982): National and International Returns to Scale in the Modern Theory of International Trade, *American Economic Review*, 72, 389-405.
- Glaeser, E. and D. Maré (1994): *Cities and Skills*, NBER WP 4728, Cambridge, Mass.
- Goodfriend, M. and J. McDermott (1995): Early Development, *American Economic Review*, 85, 116-33.
- Hamilton, J., J.F. Thisse and Y. Zenou (1997): Skill Acquisition and Wage Competition with Heterogeneous Workers and Firms, *CORE DP 9722*, Louvain-la-Neuve.
- Kim, S. (1989): Labor Specialisation and the Extent of the Market, *Journal of Political Economy*, 87, 693-705.
- Kim, S. (1990): Labor Heterogeneity, Wage Bargaining, and Agglomeration Economies, *Journal of Urban Economics*, 28, 160-77.
- Matusz, S. (1996): International Trade, the Division of Labor, and Unemployment, *International Economic Review*, 37, 71-84.

- Rebitzer, J. and L. Taylor (1995): The Consequences of Minimum Wage Laws, Some New Theoretical Ideas, *Journal of Public Economics*, 56, 245-55.
- Romer, P. (1990): Endogenous technological change, *Journal of Political Economy*, 98, S71-S102.
- Salop, S.C. (1979): Monopolistic Competition with Outside Goods, *Bell Journal of Economics*, 10, 141-156.
- Shapiro, C. and J. Stiglitz (1984): Equilibrium Unemployment as a Worker Discipline Device, *American Economic Review*, 74, 433-44.
- Zenou, Y. and T. Smith (1995): Efficiency Wages, Involuntary Unemployment and Urban Spatial Structure, *Regional Science and Urban Economics*, 25, 547-73.