How Minimum Wage Affects the Firms' Behavior in Terms of Selectivity and Job Specialization?

Samir Amine*

Abstract

This paper is based on matching model with horizontally differentiated agents and endogenous variable as the nature of jobs, the minimum wage effects on selectivity and job specialization is examined. It is explained how firms choose the characteristics of their jobs according to the labour market conditions. The objective is to understand the influence of public policies on firms' technological choice. It is shown that a higher minimum wage enhances labor productivity as the agents become more selective and the nature of jobs becomes more specialized.

Key words: Productivity, unemployment, specialization, selectivity and minimum wage.

1. Introduction

In order to reduce poverty and income inequalities between workers, most of the OECD countries have established the minimum wage legislation (Brown 1999, Nickell 2004). However, public policy of minimum wage efficiency is often considered as an instrument of income distribution. Indeed, the policy of setting the minimum wage may impact employment and economic performance negatively by increasing the labour cost. The impact of minimum wage is generally dependent on the labour market conditions in which it is introduced.

* Samir Amine, Associate Professor at Université du Québec en Outaouais, Canada; Associate Professor at Université Laval, Canada and Fellow at The Interuniversity Centre of Public Policies (CIRANO), Canada, samir.amine@uqo.ca

The monopsony model which is introduced by Stigler (1946) represents the main theoretical justification of minimum wage legislation. This model has been developed by giving different basis to the labour supply function (Burdett and Mortensen 1998; Masters, 1999). In this context, Drazen (1986) and Taylor and Rebitzer (1995) have constructed several versions of the monopsony model based on the wage efficiency theory and suggest that a minimum wage policy impact employment level positively (Shapiro and Stiglitz, 1984).

In addition, many theoretical articles, based on the matching models, have also deduced that labour market efficiency and minimum wage can be positively correlated. Using a matching model in which skilled workers bargain together their wages, Cahuc et al. (2001) explain that the impact of minimum wage on the unskilled workers' employment rely on the elasticity of substitution between skilled and unskilled workers.

In this article, the minimum wage effects are studied in a new approach. Indeed, this paper initiates a new aspect of the influence of public policies on technological choices, in partiular minimum wage and unemployment benefits. In this model, job specialization is seen as the outcome of firms' choice. This specialization choice makes the technological bias endogenous. Unemployment becomes the cause and not the effect of job specialization.

Therefore, a matching model is used to horizontally differentiate firms and workers on a circle à la Salop (1979). In this approach location of a worker on the circle indicate the type of skill possessed. Similarly, location of a firm on the circle signifies its type and the skills that fully match its needs. The hiring procedure of workers by firms is characterized by a constant returns function.

The distance between the locations of two agents on the circle indicates the mismatch of the skills. It means the extent of mismatch and the degree of specialization determines the productivity of workers. Intuitively, it can be supposed that productivity of a job-worker match may decline the more the

distance. Therefore, productivity of workers vary i.e. it increases with the extent of match (mismatch) of workers.

Prior to entering the labour market, firms specify their job specializations so as to maximize the value of a vacancy. It is shown that a higher minimum wage would make agents more selective by requiring a lower mismatch for recruiting workers. Considering that the recruitment of most-suited workers, whose mismatch is low, becomes more probable, firms in this economy respond to this increased selectivity by creating more specialized jobs. This adaptation of job characteristics leads to an enhanced matching quality, and thus productivity. In spite of the negative effect on job creation process, minimum wage is presented as a public policy instrument for regulating job assignment and for improving labour market efficiency.

Remaining part of this study is planned as such: Section 2 provides the model and the market structure. Section 3 devices the solving of the model and the definition of its equilibrium. Section 4 explains the comparative static properties of the model. Lastly, the conclusion is provided in section 5.

2. The Model

The model assumes an economy comprising of two agents i.e firms and workers. Both these agents are supposed to be risk-neutral and have similar rate of time preference r. Firms in this economy produce the same good but offer a single heterogeneous job. The *exogenous* job destruction rate is s. Nevertheless, free-entry of firms is assumed so as to keep the number of firms fixed at the stationary state. Likewise, workers are heterogeneous and have an infinite horizon.

2.1 Job Specialization and Productivity

To analysis the mismatch of workers and jobs, this study adopts the Salop (1979) model. In this model both the agents are distributed uniformly on a circle having length equal to two. The position of a worker located on the circle indicates his skill *type*. Similarly, the location of a firm on the circle shows the type of skill that perfectly matches with its requirement.

Suppose, l, represent the distance between the two positions ($0 \leq l \leq 1$). In case of a perfect match, the distance equal zero ($l = 0$). On the contrary, in the case of total mismatch between the two agents, this distance is equal to the unit ($l = 1$). Consequently, productivity $y(l)$ of a job is inversely related to the distance l. This productivity is expressed in equation (1) given as below:

$$y(l,a) = \frac{1}{2}F(a) - al \qquad (1)$$

The term a ($a \geq 0$) in equation (1) represent the endogenous variable and is a measure of the degree of specialization of the job offered. Intuitively, a higher level of specialization must increase the output level of well suited workers and vice versa. Given the above hypothesis, $F(a)$ must be an increasing and concave function.

2.2 Hiring Process

Suppose Vi be the density of vacancies located at point i on the circle and Uj the density of unemployment at point j. The ratio (Vi /Uj) expresses the labour market tightness and is represented by θij. It is also assumed that the frequency of interviews between the two agents increase the density of vacancies and unemployment located at i and j.

Formally, the matching function $\pi(Vi\ ,\ Uj\ )$, is homogenous of degree one and increase in Vi and Uj . Nevertheless, the condition of stationary equilibrium implies that θij is not dependent on the pair $(i, j)(\theta ij = \theta)$.

In accordance with intuition, all matches will not be *acceptable*. Each firm of this economy defines a maximal mismatch, called λ, for recruiting a worker. Indeed, above this mismatch threshold the two agents will reject a match.

Similar to job specialization, another choice variable of a firm is its mismatch threshold. Thus a firm would maximize the value of a vacant position with respect to a and λ. It is shown below that Nash bargaining enables unemployed workers to retain the same acceptance set as that of

firms. Hence, a firm will fill its vacancy with Poisson rate:

$$q = 2\,\lambda\,\pi(\theta) \tag{2}$$

It may be noted that this problem decreases in θ. Thus due to the congestion effect, increase in number of job vacancies negatively impact the probability to fill a job. On the contrary, an increase in λ has a positive impact on this probability. As far as workers are concerned, their hiring probability p is expressed as:

$$p = \theta q = 2\,\lambda\,\theta\,\pi(\theta) \tag{3}$$

In contrast to $q(\theta)$, the probability that an unemployed worker finds a job is positively related to θ. Thus increase in job vacancies mean workers will have more opportunities to find a job.

2.3 Intertemporal Utilities and Profits

So far, the pair (a, λ) is considered to be exogenous. The section given below shows; the choice of a firm is derived by optimizing the value of a vacant job.

The expected lifetime utility of an employed worker is located at a distance lower or equal to λ ($l \leq \lambda$). At the stationary state, lifetime utility $W(l)$ of an employed worker would be related to his wage $w(l)$, which is a function of mismatch l and the destruction rate s. So, $W(l)$ satisfies:

$$rW(l) = w(l) - s(W(l) - W_U) \tag{4}$$

Besides, the expected lifetime utility of a jobless person, Wu, depends on the probability $p(\theta)$ of finding a job and on the expected lifetime utility of a worker, $\overline{W}$, when getting a job. Utility $\overline{W}$ is given by:

$$\overline{W} = \frac{1}{\lambda}\int_0^{\lambda} W(l)\,dl \tag{5}$$

Taking into account that b denotes unemployment benefits, at the

stationary state utility *Wu* satisfies:

$$rW_U = b + p(\overline{W} - W_U) \tag{6}$$

Suppose that the firm's jobs are either vacant or filled and *J(l)* the value of a job filled with a worker is located at distance *l* lower than λ. The value varies with the net instantaneous income (*y (l, a) - w(l)*) and the destruction rate *s*. It means:

$$rJ(l) = y(l,a) - w(l) - s(J(l) - J_V) \tag{7}$$

As long as the vacancy is not filled, the firm will have to incur an investment of *c* for creating the job to find a suitable worker. Thus creating a vacancy is likely to be highly *profitable* if the probability $q(\theta)$ is high. The value *Jv* of a vacant job is a function of the mismatch threshold λ and the conditional expected value $\overline{J}$ expressed as:

$$\overline{J} = \frac{1}{\lambda}\int_0^{\lambda} J(l)dl \tag{8}$$

Under these conditions, the value *Jv* satisfies:

$$rJ_V = -c + q(\overline{J} - J_V) \tag{9}$$

Given the assumption of free-entry, it is admitted that job creation would take place till the optimal job value of a vacancy equals zero:

$$Jv = 0 \tag{10}$$

Moreover, the *average* productivity $\overline{y}$ and average wage $\overline{w}$ are:

$$\overline{y} = \frac{1}{\lambda}\int_0^{\lambda} y(l,a)dl \tag{11}$$

$$\overline{w} = \frac{1}{\lambda}\int_0^{\lambda} w(l)dl \tag{12}$$

2.4 Wage Bargaining and Surplus Sharing

According to the usual matching models, the surplus generated by a firm and workers is shared by both. The share of each agent would depend on the

strength of their respective bargaining power. However, Generalized Nash rule is constrained here by giving the worker a wage higher than the minimum wage (m). In fact, if β ($0 < \beta < 1$) denotes the bargaining power of workers, a firm's optimization function is:

$$Max(W(l) - W_U)^{\beta} (J(l) - J_V)^{(1-\beta)} \quad s.c \quad w(l) \geq m \tag{13}$$

This program has two solutions depending on the minimum wage level. First, for small values of this minimum wage, the constraint is not binding. Therefore, the global surplus, noted as S (l), is shared by the firms and workers as per the Nash rule:

$$J(l) - J_V = (1-\beta)(W(l) + J(l) - J_V - W_U) = (1-\beta) S(l) \tag{14}$$

$$W(l) - W_U = \beta \ (W(l) + J(l) - J_V - W_U) = \beta \ S(l) \tag{15}$$

In addition to be accepted, matches must generate a positive global surplus and satisfy the following condition:

$$W(l) - Wu + J(l) - Jv \geq 0 \tag{16}$$

Consequently, in the first case, the wage setting is *free* and the mismatch threshold λ cancels the global surplus:

$$S(\lambda) = W(\lambda) - Wu(\lambda) + J(\lambda) - Jv(\lambda) = 0 \tag{17}$$

On the contrary, if minimum wage is high (that is the case of interest), the constraint is binding for less productive matches (*i.e.* for ill- suited workers).

The solution to (13) depends on the mismatch l between the firm and the worker who fills the job. Two systems of wage setting should be distinguished. Considering the mismatch transition, noted as l_i^m the Generalized Nash rule implies a bargained wage equal to minimum wage m:

$$w(l^m) = m \tag{18}$$

In the first system, the mismatch l between the firm and the worker who fills the job is inferior to l^m. In this case, wage is determined by the Generalized Nash rule.

On the contrary, in the second system, the mismatch l is superior to l^m and the Nash rule generates a low wage. In this case, a worker who fills the job receives a minimum wage. Thus, a firm makes a profit equal to (y (l, a) - m). It is clear that productivity of a job is a decreasing function in mismatch l and the surplus of a firm, ($J(l)$ - Jv), must be positive. Considering the free-entry assumption, the mismatch threshold λ must satisfy the following condition:

$$y\,(\lambda\,,\,a) = m \tag{19}$$

A higher minimum wage positively impacts the minimal productivity (marginal worker's productivity). It means firms become more selective by requiring a lower mismatch and the threshold λ decreases. Consequently, it seems the introduction of a minimum wage can be a source of regulating job assignment and labour productivity (Amine and Lages, 2011).

In a stationary equilibrium, workers losing their jobs must match the number of jobless workers who get a job ($p(\theta)U = sL = s(N - U)$). This condition means that the equilibrium unemployment rate u depends on the labour market tightness:

$$u = \frac{s}{s + p(\theta)} \tag{20}$$

Or a given level of p(θ), a higher destruction rate s causes a rise in the equilibrium unemployment rate. Whereas, the later is negatively related to probability p(θ)**.**

3. The Model Equilibrium

This section establishes the interactions among labour market tightness θ, mismatch transition l^m, degree of specialization a and mismatch threshold λ.

It first studies and specifies the optimal choices of job specialization and selectivity. Then, using the wage setting and the surplus sharing rule, the labour market tightness is introduced. The last expression of the model is derived from the job creation process.

3.1 Optimal Choice of Job Specialization

A firm while entering the labour market not only makes a choice about the degree of specialization i and of the mismatch threshold but also on the mismatch transition. These optimal choices are derived from maximizing the asset value Jv. Using equations (14) and (15), at the symmetric equilibrium, maximization of (9) with respect to a, λ and l^m implies:

$$(1-\beta)(F'(a)-l^m) = -(\lambda - l^m)(F'(a)-(\lambda + l^m)) \qquad (21)$$

Differentiating the expression (21), a positive relationship between mismatch threshold λ and degree of specialization a *is deduced*. An increase in this threshold implies that firms and workers become more selective and accept only high productive matches (for a given level of the mismatch transition l^m).

This rise in selectivity directly affects the job characteristics in this economy. Indeed, recruiting well-suited workers become easier and firms prefer to create more specialized jobs by making skills less *substituable*. If wage setting is *free* (*i.e*. absence of minimum wage), mismatch transition and mismatch threshold are equal ($\lambda = l^m$) (Amine et al., 2007 and Amine and Lages, 2010).

3.2 Wage Setting

It is known that the global surplus is divided according to the Nash rule when the bargained wages are superior to minimum wage i.e, when the mismatch between the two agents is inferior to the mismatch transition ($l \leq l^m$). Taking into account the free-entry assumption (equation (10)) and using equations deduced from the surplus sharing rule (equations (4), (6), (14) and

(15)), the first expression between endogenous variables of the model is established as:

$$\frac{m-b(1-\beta)}{\beta}=y(l^m,a)+\frac{p(y(l^m,a)-m)}{r+s}+\frac{p(1-\beta)}{r+s}\left(\int_0^{l^m} y(l,a)dl-l^m y(l^m,a)\right) \qquad (22)$$

Considering that the probability $p(\theta)$ of finding a job increases in θ, the expression (22) defines the mismatch transition as implicit function of θ, a and λ.

3.3 Job Creation

In order to establish another expression between endogenous variables of the model, equations (7) and (9) are used to describe the value of vacant and filled jobs. Since free entry of firms is assumed, the second expression describing interactions between endogenous variables is as follows:

$$q\left[\bar{y}-m-\beta\frac{l^m}{\lambda}\left(\frac{1}{l^m}\int_0^{l^m} y(l,a)dl-y(l^m,a)\right)\right]=(r+s)c \qquad (23)$$

Considering that the probability $q(\theta)$ of filling a job is a decreasing function in θ, the expression (23) defines the mismatch transition as implicit function of θ, a and λ. In sum , the definition of labor market equilibrium is

Definition 1: *The labour market equilibrium is a set of variables* (λ; θ; a; l^m) *which jointly satisfy equations (19), (21), (22) and (23).*

4. Results

In this section, quantitative analysis is given in order to examine the impact of minimum wage on the variables of interest and particularly on job specialization. This model represents a case similar to the French economy. Accordingly, the annual rate of time preference is estimated at 5 percent and the job destruction rate is fixed at 0.15. A Cobb-Douglas function $\pi(\theta) = h\theta^{\eta}$ *is used* to express the matching function. According to the usual matching

models (Cahuc and Lehmann, 2000, Mortensen and Pissarides, 1999), the elasticity, denoted by the term η, with respect to job vacancy is 0.5. The bargaining power is assumed as 0.5. The Hosios condition is hence satisfied. Unemployment benefits, financed by a neutral tax, are 50 percent of wages, and domestic productivity is fixed at 5 percent. Thus, this economy has an unemployment rate of 11.46 percent for a minimum wage level of 0.6. The parameter values are reported in table 1.

Table 1
The Model Calibration

r	s	3	η	h	c	b
0.05	0.15	0.5	0.5	1.1	0.35	0.5

For these simulations, it is assumed that the productivity $y(l,a)$ is written as follows:

$$y(l,a) = \frac{1}{2} a^{\frac{1}{3}} - a\,l + 0.1 \tag{24}$$

The table given below illustrates all impacts obtained with these simulations.

Table 2
Impact of the Minimum Wage on Model Variables

	θ	l^m	λ	a	$\bar{y}$	$\bar{w}$	p	q	u
m	-	-	-	+	+	+	-	-	+

According to these results, it appears a higher minimum wage positively influence agents' selectivity. Indeed, firms and workers require a lower mismatch between two skill *types* and accept only productive and efficient matches. Thus, the mismatch threshold λ rises. Analytically, this effect is deduced from equation (19). According to this equation an increase in minimum wage generates a proportional rise in marginal productivity $y(\lambda,a)$. Firms react to this increased selectivity by adapting the job characteristics to

the well-suited workers. This *adaptation* is translated by creating more specialized jobs (increase in a).

Consequently, the matching quality improvement explains a rise in labour productivity. In this case, the minimum wage is considered an instrument of regulating job assignment. In addition, considering that the global surplus becomes more important, workers bargain higher wages and the average wage rises. Likewise, in accordance with intuition, the proportion of workers receiving minimum wage increases.

Nevertheless, despite enhanced labor productivity, the minimum wage policy has a negative effect on job creation and the labour market tightness θ decreases. Or, the fall in the value of vacant job (equation (9)) makes incentives, to create a job and to invest in the labour market less important. As a consequence, the probability $q(\theta)$ of filling a job decreases. Likewise, workers will have more difficulties in searching for employment opportunities and rate of unemployed u rises. In addition, the paper obtains a negative effect on the mismatch transition l^m. This affect means that a higher minimum wage leads to reduce the mismatch between firms and workers. To summarize, the following proposition is established:

Proposition: *In a matching model where technological choices are endogenous, a higher minimum wage would make agents more selective and jobs more specialized, thus improving labour productivity.*

5. Conclusion

This paper aims at understanding interactions between labour market performance and public policies used to reduce inequalities. Within an economy in which the nature of jobs is endogenous, the consequences of introducing and increasing the minimum wage are analyzed. This instrument is generally considered as a source of labour market inflexibility.

Considering that job specialization results from firm's choice, it is shown that raising minimum wage may simultaneously affect firms' behavior for recruitment and job characteristics. Against this public policy, firms require a

lower mismatch and create more specialized jobs. In spite of productivity improvement, job creation decreases. In conclusion the minimum wage policy reduces the size of economy by making it more competitive.

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