Simulating the impact of immigration on wages and unemployment*

Liesbet Okkerse†

Abstract

This paper looks at the effects of migration in labour market models that allow for unemployment in equilibrium. We include three different models: a competitive labour market model, a wage bargaining model and an efficiency wage model. We simulate a one-percentage point increase in the labour force due to migration. Simulation results show that effects of migration do not differ that much between different labour market models: wages decrease with 0.3% to 0.4% and the unemployment rate increases with at most 0.24 percentage points. Migration also positively affects public financing by increasing government’s budget with 0.3% to 0.5%.

1 Introduction

The labour market effects of immigration are often described using a neo-classical competitive model of supply and demand in the market for labour services (Borjas 1995; Johnson 1980). These models concentrate on wage, employment and welfare effects of migration. As long as labour supply is perfectly inelastic and wages are flexible, unemployment effects are absent and full employment is guaranteed. Unemployment effects of migration only occur in a model with responsive labour supply. In that case, unemployment is always voluntary in a sense that no one who wants to work at the going wage rate is unable to do so. Migration only affects the number of participants in the labour market. Due to migration pressure, some native labourers voluntarily choose to leave the labour market. These models cannot explain the fear of the public that foreigners aggravate job opportunities and increase unemployment.

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This paper will concentrate more closely on models that can capture unemployment effects of migration. Wage setting in these models typically results from the intersection of two curves: a conventional labour demand curve and a wage-setting curve. Although the models differ in the underlying philosophy of the wage-setting curve, they have in common that in equilibrium unemployment may occur. Migration will change labour market equilibrium through its influence on the position of the wage-setting curve.

The first model repeats a conventional competitive labour market model with responsive labour supply and voluntary unemployment. We model labour supply explicitly as the result of utility maximisation by consumers. This utility maximisation problem will result in a labour supply function that is non-linear in the real wage rate. A consumer’s budget available for consumption spending depends on the number of hours worked. Each consumer wants to divide this budget between consumption goods and leisure in such a way that his utility is maximised. When the optimal amount of leisure is positive part of a person’s time endowment is spent off work. We interpret time off work as unemployment and therefore unemployment is voluntary in this model.

The second model introduces involuntary unemployment through union wage bargaining. The wage-setting curve in the union model results from utility maximisation by unions. Given firms’ labour demand, unions optimally choose wages to maximise utility for their members. Immigration may influence union behaviour through its effect on unemployment probabilities. If unions hold on to their premigration wage level, unemployment probabilities will increase after migration. With higher unemployment probabilities, the premigration wage level will no longer be optimal and unions will have an incentive to moderate wage demands.

The last model we will consider in this paper is a non-shirking efficiency wage model. The wage-setting curve here follows from a non-shirking condition. Firms want to stimulate workers to make effort and be productive. Therefore they pay wages high enough to make shirking unprofitable. When the unemployment rate is low, a shirker can easily find a new job after being fired when caught shirking. So, the lower the unemployment rate, the stronger the incentive to shirk and the higher the wages needed to prevent shirking. Through its influence on unemployment probabilities, migration will affect the non-shirking constraint and labour market equilibrium.

The introduction of union models and efficiency wage models in the economics of migration is certainly not new. Other authors already have used different variants of these models to look at welfare and labour market effects of immigration (Schmidt, Stilz, and Zimmermann 1994; Winter-Ebmer and Zweimüller 1996; Müller 2003; Carter 1999). We contribute to existing literature by comparing effects of immigration over these different labour market models. There is empirical support for each of these models and none of the models claims to be "the" model of our labour market. We focus here on the question how much quantitative difference it makes to use one model
rather than another when analysing labour market effects of migration.

We use section 2 to explain each model in more detail and to set up the different wage-setting
curves. In section 3 we explain the way migration affects the position of the wage-setting curve
and how this influences labour market equilibrium. The next section takes up the different labour
market models in a more general model including the capital market and the production process.
The model described in section 4.1 is calibrated in section 4.2 and used in section 4.3 to simulate
the effects of migration under different labour market models.

2 Wage-setting curves in different labour market models

2.1 A competitive labour market

In competitive labour market models wages are set at a level where total labour demand equals
total labour supply. This equilibrium wage rate ensures that everyone who wants to work at the
going wage rate can work. The resulting employment level therefore equals full employment as there
are no involuntarily unemployed workers. Unemployment in competitive labour market models is
always voluntary and results from an optimal division of a person’s available time endowment in
time at work and leisure. A worker may choose to spend some of its time endowment doing other
things than working. We interpret the proportion of time off work as unemployment.

In neoclassical theory labour supply results from a consumer’s choice between consuming more goods
and consuming more leisure. Economic theory translates this optimal choice into a constrained
maximisation problem. A person wants to maximise his attainable utility from leisure and other
goods under a budget constraint. The budget constraint states that consumption spending cannot
exceed a person’s income earned within and outside the labour market. Assume an individual
\( i \) maximises a CES-utility function containing a composite consumption good \( X_i \) and leisure.
Individual time endowment is normalised to unity and (the fraction of) working time is denoted by
\( L_i \).

\[
\max_{X_i, L_i} B \left( \beta X_i^{\frac{\mu-1}{\mu}} + (1 - \beta) (1 - L_i) \right)^{\frac{\mu}{\mu-1}}
\]

\( B, \beta \) and \( \mu \) are positive parameters with \( 0 < \beta < 1 \).

The budget constraint shows that a person has to earn enough income to pay for his consumption.
During time at work he earns a real wage rate \( w \) so income from work totals \( wL_i \). Income received
outside the labour market is usually fixed but here we will assume that it depends on the fraction of
leisure time. This is motivated by interpreting leisure time as unemployment. During unemployment
a person usually gets a replacement income which we assume to be a fraction $\delta$ of $w$. For a price of the composite commodity equal to one, the budget constraint reads:

$$X_i = wL_i + \delta w(1 - L_i)$$

After substituting the budget constraint, the utility maximisation problem becomes:

$$\max_{L_i} U_i = B \left[ \beta \left[ wL_i + \delta w(1 - L_i) \right]^{\frac{\mu+1}{\mu}} + (1 - \beta)(1 - L_i)^{\frac{\nu+1}{\nu}} \right]^{\frac{\mu\nu}{\mu+\nu}}$$

Solving the first order condition for individual labour supply gives:

$$L_i = \left[ \frac{\beta w (1 - \delta)^{\mu} - (1 - \beta)^{\mu} \delta w}{\beta w (1 - \delta)^{\mu} + (1 - \beta)^{\mu} (1 - \delta)w} \right]$$

An individual’s labour supply curve is upward sloping for $\mu > 1$, vertical for $\mu = 1$ and downward sloping for $\mu < 1$. We will assume that we are operating in the upward sloping part of an individual’s labour supply curve such that substitution effects of wage changes dominate income effects.

Total labour supply is obtained by horizontally summing up individual labour supply over all individuals. In an economy with $LS$ identical individuals in the labour market, total labour supply therefore equals:

$$L = \sum_{i=1}^{LS} L_i = LS \left[ \frac{\beta w (1 - \delta)^{\mu} - (1 - \beta)^{\mu} \delta w}{\beta w (1 - \delta)^{\mu} + (1 - \beta)^{\mu} (1 - \delta)w} \right]$$

The labour supply curve is the wage-setting curve in a competitive labour market. This curve slopes upward in $w - L$ space, is convex and has a vertical asymptote if $L$ approaches $LS$.

### 2.2 A labour market with union wage bargaining

There are two common models for bargaining behaviour: the right-to-manage model and the efficient contract model. In the right-to-manage model the union and the firm bargain over the wage rate but the firm keeps the right to settle the level of employment unilaterally. This model turns out to be inefficient in the sense that one party to the bargain could be made better off without making the other party worse off. The key to increase efficiency is to add the level of employment to the bargaining agenda. Therefore, in the efficient contract model the firm and the union simultaneously bargain over wages and employment.
The efficient contract model has less empirical support than the right-to-manage model. Obviously, the level of employment is not really a bargaining issue for unions. It is rare to find instances of union-firm bargaining over both wages and employment (Booth 1995). There is evidence that usually it is the employer who has the one-sided right to fix the total number of jobs (Oswald and Turnbull 1985; Oswald 1993).

In the right-to-manage model wages are determined by maximisation of the product of each agent’s gains from reaching a bargain, weighted by their respective bargaining strengths. We will work here with a monopoly union model which is a special case of the right-to-manage model with the firm’s bargaining power set to zero. In a monopoly union bargaining structure unions optimally set the wage rate subject to a sector’s labour demand curve. Once the union set the wage rate, the sector hires the number of workers that matches with this wage rate on the labour demand curve. A union considers both employed and unemployed union members in its objective function. We formalise this idea in the following objective function for a union in sector $j$:

$$\max_{w_j} \Omega_j = L_j w_j + \phi(M_j - L_j)C$$

with $L_j$ employment in sector $j$, $M_j$ the number of union members and $C$ the alternative wage an unemployed member can get. We allow employed and unemployed members to have a different relative influence on union behaviour through the parameter $\phi$. The weight for employed members in the objective function is normalised to unity and the weight for unemployed members is $\phi$.

The union maximises this objective function subject to the sector’s labour demand function $L_j = f(w_j)$. This maximisation problem results in the following first order condition:

$$f'(w_j) [w_j - \phi C] + L_j = 0$$

with $f'(w_j) = \partial f(w_j)/\partial w_j$.

With all sectors being identical, all decentralised unions will negotiate the same wage and employment for their members. Adding up first order conditions over sectors will then yield the following condition at aggregate level:

$$F'(w) [w - \phi C] + L = 0$$

with $F(w)$ total labour demand, $w$ the overall wage rate and $L$ national employment. This aggregate first order condition is the wage-setting curve for the monopoly union model. Exogenous labour supply $LS$ influences the position of the wage-setting curve through its effect on the alternative wage $C$. An unemployed person has some chance to find a job in another sector and earn $w$ or to
stay unemployed and get an unemployment benefit which is a fraction \( \delta \) of \( w \). In other words:

\[
C = \frac{L}{LS} w + \left( 1 - \frac{L}{LS} \right) \delta w
\]

Substituting this expression for \( C \) in the wage-setting curve gives:

\[
F'(w) w \left[ 1 - \phi \delta - \phi(1 - \delta) \frac{L}{LS} \right] + L = 0
\]

The wage-setting curve is upward sloping in \( w - L \) space if \( F''(w)w + F'(w) < 0 \). This condition is satisfied for all linear or concave labour demand functions but it may be violated for convex labour demand functions. We will assume this condition is satisfied and check it in the simulations.

### 2.3 A labour market with efficiency wages

All efficiency wage models we know of today stem from Solow’s (1979) argument that higher wages induce more effort and therefore increase productivity. Different models of efficiency wages sketch the same central idea: an employer might gain from paying his employees a wage above the market clearing wage. The union threat model by Dickens (1986) showed that non-union employers might benefit from paying above-market-clearing wages to discourage unionisation in their firms. Salop (1979) and Stiglitz (1979) elaborated an efficiency wage model around turnover costs. The higher the wages, the more reluctant workers are to quit their job. Therefore a firm that pays a higher wage should experience lower turnover costs. The adverse selection model stresses that efficiency wages also serve a sorting function. Higher wages attract more productive workers and the resulting increase in productivity might compensate for the higher wage cost (Weiss 1980). We will use here the shirking model of Shapiro and Stiglitz (1984) which is the most well-known and frequently cited efficiency wage model. It builds on the assumption that higher wages will motivate workers to provide the contracted amount of labour services and prevent them from shirking.

The starting point for the efficiency wage model of Shapiro and Stiglitz (1984) is the assumption that labour productivity depends on the level of effort exerted by workers. If a worker exerts no effort he adds nothing to total production. In reality firms cannot monitor the effort level of their workers perfectly which creates an incentive for workers to sit back and relax. However, shirking is risky as there is an exogenous rate \( d \) a year that a worker who is not exerting effort is being caught and fired. It is in the best interest of the firm to prevent shirking as much as possible as all shirking workers who are not caught shirking will have to be paid the same wage as non-shirking workers.

The key feature is that firms will raise their wages above the market clearing level so that its workers
will value their job and will not shirk. In equilibrium there will be unemployment that serves as a worker’s discipline device: fired workers will not be rehired immediately and therefore incur a cost. To prevent this they prefer not to shirk.

Consider an economy with identical and risk-neutral workers with an instantaneous utility function \( U = w - E \), where \( w \) is the instantaneous wage rate assumed to be constant over time and \( E \) the level of effort. The latter can take only one of two values: zero if a worker exerts no effort and some positive level \( e \) otherwise. A shirker who is caught shirking joins the ranks of the unemployed and receives a fraction \( \delta \) of the wage rate as unemployment benefit. While unemployed there is some rate \( z \) a year to find another job. Besides the rate \( d \) of being detected as a shirker there is an exogenous rate \( q \) per unit time for all workers of losing their job for other reasons.

The expected lifetime utility of a shirker \( V_S \) satisfies:

\[
iV_S = w + (d + q)(V_U - V_S)
\]

with \( i \) the real rate of interest which is constant and exogenous. This equation shows that, at every moment, a shirker entails a discounted expected flow of income \( iV_S \) equal to the wage \( w \), to which is added average income \( (d + q)(V_U - V_S) \) stemming from a possible change in the employee’s status. \( V_U \) in this expression stands for the lifetime utility of an unemployed person. For a formal derivation of this equation we refer to de la Fuente (2000).

In a similar way lifetime utility of a non-shirking worker \( V_N \) satisfies:

\[
iV_N = (w - e) + q(V_U - V_N)
\]

In other words a non-shirker entails a discounted expected flow of income \( iV_N \) equal to its instantaneous utility \( w - e \), to which is added average income \( q(V_U - V_N) \) from changing status from employment to unemployment.

An employed worker will choose not to shirk if \( V_N \geq V_S \). Firms will offer the minimal wage needed to prevent their workers from shirking. This wage rate will satisfy \( V_N = V_S = V_E \) where \( V_E \) means the lifetime utility of an employed worker. Using the expressions for lifetime utility of shirkers and non-shirkers, the non-shirking condition reads:

\[
w = iV_U + \frac{e}{d}(i + d + q)
\]

To substitute \( V_U \) in the non-shirking condition a similar expression for the expected lifetime utility
of an unemployed worker is used as the ones for the lifetime utility of employed workers:

\[ iV_U = \delta w + z(V_E - V_U) \]

An unemployed worker has an instantaneous income of \( \delta w \) and he leaves unemployment with probability \( z \). The average income from changing status is therefore \( z(V_E - V_U) \).

We can now restate the non-shirking constraint as:

\[ (1 - \delta)w = e + \frac{e}{d}(z + q + i) \]

Notice the critical wage to avoid shirking is higher: the greater is unemployment benefit \( \delta \), the higher is the rate of finding another job \( z \) and the lower is the rate of being caught shirking \( d \).

The exit rate from unemployment \( z \) will depend on the overall employment level \( L \) and therefore the non-shirking constraint supplies a link between wages and employment. We can make this link explicit by imposing a stationary state with the flows into unemployment \( qL \) equal to the flows out of it \( z( LS - L ) \). This infers the following relation for the exit rate from unemployment \( z \):

\[ z = \frac{qL}{LS - L} \]

Substituting this expression for \( z \) in the non-shirking constraint yields:

\[ (1 - \delta)w = e + \frac{e}{d} \left[ \frac{qLS}{LS - L} + i \right] \]

The non-shirking constraint is convex, slopes upward and has a vertical asymptote for \( L \) approaching \( LS \).

3 The effects of migration on the wage-setting curve and labour market equilibrium

In section 2 we traced wage-setting curves for different labour market models. These wage-setting curves have in common that they are upward sloping in \( w - L \) space. The intersection of such an upward sloping wage-setting curve with a conventional downward sloping labour demand curve fixes the wage rate and employment level in equilibrium. Figure 1 illustrates this with WSC a
wage-setting curve and $D$ a labour demand curve. The equilibrium wage is $w_0$ and employment settles at $L_0$. Unemployment results if equilibrium employment does not equal total labour supply which is assumed to be perfectly inelastic in these models at an initial level $LS_0$. There are $U_0$ unemployed workers in the equilibrium drawn in figure 1.

Figure 1: Labour market equilibrium with unemployment

For the competitive labour market model $L_0/LS_0$ represents the optimal fraction of working time that maximises each individual’s utility function. The corresponding wage rate $w_0$ generates enough income to consume the optimal amount of goods and leisure. For the monopoly union model $w_0$ is the optimal wage rate set by the unions that maximises their utility. The employment level $L_0$ is the number of workers that matches with this wage rate on the labour demand curve. Therefore the different sectors have no incentives to change the equilibrium. Finally, for the efficiency wage model $w_0$ is the only wage rate at which firms can hire the labour they want and hired workers have no incentives to shirk. Firms have no incentive to raise the wage above the equilibrium wage, nor do they have an incentive to lower the wage. Paying a lower wage would simply induce shirking.

All wage-setting curves depend on the exogenous amount of labour supply $LS$. By increasing $LS$ immigration alters the position of the wage-setting curve and therefore also equilibrium wage and employment levels. In all models an increase in $LS$ will shift the wage-setting curve outwards. This is obvious in the competitive model: immigration increases labour supply. For the monopoly
union model the effect of an increase in $LS$ comes through its effect on the alternative wage $C$. Immigration increases the probability of staying unemployed and therefore decreases the alternative wage $C$. With a lower alternative wage utility for unemployed union members decreases and it becomes more important for unions to increase employment. The only way to increase employment is to moderate their wage demands which shifts the wage-setting curve outwards. For the efficiency wage model the increase in $LS$ will not only increase the unemployment probability but also decrease the exit rate out of unemployment. Prospects for unemployed workers worsen and therefore lower wages will do to prevent workers from shirking. Again, the wage-setting curve shifts outwards.

The effects of an increase in labour supply and the consequent shift of the wage-setting curve are graphically illustrated in figure 2. The wage rate reduces to $w_1$ and employment increases to $L_1$. We can show that in all models the increase in employment is not large enough to guarantee a job for every newcomer. In other words, the increase in employment does not compensate fully for the increase in labour supply. As a result immigration increases the number of unemployed labourers from $U_0$ to $U_1$.

![Figure 2: The effects of migration on labour market equilibrium](image-url)
4 Simulating the effects of migration

4.1 The model

In this section we will combine the different wage-setting curves with labour demand that follows from a realistic production structure. In other words, labour demand is explicitly modelled as the result from an optimal decision by firms to combine different inputs in the production process for given input prices. Our economy uses two production factors, capital $K$ and labour $L$, to produce an aggregate good $Y$. We assume production is characterised by the following CES-production function:

$$Y = a \left[ \gamma K^{\frac{1}{1-\sigma}} + (1-\gamma) L^{\frac{1}{1-\sigma}} \right]^{-\frac{1}{1-\sigma}}$$

with $a$ an efficiency parameter, $\gamma$ the share parameter of capital and $\sigma$ the elasticity of substitution between capital and labour.

Firms want to maximise profits and therefore have to produce at minimal costs. Cost minimisation for a given price of capital $r$ and a given price of labour $\bar{w}$ leads to the following conditional factor demand functions:

$$K = \frac{Y}{a} \gamma^\sigma r^{-\sigma} \left[ \gamma^\sigma r^{1-\sigma} + (1-\gamma)^\sigma \bar{w}^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$$  \hspace{1cm} (1)$$

$$L = \frac{Y}{a} (1-\gamma)^\sigma \bar{w}^{-\sigma} \left[ \gamma^\sigma r^{1-\sigma} + (1-\gamma)^\sigma \bar{w}^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$$  \hspace{1cm} (2)$$

Our CES production function has constant returns to scale and therefore profits are zero. Knowing the price of output is the numeraire, the zero-profit condition looks as follows:

$$\bar{w}L + rK = Y$$  \hspace{1cm} (3)$$

Notice that the factor price $\bar{w}$ differs from the wage received by workers $w$ due to direct taxation. We assume government imposes a proportional tax rate $\theta$ which creates the following link between the net wage $\bar{w}$ and the gross wage $w$:

$$w = (1-\theta)\bar{w}$$  \hspace{1cm} (4)$$

We now endogenise factor prices by explicitly modelling the capital and labour market. The rental rate $r$ depends on capital demand (equation 1) and capital supply. We assume the supply of capital
to be fixed and exogenously given at a level $\bar{K}$:

$$K = \bar{K} \tag{5}$$

The last equation closes the labour market and settles the equilibrium wage rate. The structure of this equation depends on the model under consideration. In the competitive labour market model the missing equation is aggregate labour supply:

$$N = LS \frac{[\beta w(1 - \delta)]^\mu - (1 - \beta)^\mu \delta w}{[\beta w(1 - \delta)]^\mu + (1 - \beta)^\mu (1 - \delta) w} \tag{6a}$$

For a model with union wage bargaining the missing equation is the aggregate first order condition resulting from union’s behaviour:

$$F'(\bar{w}) w \left[1 - \phi \left(1 - \delta \frac{L}{LS} + \delta \right)\right] + L = 0 \tag{6b}$$

We can show this first order condition is upward sloping for reasonable values of the elasticity of substitution between capital and labour. The condition that has to be met, $F''(w) w + F'(w) < 0$, becomes for this particular case $\sigma < 1$. All reasonable estimates for $\sigma$ produce values smaller than 1 (Bosworth, Dawkins, and Stromback 1996).

Finally, for a model with efficiency wages the missing equation is the non-shirking condition:

$$(1 - \delta) w = e + \frac{e}{d} \left(\frac{qLS}{LS - L} + i\right) \tag{6c}$$

This system of six equations solves for output level $Y$, capital use $K$, employment $L$, the equilibrium gross and net wage rate $\bar{w}$ and $w$ and the equilibrium price of capital $r$ for given values of capital supply $\bar{K}$ and available workers $LS$.

After solving the model a number of interesting variables can be calculated such as: output per capita ($Y/LS$), the equilibrium unemployment rate $(1 - L/LS)$, the tax base $(\bar{w}L)$, total amount of unemployment benefits paid $(\delta w(LS - L))$ and government budget $(\theta \bar{w}L - \delta w(LS - L))$.

### 4.2 Calibration

All parameters in the model need to be calibrated before simulation exercises can take place. Calibration is based on a benchmark equilibrium for Belgium. We want the parameters to be
calibrated in such a way that the model mirrors this benchmark situation. In other words, the calibrated model has to produce the benchmark equilibrium as a solution.

According to Belgostat\(^1\) Belgium produces a yearly output \(Y\) of around \(€ 280 \times 10^9\) and the capital stock \(K\) is around \(€ 1264 \times 10^9\). Belgian firms have on average a yearly labour cost \(\bar{w}\) of \(€ 46,720\) per worker for an employed labour force \(L\) of 4.1 million workers\(^2\). We assume the net wage \(w\) is about one half of the labour cost \(\bar{w}\) which means the tax rate \(\theta\) equals 0.5. If we want the zero-profit condition to be satisfied the benchmark value for \(r\) has to be around 0.07 or 7\%. The size of the labour force \(LS\) is set at 4.4 million people in the benchmark situation implying an unemployed population of 300 000 or an unemployment rate of 6.82\%.

Let us first calibrate the parameters of the production function. It is impossible to trace the substitution elasticity between capital and labour from the benchmark equilibrium so we have to search for estimates in the literature. A review of many studies on the elasticity of substitution produces a wide range of results with an absolute value of the elasticity somewhere in the range 0.3 to 0.78 (Bosworth, Dawkins, and Stromback 1996). We set our parameter value equal to Hammermesh’s (1993) conclusion that a simple mean of the estimates for \(\sigma\) is 0.75. Once the substitution elasticity is set, the other production function parameters follow from the benchmark equilibrium. Dividing equation 1 through equation 2 and solving for \(\gamma\) yields:

\[
\gamma = \left[1 + \frac{\bar{w}}{r_0} \left( \frac{K_0}{L_0} \right)^{-\frac{1}{\delta}} \right]^{-1}
\]

with the subscript 0 marking the benchmark value of the variables. For the efficiency parameter \(a\) we can rewrite the CES production function:

\[
a = Y_0 \left[ \gamma K_0^{-\frac{1-\sigma}{\sigma}} + (1 - \gamma)L_0^{-\frac{1-\sigma}{\sigma}} \right]^{-\frac{\sigma}{1-\sigma}}
\]

The different labour market models have one parameter in common \(\delta\). This parameter indicates the fraction of the wage rate that unemployed workers receive as unemployment benefit. We assume this fraction equal to 0.5.

For the competitive labour market two parameters of the utility function, \(\beta\) and \(\mu\), need to be calibrated. Both parameters are calibrated simultaneously using Excel’s solver tool. We choose \(\mu\) such that it produces a reasonable uncompensated wage elasticity of labour supply for the benchmark

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1Information from Belgostat online (http://www.belgostat.be)

2Information from the National Institute of Statistics (http://statbel.fgov.be). Labour cost is based on estimates for 2000 and adjusted to 2004 based on the wage index from FPS employment, labour and social affairs (http://www.meta.fgov.be).
equilibrium. It is not straightforward to define a reasonable value for this elasticity as estimates have been found in a very broad range (Blundell and Macurdy 1999). We opt for a labour supply elasticity of 0.1 which is in line with estimates for our neighbouring countries France (Bourguignon and Magnac 1990) and the Netherlands (Van Soest, Woittiez, and Kapteyn 1990). This implies a value of $\mu$ equal to 2.4. For this value of $\mu$ the share parameter $\beta$ solves from equation 6a and the benchmark values:

$$\beta = \frac{w_0^{\frac{1}{\mu}} [\delta LS_0 + (1 - \delta)L_0]^{\frac{1}{\mu}}}{w_0(1 - \delta)(LS_0 - L_0)^{\frac{1}{\mu}} + w_0^{\frac{1}{\mu}} [\delta LS_0 + (1 - \delta)L_0]^{\frac{1}{\mu}}}$$

Calibration of the union wage model is less complicated. There is only one model specific parameter $\phi$ that solves directly from equation 6b:

$$\phi = \frac{a^{\frac{1}{1-\sigma}}(\sigma - 1) + (1 - \gamma)^{\sigma} \bar{w}_0^{1-\sigma}}{\sigma a^{1-\sigma} [\delta + (1 - \delta)\frac{L_0}{LS_0}]}$$

In the efficiency wage model, four parameters need to be calibrated: the probability of losing a job after shirking $d$, the probability of losing a job for other reasons $q$, the cost of effort $e$ and the discount rate $i$. There is no empirical evidence on $d$ but we assume a shirker is detected after six month (or half a year) such that $d = 1/0.5 = 2$. A reasonable value for the exogenous job destruction rate $q$ is 0.15 (Cahuc and Zylberberg 2004) which means an average job duration of around six and a half years. We assume the interest rate $i$ equal to 7% which is the benchmark value of $r$. The cost of effort $e$ follows from the benchmark and from equation 6c:

$$e = (1 - \delta)w_0 \left[ \frac{d(LS_0 - L_0)}{(d + q + i)LS_0 - (d + i)L_0} \right]$$

Table 1 gives a review of all the parameters and their calibrated values.

### 4.3 Simulation results

We used the General Algebraic Modeling System GAMS (Brooke et al. 1998) to program the three different sets of equations (one for each labour market type) from the previous section. The different models were solved with the CONOPT algorithm which is a solver for non-linear models. After implementation in GAMS the model could reproduce the benchmark equilibrium as a model’s solution which ensures the specification is correct.
Production structure parameters:

- $a$: efficiency parameter 6.393
- $\gamma$: parameter of capital 0.969
- $\sigma$: elasticity of substitution between capital and labour 0.75

Labour market parameters:

- $\delta$: fraction of wage rate that is unemployment benefit 0.5
- $\theta$: tax rate direct taxation 0.5

*Common to all models*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$: share parameter of the composite consumption good</td>
<td>0.017</td>
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<tr>
<td>$\mu$: elasticity of substitution between consumption and leisure</td>
<td>2.4</td>
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*Specific for competitive labour market*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\phi$: weight for the unemployed in unions utility</td>
<td>0.599</td>
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*Specific for non-shirking model*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>$e$: cost of effort</td>
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</tr>
<tr>
<td>$d$: rate at which shirking is detected per year</td>
<td>2</td>
</tr>
<tr>
<td>$q$: probability of loosing a job for other reasons than shirking</td>
<td>0.15</td>
</tr>
<tr>
<td>$i$: real interest rate</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Table 1: Parameters of the model

The aim of the models is to simulate the effects of migration and see whether results differ dramatically over different labour market types. Immigration in this model translates in an increase in labour supply $L_S$. As was graphically illustrated before, an increase in labour supply influences the position of the wage-setting curve which will shift downward in all models. Wages will decrease and employment will increase although not enough to prevent unemployment from rising. The magnitudes of the effects however may differ between different labour market models. The underlying principles of the different wage-setting curves are completely different and so is calibration.

We simulate the effects of an increase in the labour force $L_S$ with 1 per cent or 44 000 persons. An influx of this size approaches net migration of foreigners at working age in Belgium during one year. In 2001 for instance, net migration in Belgium counted 35 000 foreigners aged between 15 and 60 (NIS 2001). Table 2 shows simulation results for the different labour market models. The first column repeats the benchmark values, the next three columns show results for the different labour market models. The percentages in parentheses show percentage changes from the benchmark values.
<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Competitive model</th>
<th>Union model</th>
<th>Efficiency wage model</th>
</tr>
</thead>
<tbody>
<tr>
<td>output</td>
<td>280 000*10^6</td>
<td>281 835*10^6 (+0.65%)</td>
<td>281 421*10^6 (+0.51%)</td>
</tr>
<tr>
<td>output per capita</td>
<td>63 636</td>
<td>63 419 (-0.34%)</td>
<td>63 326 (-0.49%)</td>
</tr>
<tr>
<td>price of capital</td>
<td>0.07</td>
<td>0.071 (+0.87%)</td>
<td>0.07 (+0.68%)</td>
</tr>
<tr>
<td>cost of labour</td>
<td>46 720</td>
<td>46 532 (-0.4%)</td>
<td>46 574 (-0.31%)</td>
</tr>
<tr>
<td>net wage</td>
<td>23 360</td>
<td>23 266 (-0.4%)</td>
<td>23 287 (-0.31%)</td>
</tr>
<tr>
<td>labour supply</td>
<td>4 400 000</td>
<td>4 444 000 (+1%)</td>
<td>4 444 000 (+1%)</td>
</tr>
<tr>
<td>employment</td>
<td>4 100 000</td>
<td>4 139 345 (+0.96%)</td>
<td>4 130 453 (+0.74%)</td>
</tr>
<tr>
<td>unemployment rate</td>
<td>6.818%</td>
<td>6.855% (+0.55%)</td>
<td>7.056% (+3.48%)</td>
</tr>
<tr>
<td>tax base</td>
<td>191 552*10^6</td>
<td>192 613*10^6 (+0.55%)</td>
<td>192 374*10^6 (+0.43%)</td>
</tr>
<tr>
<td>unemployment benefits</td>
<td>3 504*10^6</td>
<td>3 544*10^6 (+1.14%)</td>
<td>3 651*10^6 (+4.19%)</td>
</tr>
<tr>
<td>government budget</td>
<td>92 272*10^6</td>
<td>92 762*10^6 (+0.53%)</td>
<td>92 536*10^6 (+0.29%)</td>
</tr>
</tbody>
</table>

Table 2: Simulation results for an increase in labour supply with 1 per cent
Wages respond most in the competitive model and the efficiency wage model with a wage decrease of around 0.4%. In a union wage setup, wages are less responsive and decrease with only 0.31%. These simulated wage effects are well in line with estimates found in empirical research. Altonji and Card (1991) for instance predict a wage decrease between 0.3% and 1.2% and Borjas (2003) and Camarota (1998) find estimates of around 0.5%.

The smaller the wage decrease, the smaller the increase in employment and the higher the pressure on unemployment. In the union model employment increases with 0.74% whereas in the competitive and the efficiency wage model employment increases with 0.96% and 0.94% respectively. This means that under constant native employment only 69% of the newly arrived immigrants find employment in the union model whereas in the competitive and the efficiency wage model more than 87% do find a job. Therefore unemployment increases most in the union model whereas the pressure on the unemployment rate is smaller in both alternative models. Although there are some differences in the size of the unemployment rate effect, the overall effect is very small with an increase of at most 0.238 percentage points.

The price of capital increases in all models and therefore capital owners always gain. The degree to which capital owners gain depends on the degree to which workers loose: the larger the decrease in the wage rate, the higher the increase in the price of capital. Depending on the type of model the price of capital increases between 0.68% and 0.87%. The amount of capital stays constant at the premigration level because of our assumption that capital supply is fixed in the short run. It would be interesting to compare the effects found here, with effects generated by a set of models that represent the long run. Long run models would allow the capital stock to change until the price of capital settles at the world price.

Migration stimulates production and increases total output with 0.51% in the union model, 0.64% in the efficiency wage model and 0.65% in the competitive model. The percentage increase in output is smaller than the percentage increase in labour supply. Therefore output per capita, often used as a welfare measure, decreases with between 0.34% and 0.49%. This does not necessarily mean there will be an immigration deficit or a decrease in total income per native. The probability of an immigration deficit is smaller: the better natives can hold on to their ownership of the fixed amount of capital and the better natives can hold on to their premigration jobs. The first argument is obvious: natives own the whole capital stock in the premigration situation and capital owners gain most from migration. The second argument considers the fact that employed workers earn more than unemployed workers. To what extend natives can hold on to their premigration jobs depends on the speed at which immigrants integrate in the job market and to what extend employers discriminate foreigners.

The last three rows of table 2 show useful results on the effects of migration on public financing. An
inflow of foreigners may affect public revenues through its effect on the tax base. The way in which the tax base will adjust is not a priori clear. On the one hand, immigration decreases wages which will lower the tax base but on the other hand, immigration increases employment and more workers will pay direct taxes. Our simulation results show the tax base will increase in all models and migration produces more public revenues. However, at the same time immigration also increases public spending by increasing the number of unemployed workers. Simulation results show that in the union model, which is the worst case scenario, public spending for unemployment benefits may increase with 4%. Nevertheless, the overall effect of migration is positive for public financing: government’s budget increases with between 0.29% and 0.53%.

5 Conclusion

The main aim of this paper was to look at the effects of migration using labour market models that allow for unemployment in equilibrium. We worked on three different models: a competitive labour market model, a wage bargaining model and an efficiency wage model. These models are similar in so far that they all produce an upward sloping wage-setting curve which will determine labour market equilibrium when combined with a conventional labour demand curve. In equilibrium unemployment occurs which is voluntary in the competitive model but involuntary in the wage bargaining model and the efficiency wage model.

Migration flows influence the position of the wage-setting curve and change labour market equilibrium. In all models the wage-setting curve will shift outwards resulting in lower wages, higher employment and higher unemployment. We ran simulations for an influx of 44,000 persons (1% of the labour force). Results showed that wages in the union model are least responsive and therefore pressure on unemployment is higher in this model than in both alternative models. Despite these minor differences in magnitudes of effects our results are well in line with results found in earlier empirical studies and simulation exercises. It is reassuring that models with a different underlying philosophy give results that confirm each other and support empirical estimates. A migration flow that increases labour supply with 1% decreases wages with 0.3% to 0.4% and increases the unemployment rate with at most 0.24 percentage points.

The simulation results also shed light on some interesting side effects of migration. Given population ageing, many countries wonder about effects of migration on public financing. Our results confirm that migration positively affects government’s budget: the increase in public revenues due to a larger tax base is larger than the increase in public spending due to higher unemployment. In other words, migration may help to finance the social security system despite their negative effects on
wages and employment rates.

References


