Regional Hiring Subsidy Policies for Target Groups, Worker Flows and Employment

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Abstract

This paper presents the main features of a small macroeconomic model resting on a dynamic view of labour markets. The interest of developing such a model is threefold. Firstly, it makes the connection between statistics on worker flows and national account data. Secondly, it extends the architecture of an existing operational static macromodel by adding key dynamic features on job changes. Thirdly, it answers to a potential key concern by public deciders, namely the evaluation of the effects of hiring subsidy policies for target groups. This is precisely the case in Wallonia, one of the three main regions of Belgium, for which first simulation results of the model are provided.

JEL classification: E62, H71, J08, R23.

Keywords: Macroeconomic modelling, Fiscal federalism, Hiring subsidy, Target group, Stock-flow employment data.

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†IWEPS (*Institut Wallon de l'Evaluation, de la Statistique et de la Prospective*) is the official Statistics Authority of Wallonia, one of the three main regions of Belgium. A such, it belongs to the Belgian Interfederal Institute of Statistics and to the Belgian Institute of National Accounts. The main missions of IWEPS is to centralize and distribute official data on Wallonia, to develop statistical methodologies, to carry out socioeconomic studies and strategic foresight analyses, and to perform regional macroeconomic forecasting and policy evaluations.

I. Introduction

Over the last four decades labour economists have progressively moved away from a static view of labour markets, based on the analysis of the stock of the (un)employed, to favour a dynamic view of labour markets, resting on the examination of job and worker flows. While the former approach is characterized by the use of situational indicators, for instance the number of workers observed at a specific moment of time, the latter approach looks after indicators of motion and studies transitions within labour markets.

The tipping point of this methodological shift is probably of statistical order. When observations on the dynamics of the US labour market were first released in the early 1980s − see a.o. Leonard (1987) −, one became aware of the magnitude of job creations and job destructions, each estimated at a million of jobs per year. Such a result could be regarded as the empirical validation of the creative destruction process enlightened by Schumpeter (1942). New dynamic theories of employment and unemployment emerged on this wave, the most famous of which include Diamond (1982) and Mortensen and Pissarides (1994).

To better understand how labour markets operate and why they may fail, we should thus go beyond the sole analysis of the net change in employment. Instead, we should view this indicator as the difference between hirings and separations, and investigate both variables as well as the interactions between them. Such a diagnosis was made possible within the statistical context developed by Davis and Haltiwanger (1998), and thanks to the proposal of new labour market indicators such as churning, the difference between worker reallocation and job reallocation, see a.o. Burgess *et al.* (2000), or Ilmakunnas and Maliranta (2005).

Notwithstanding this successful niche in the literature, the two perspectives on the labour market − static versus dynamic − should most probably remain complementary and the more recent one should not dominate the more traditional one both in theoretical and in empirical research. Instead, we strongly believe that results obtained from each of these approaches should feed each other and contribute to bring adequate and efficient solutions to issues related to labour markets, especially in policy analysis. This is precisely the context

of this research.

The present paper exposes the main features of a small regional macroeconomic model which makes the connection between a static and a dynamic view of labour markets. It is being developed in the context of the sixth State reform recently implemented in Belgium, which notably implied the transfer of targeted employment policies from the federal state to the federated entities[1]. This reform tends to increase the fiscal autonomy of Belgian regions while maintaining solidarity between federated entities to ensure long term sustainability of national public finances. This institutional review clearly requires the availability of adequate tools in the country so as to evaluate (1) the impact of newly regionalized hiring subsidy policies, which aim at stimulating job creations in vulnerable groups, and (2) the impact of federal employment subsidies policies, designed above all to maintain existing jobs.

Such a research agenda is a challenging one for the macroeconomic modeller as many interactions have to be formalized mathematically. Hiring and employment subsidy policies do not produce independent effects as flow and stock indicators of the labour market are related by definition. Also, though decided at a different level of power, any of the two cited above labour policies will affect both regional and national public budgets. Furthermore, one has to take account of the presence of heterogeneous regional economic structures as well as the existence of asymmetric trade relations between the regions of the country. To adequately cater for these specificities we propose to apply a two-stage methodology.

The first step rests on the use of PREVIEW, a regional macroecomomic model which allows the assessment of the long run effects of employment subsidy policies in Belgium. In this model regional firms are minimizing total costs of production, the level of which is constrained by the level of demand addressed to their products. The regional structure of the country in terms of trade flows and worker mobility is also considered. As such, PREVIEW can identify not only the direct effet on the beneficiaries of the employment policy but also the substitution effects and the feedback effects (for more details, see Verschueren, 2018).

[1]For the most important institutional evolutions of the Belgian federalism stemming from the implementation of the sixth State reform, see Goossens and Cannoot (2015).

The second step is to add to this static macromodel a dynamic labour market module making the connection between average employment indicators and alternative worker flow measures, such as hirings and separations. This is the core of the paper. It first needs to harmonize different statistical sources on employment, namely regional accounts of the country, on the one hand, and statistics on worker's dynamics calculated in the context of the Dynam project[2], on the other hand. Also, an important assumption, tested empirically, states that the regional worker inflow rate (or hiring rate) depends positively on the rate of the net change in regional employment. The sign of the effect of the latter variable on the separation rate depends on the value taken by the linear parameter characterizing the hiring rate equation.

Within this consistent statistical and economic framework we show that the marginal cost of labour differs from the average cost of labour for the target category of workers benefiting from a regional hiring subsidy. This key result helps us to get a more realistic estimation (than with a pure static approach) of the impact of targeted employment policies that would aim at stimulating the hiring of low educated workforce in Wallonia, one of the three NUTS1 statistical regions of Belgium − the two remaining ones being the Flemish region and the Brussels-Capital region.

Beyond the empirical exercise presented here, alternative differently calibrated hiring and employment subsidy policies could be simulated by the model, providing political decision-makers in the country with a useful tool to coordinate their employment policies and ensure their effectiveness and efficiency at the regional and at national level.

The sequel of the paper is organized as follows: section II explains how static and dynamic labour market indicators are related, section III formalizes how employment reacts to labour cost and discusses the implications of changing the level of regional hiring subsidy, section IV implements the methodology to simulate a simplified Walloon labour market reform, and finally section V draws the main conclusions.

[2]The most recent data related to Dynam are discussed in Goesaert and Struyven (2018). For a deep analysis of employment dynamics in Wallonia based on these statistics, see Meunier *et al.* (2018).

II. Connecting dynamic and static employment indicators

A. Notations

In line with Davis and Haltiwanger, let us note L_{t-1} the (aggregate) level of employment observed at the end of year $t-1$, or equivalently at the begining of year t. L_{t-1} is considered to be fixed. Net change in employment at year t is written D_t:

$$D_t = L_t - L_{t-1} \tag{1}$$

Net change in employment can also be viewed as net hirings, i.e. total worker inflows (or hirings) H_t minus total worker outflows (or separations) S_t:

$$D_t = H_t - S_t \tag{2}$$

At the plant level, a worker recorded in a firm at date t but not recorded in the same firm at date $t-1$ is considered to be an inflow in the firm. If (s)he was recorded in a firm at date $t-1$ but is no longer recorded in it at date t, (s)he is considered to be an outflow from the firm. As a result, total worker inflows H_t correspond to the sum of all individual hirings during year t, while total worker outflows S_t consist in the sum of all individual separations during year t.

We next define $\overline{L}_t$ as the average level of employment at year t so that:

$$\overline{L}_t = \frac{L_t + L_{t-1}}{2} \tag{3}$$

Together with (1), one can write equivalently:

$$D_t = 2\left(\overline{L}_t - L_{t-1}\right) \tag{4}$$

$$\overline{L}_t = L_{t-1} + \frac{D_t}{2} \tag{5}$$

These latter two equations will be used subsequently.

Lastly, the worker inflow (hiring) rate h_t, the worker outflow (separation) rate s_t and the net hiring rate d_t are respectively defined as:

$$h_t = \frac{H_t}{\overline{L}_t} \tag{6}$$

$$s_t = \frac{S_t}{\overline{L}_t} \tag{7}$$

$$d_t = \frac{D_t}{\overline{L}_t} = h_t - s_t \tag{8}$$

B. Cyclical nature of hirings and separations

The cyclical nature of worker flows is well documented in the literature, see Lazear and Spletzer (2012). For the modelling of flows between employment, unemployment, and non participation over the business cycle, see Krusell *et al.* (2017). Worker dynamics is explained by a simultaneous change both in worker inflows and in worker outflows. These worker flows are here assumed to depend on the cycle of employment. When the labour market is improving so that $\Delta d_t > 0$, the worker inflow rate is by definition higher than the worker outflow rate. Expressed in terms of rates, we would thus have:

$$h_t = \alpha + \sigma d_t \tag{9}$$

with $\sigma > 0$.

By construction:

$$s_t = \alpha - (1 - \sigma)\, d_t \tag{10}$$

Parameter α is interpreted as the worker inflow rate that must be exceeded to ensure a positive net change in net employment ($0 < \alpha < 1$). At this rate, worker inflows and worker outflows are equal so that α can be viewed as an equilibrium rate. Parameter σ must be understood as the change in the worker inflow rate that would result of a one percentage point increase in the net hiring rate. At the same time, the worker outflow rate would decrease by $(1-\sigma)$ pourcentage point(s). Various configurations are actually possible. When $\sigma < 1$, improvement in the labour market performance will raise the inflow rate but lower the outflow rate. When $\sigma = 1$, there is no effect on the outflow rate. When $\sigma > 1$, both inflow and outflow rates are increasing and turnover in the labour force plays a key role in employment dynamics as, implicitly, workers can move to higher paying jobs.

Let us now investigate how worker flows will react to a *change in average employment* $\overline{L}_t$ provided assumption (9)-(10). Multiplying the two latter equations by $\overline{L}_t$, then using (4) to eliminate D_t and remembering L_{t-1} is exogenous with respect to average employment, we obtain the following derivative forms:

$$\frac{\partial H_t}{\partial \overline{L}_t} = \alpha + 2\sigma > 0 \quad \text{and} \quad \frac{\partial S_t}{\partial \overline{L}_t} = \alpha - 2\,(1 - \sigma) \tag{11}$$

$$\frac{\partial h_t}{\partial \overline{L}_t} = 2\sigma \frac{L_{t-1}}{\left(\overline{L}_t\right)^2} > 0 \quad \text{and} \quad \frac{\partial s_t}{\partial \overline{L}_t} = -2\,(1 - \sigma)\, \frac{L_{t-1}}{\left(\overline{L}_t\right)^2} \tag{12}$$

Clearly, an upward change in $\overline{L}_t$ positively affects worker inflows as well as the inflow rate, but the effect on worker outflows and on the worker outflow rate depends on the values assigned to parameters α and σ. Let us define the threshold value $\sigma^T = 1 - \frac{\alpha}{2}$. When $\sigma < \sigma^T$, a positive change in $\overline{L}_t$ lowers both S_t and s_t. When $\sigma = \sigma^T$, the worker outflow rate decreases

but there is no effect on worker outflows. When $\sigma^T < \sigma < 1$, the worker outflow rate still decreases but worker outflows are positively stimulated. When $\sigma = 1$, worker outflows are positively affected but there is no effect on the worker inflow rate. Finally, when $\sigma > 1$, there is a positive effect on each of the dynamic indicators of employment investigated, and this situation could indicate the working of a creative destruction process within the labour market.

By construction:

$$\frac{\partial D_t}{\partial \overline{L}_t} = 2 \quad \text{and} \quad \frac{\partial d_t}{\partial \overline{L}_t} = 2\frac{L_{t-1}}{\left(\overline{L}_t\right)^2} \tag{13}$$

Table 1 summarizes the results related to derivatives. Let us point out again that when $1 - \frac{\alpha}{2} < \sigma < 1$, stimulating average employment increases separations but lowers the separation rate.

Table 1: alternative effects of a change in $\overline{L}$

$\sigma =$	0 ...	$1-\frac{\alpha}{2}$	...	1	...
$\frac{\partial H_t}{\partial \overline{L}_t}$	$+$	$+$	$+$	$+$	$+$
$\frac{\partial h_t}{\partial \overline{L}_t}$	$+$	$+$	$+$	$+$	$+$
$\frac{\partial S_t}{\partial \overline{L}_t}$	$-$	0	$+$	$+$	$+$
$\frac{\partial s_t}{\partial \overline{L}_t}$	$-$	$-$	$-$	0	$+$
$\frac{\partial D_t}{\partial \overline{L}_t}$	$+$	$+$	$+$	$+$	$+$
$\frac{\partial d_t}{\partial \overline{L}_t}$	$+$	$+$	$+$	$+$	$+$

C. Relating to macroeconomic average employment

In equation (3), average employment $\overline{L}_t$ is defined by refering only to two observation points. Standard macroeconomic models, however, are based on an alternative measure of average employment, we note $\overline{\overline{L}}_t$. This indicator combine levels observed at different moments of the year, typically at each quarter end.

In that respect:

$$\overline{\overline{L}}_t = \frac{1}{4}\sum_{j=1}^{4} L_{j,t} \tag{14}$$

where $L_{j,t}$ stands for the level of employment observed at the end of quarter j.

To write down (14) in terms of the dynamic framework of section II, we have to make assumptions on how worker flows are distributed in the quarters, considering that such statistics are generally not available – it is the case in Belgium. To make things simpler, we select as working hypothesis the discrete uniform distribution: 25% of yearly total hirings and 25% of yearly total separations are both realized at the end of each quarter, so that:

$$H_{j,t} = \frac{H_t}{4} \quad \text{and} \quad S_{j,t} = \frac{S_t}{4}, \quad j = 1, ..., 4 \tag{15}$$

Therefore, as $L_{t-1} = L_{4,t-1}$:

$$L_{j,t} = L_{t-1} + \frac{j}{4} D_t, \quad j = 1, ..., 4 \tag{16}$$

It is implicitly expected that the employment level remains unchanged inside each quarter.

Using (16), equation (14) can be written as:

$$\overline{\overline{L}}_t = L_{t-1} + \frac{5}{8} D_t \tag{17}$$

The connection between average indicators $\overline{\overline{L}}_t$ and $\overline{L}_t$ is now straightforward. Using (5) and (17) we get:

$$\overline{\overline{L}}_t = \overline{L}_t + \frac{D_t}{8} \tag{18}$$

The higher the absolute value of net hirings, the more both measures of average employment differ. Specifically, the percentage difference between $\overline{\overline{L}}_t$ et $\overline{L}_t$ is proportional to the

net hiring rate. In other words, the position in the cycle of employment distorts the identity relation between the static indicator of average employment and its dynamic counterpart.

Let us now introduce a regional feature in our model as well as a socioeconomic breakdown in the working population, and show how macroeconomic average employment of the more vulnerable workers would react to the presence of a subsidy granted in case of hirings from this target group.

III. Regional hiring subsidy policies for target groups

A. A consistent definition of labour cost

The structure of labour cost.—Let us consider two categories of worker occupied in a specific region, the first one with a low level of qualification − that is, at most the lower secondary education − and the second one with a higher level of education. We note $LC_{q,j,t}$ the total labour cost of category q observed at the end of quarter j of year t. Labour cost consists in gross wages with legal employers' social security (ESS in the sequel of the text) contributions, minus reductions of ESS contributions. Quaterly gross wages are defined as the average gross wage of the category, $w_{q,t}$, multiplied by the employment level observed at the end of the quarter, $L_{q,j,t}$. Average wages are supposed to be stable over the year. Legal ESS contributions are calculated as a fixed proportion of gross wages, with $\tau^E_{q,t}$ the compulsory contribution rate of year t. In both categories, at a quaterly pace, a fixed amount of reductions of ESS contributions ($r^S_{q,t}$) is granted to employers on any existing job − they are called *structural reductions* in Belgium. They have to be seen as employment subsidies mainly seeking to preseve jobs in the region. Both legal ESS contributions and related structural reductions are managed by the federal state.

Target groups and hiring subsidies.—We also take into account of a second type of quarterly reductions, written $r^H_{q,t}$. These reductions of ESS contributions are granted by the regional state and eligible only in case of hirings from a specific target group, namely the low educated unemployed living in the region. Education is an important criterion of

eligibility for many hiring subsidies in Wallonia[3]. The system of regional subsidies is thus simplified to keep only one target group.

Refering to the notations of the previous section, we define $H_{LQ,j,t}$ as the inflows of low educated workers at the end of quarter j of year t. To identify the target group in this aggregate, we consider a simplified closed system with four transition statuses in the regional labour market. Total hirings are hence decomposed into hirings of local unemployed workers (UH), on the one hand, and hirings coming from regional job-to-job transitions (SH), on the other hand. Variable SH is next defined as a fraction ρ of total separations observed in the region, so that $SU = (1 - \rho)S$ workers move to unemployment.

Thus:

$$H_{LQ,j,t} = UH_{LQ,j,t} + SH_{LQ,j,t} \tag{19}$$

$$SH_{LQ,j,t} = \rho S_{LQ,j,t} \tag{20}$$

$$S_{LQ,j,t} = SU_{LQ,j,t} + SH_{LQ,j,t} \tag{21}$$

Assuming a stable working population, we get:

$$\Delta U_{LQ,j,t} = SU_{LQ,j,t} - UH_{LQ,j,t} = -\Delta L_{LQ,j,t} \tag{22}$$

We can derive the probability of switching from unemployment to employment, and the probability of switching from employment to unemployment; they are given respectively by:

$$p^{UL}_{LQ,j,t} = \frac{UH_{LQ,j,t}}{U_{LQ,j,t-1}} \tag{23}$$

[3]For more details, see http://emploi.wallonie.be/en/home/aides-a-lemploi/reforme-des-aides-a-lemploi.html.

$$p_{LQ,j,t}^{LU} = \frac{SU_{LQ,j,t}}{S_{LQ,j,t}} = 1 - \rho \tag{24}$$

This simplified setting still ignores regional hirings other than from local unemployed workers, job-to-job transitions between regions and separations of non local workers moving to unemployment. Actually, we consider here the labour market of the low educated as mainly local with a workforce characterized by little mobilily, which is not an unrealistic assumption for this population of worker.

From all these writings, total *annual* labour cost of category q gets the following expression:

$$LC_{q,t} = \begin{cases} \sum_{j=1}^{4} \left\{ \left(\left(1 + \tau_{q,t}^{E}\right) w_{q,t} - r_{q,t}^{S} \right) L_{q,j,t} - r_{q,t}^{H} \left(\frac{H_{q,j,t} - \rho S_{q,j,t}}{4} \right) \right\}, & q = LQ \\ \sum_{j=1}^{4} \left\{ \left(\left(1 + \tau_{q,t}^{E}\right) w_{q,t} - r_{q,t}^{S} \right) L_{q,j,t} \right\}, & q = HQ \end{cases} \tag{25}$$

or, using (14) and (15):

$$LC_{q,t} = \begin{cases} \left(\left(1 + \tau_{q,t}^{E}\right) w_{q,t} - R_{q,t}^{S} \right) \overline{\overline{L}}_{q,t} - r_{q,t}^{H} \left(H_{q,t} - \rho S_{q,t} \right), & q = LQ \\ \left(\left(1 + \tau_{q,t}^{E}\right) w_{q,t} - R_{q,t}^{S} \right) \overline{\overline{L}}_{q,t}, & q = HQ \end{cases} \tag{26}$$

where $R_{q,t}^{S}$ is the lump sum structural reduction (i.e. employment subsidy) expressed on an annual basis.

Labour cost and macroeconomic average employment.—Assumption (9) on the worker inflow rate implies that hirings and separations are not independent from the macroeconomic average employment $\overline{\overline{L}}_{t}$. Indeed, we can write down hirings $H_{q,t}$ successively as:

$$\begin{aligned} H_{q,t} &= \alpha_q \overline{L}_{q,t} + \sigma_q \Delta L_{q,t} \\ &= \alpha_q \left(\overline{\overline{L}}_{q,t} - \frac{1}{8} \Delta L_{q,t} \right) + \sigma_q \Delta L_{q,t}, \quad \text{see (18)} \\ &= \alpha_q \overline{\overline{L}}_{q,t} + \left(\sigma_q - \frac{1}{8} \alpha_q \right) \left(\frac{8}{5} \left(\overline{\overline{L}}_{q,t} - L_{q,t-1} \right) \right), \quad \text{see (4)} \\ &= \frac{4}{5} \left(\alpha_q + 2\sigma_q \right) \overline{\overline{L}}_{q,t} - \frac{8\sigma_q - \alpha_q}{5} L_{q,t-1} \end{aligned} \tag{27}$$

For separations, we get:

$$
\begin{aligned}
S_{q,t} &= H_{q,t} - \Delta L_{q,t} \\
&= \left(\frac{4}{5}\left(\alpha_q + 2\left(\sigma_q - 1\right)\right)\right)\overline{\overline{L}}_{q,t} - \left(\frac{8\left(\sigma_q - 1\right) - \alpha_q}{5}\right) L_{q,t-1}
\end{aligned} \tag{28}
$$

Also, target hirings UH_{LQ} can be written as:

$$
UH_{LQ,t} = \phi_{LQ}\overline{\overline{L}}_{LQ,t} - \xi_{LQ} L_{LQ,t-1} \tag{29}
$$

with:

$$
\phi_{LQ} = \frac{4}{5}\left(\left(1 - \rho_{LQ}\right)\left(\alpha_{LQ} + 2\sigma_{LQ}\right) + 2\rho_{LQ}\right) \tag{30}
$$

$$
\xi_{LQ} = \frac{\left(1 - \rho_{LQ}\right)\left(8\sigma_{LQ} - \alpha_{LQ}\right) + 8\rho_{LQ}}{5} \tag{31}
$$

Making use of equations (27) up to (31), the annual labour cost (26) can finally be expressed as:

$$
LC_{q,t} = \begin{cases} \left(\left(1 + \tau^E_{q,t}\right) w_{i,t} - R^S_{q,t} - \phi_q r^H_{q,t}\right)\overline{\overline{L}}_{q,t} + \xi_q r^H_{q,t} L_{q,t-1}, ...q = LQ \\ \left(\left(1 + \tau^E_{q,t}\right) w_{q,t} - R^S_{q,t}\right)\overline{\overline{L}}_{q,t}, \quad q = HQ, \end{cases} \tag{32}
$$

B. Policy implications in a cost minimizing context

Target group: marginal and average labour costs differ.—Let us assume that regional employers are using three substitutable factors in the production process: labour (low vs. high educated workforce) and capital $\overline{\overline{K}}$. Also, the production technology takes the form of a Cobb-Douglas function with constant returns to scale:

$$
\overline{\overline{VA}}_t = A\left(\overline{\overline{L}}_{LQ,t}\right)^{\beta_{LQ}}\left(\overline{\overline{L}}_{HQ,t}\right)^{\beta_{HQ}}\left(\overline{\overline{K}}_t\right)^{1-\beta_{LQ}-\beta_{HQ}} \tag{33}
$$

with $\overline{\overline{VA}}_t$ the regional value added observed at year t.

Regional employers are supposed to minimize total cost of production:

$$COST_t = LC_{LQ,t} + LC_{HQ,t} + KC_t \tag{34}$$

subject to (33), with $KC_t = c_t \overline{\overline{K}}_t$ and c_t the user cost of capital.

The average labour cost of category q is given by:

$$\overline{\overline{\omega}}_{q,t} \equiv \frac{LC_{q,t}}{\overline{\overline{L}}_{q,t}}, \quad q = LQ, HQ \tag{35}$$

The marginal cost of high educated labour (see definition in the previous subsection) and the marginal cost of capital are written respectively as:

$$\frac{\partial LC_{HQ,t}}{\partial \overline{\overline{L}}_{HQ,t}} = \overline{\overline{\omega}}_{HQ,t} = \left(1 + \tau^E_{HQ,t}\right) w_{HQ,t} - R^S_{HQ,t}$$

$$\frac{\partial KC_t}{\partial \overline{\overline{K}}_t} = c_t \tag{36}$$

In contrast, as $L_{q,t-1}$ is fixed, we get for the low educated:

$$\begin{aligned} \frac{\partial LC_{LQ,t}}{\partial \overline{\overline{L}}_{LQ,t}} &\equiv \omega_{LQ,t} = \left(1 + \tau^E_{LQ,t}\right) w_{LQ,t} - R^S_{LQ,t} - \phi_q r^H_{LQ,t} \\ &= \overline{\overline{\omega}}_{LQ,t} - \xi_q r^H_{LQ,t} \frac{L_{LQ,t-1}}{\overline{\overline{L}}_{LQ,t}} < \overline{\overline{\omega}}_{LQ,t} \end{aligned} \tag{37}$$

This is a key result. For the target category, the marginal labour cost reveals to be lower than the average labour cost and the gap between the two measures of cost arises due to the presence of the hiring subsidy. Actually, structural and hiring reductions do not involve the same employment indicators (stocks vs. flows) so that at a comparable budget cost, the hiring subsidy policy will stimulate more jobs than the employment subsidy policy.

Direct effects of a change in a hiring subsidy policy.—At this stage of development of the model, we have gathered all the tools to be able to assess the effect of the selected regional policy, i.e. what would be the direct effets on average macroeconomic employment, as well as on hirings and separations, of a change in regional target group ESS reductions.

Let us start with the low qualified. We first note that, using the law of successive derivatives, we get:

$$\begin{aligned} \frac{\partial \ln \overline{\overline{L}}_{LQ,t}}{\partial \ln r^H_{LQ,t}} &= \frac{\partial \ln \overline{\overline{L}}_{LQ,t}}{\partial \ln \omega_{LQ,t}} \frac{\partial \ln \omega_{LQ,t}}{\partial \omega_{LQ,t}} \frac{\partial \omega_{LQ,t}}{\partial r^H_{LQ,t}} \frac{\partial r^H_{LQ,t}}{\partial \ln r^H_{LQ,t}} \\ &= \frac{\partial \ln \overline{\overline{L}}_{LQ,t}}{\partial \ln \omega_{LQ,t}} \frac{\partial \omega_{LQ,t}}{\partial r^H_{LQ,t}} \frac{r^H_{LQ,t}}{\omega_{LQ,t}} \end{aligned} \tag{38}$$

The context of minimization of the production costs implies that the first term on the right hand side of (38) is equal to $-(1-\beta_{LQ})$. Using (37), we can then solve the second term so that the employment elasticity to the hiring subsidy can be written as:

$$\frac{\partial \ln \overline{\overline{L}}_{LQ,t}}{\partial \ln r^H_{LQ,t}} = (1-\beta_{LQ})\phi_{LQ} \frac{r^H_{LQ,t}}{\omega_{LQ,t}} > 0 \tag{39}$$

Equation (39) indicates that the percentage impact on the macroeconomic average employment of a more attractive hiring subsidy policy is higher the higher are the hiring subsidy, the equilibrium rate α_{LQ} and the linear parameter σ_{LQ}, and the lower are the elasticity of production to the less educated, the average gross wage and the turnover parameter ρ_{LQ} – see the definition of ϕ_{LQ} in equation (30). Note that in our optimization setting, β_{LQ} can also be interpreted as the share of the low educated labour cost in the total production cost.

Thereafter, the effect of a unit change in the target group ESS reduction is given by:

$$\begin{aligned} \frac{\partial \overline{\overline{L}}_{LQ,t}}{\partial r^H_{LQ,t}} &= \frac{\partial \ln \overline{\overline{L}}_{LQ,t}}{\partial \ln r^H_{LQ,t}} \frac{\overline{\overline{L}}_{LQ,t}}{r^H_{LQ,t}} \\ &= (1-\beta_{LQ})\phi_{LQ} \frac{\overline{\overline{L}}_{LQ,t}}{\omega_{LQ,t}} > 0 \end{aligned} \tag{40}$$

Using (27) and (28), the following results are straightforward:

$$\frac{\partial \ln H_{LQ,t}}{\partial \ln r^H_{LQ,t}} = \frac{4}{5}\left(\alpha_{LQ} + 2\sigma_{LQ}\right)\left(1-\beta_{LQ}\right)\phi_{LQ}\frac{\left(\overline{\overline{L}}_{LQ,t}\right)^2}{\omega_{LQ,t}H_{LQ,t}} > 0 \tag{41}$$

$$\frac{\partial \ln S_{LQ,t}}{\partial \ln r^H_{LQ,t}} = \frac{4}{5}\left(\alpha_{LQ} + 2\left(\sigma_{LQ}-1\right)\right)\left(1-\beta_{LQ}\right)\phi_{LQ}\frac{\left(\overline{\overline{L}}_{LQ,t}\right)^2}{\omega_{LQ,t}S_{LQ,t}} \tag{42}$$

with, as checked before, the elasticity of separations to the hiring subsidy being positive when $\sigma_{LQ} > 1 - \frac{\alpha_{LQ}}{2}$.

Equations (41) and (42) allow us to derive the effects of the regional policy on worker flows as:

$$\frac{\partial H_{LQ,t}}{\partial r^H_{LQ,t}} = \frac{\partial \ln H_{LQ,t}}{\partial \ln r^H_{LQ,t}}\frac{H_{LQ,t}}{r^H_{LQ,t}} > 0 \tag{43}$$

$$\frac{\partial S_{HQ,t}}{\partial r^H_{LQ,t}} = \frac{\partial \ln S_{LQ,t}}{\partial \ln r^H_{LQ,t}}\frac{S_{LQ,t}}{r^H_{LQ,t}} \tag{44}$$

Another attractive result can be obtained refering to (19) and (20). It is readily checked that an increase in the amount of hiring subsidy would stimulate more hirings from targeted unemployed than hirings from external mobility (i.e. $\frac{\partial UH_{LQ,t}}{\partial r^H_{LQ,t}} > \frac{\partial SH_{LQ,t}}{\partial r^H_{LQ,t}}$) when:

$$\rho_{LQ} < \frac{1}{2}\frac{\alpha_{LQ} + 2\sigma_{LQ}}{\alpha_{LQ} + 2\left(\sigma_{LQ}-1\right)} \tag{45}$$

Before turning to the empirical section, let us recall that the new hiring subsidy policy

will also affect high educated employment by a substitution effect. For instance:

$$\begin{aligned} \frac{\partial \ln \overline{\overline{L}}_{HQ,t}}{\partial \ln r^{H}_{LQ,t}} &= \frac{\partial \ln \overline{\overline{L}}_{HQ,t}}{\partial \ln \omega_{LQ,t}} \frac{\partial \ln \omega_{LQ,t}}{\partial \ln \overline{\overline{L}}_{LQ,t}} \frac{\partial \ln \overline{\overline{L}}_{LQ,t}}{\partial \ln r^{H}_{LQ,t}} \\ &= -\frac{\beta_{LQ}}{1-\beta_{LQ}} \frac{\partial \ln \overline{\overline{L}}_{LQ,t}}{\partial \ln r^{H}_{LQ,t}} \end{aligned} \tag{46}$$

IV. Simulating a simplified Walloon labour market reform

This section applies the methodology exposed in the foregoing sections to the case of Wallonia, one of the three NUTS1 statistical regions of Belgium. Specifically, it seeks to answer the following question: *"In a given year, what would have been the direct effects of having implemented in the region a different target group hiring subsidy policy than the one actually adopted?"*

Testing the cyclicality of hirings and separations.—A key assumption of our model relies on equations (9) and (10), postulating the cyclical nature of inflow and outflow rates. To test the validity of this assumption, we make use of historical data coming from the Dynam database, in which Belgian hirings and separations are provided by region[4]. Monoregional employers − meaning that their production sites are all located in the same region − are interestingly distinguished from multiregional employers. Nonetheless, when browsing these statistics, we are facing two constraints. Firstly, the Walloon part of employment in multiregional Walloon employers can not be isolated. Secondly, a breakdown of data according to education is not yet available. Consequently, we consider as a first approximation that inflow and outflow rates are the same for both categories of worker and, besides, exploit only monoregional statistics.

Figure 1 depicts the evolution of inflow and outflow rates during the period 2006-2014 in Wallonia. Clearly, both indicators are characterized by an historical downward trend although the slope is less marked for the separation rate. In 2012 and 2013, the rate of the

[4]For a presentation of the Dynam project, see http://www.dynam-belgium.org/site/index.php/en/about-dynam.

net change in employment was negative in the region as total separations exceeded total hirings.

Figure 1 - hiring and separation rates in Wallonia

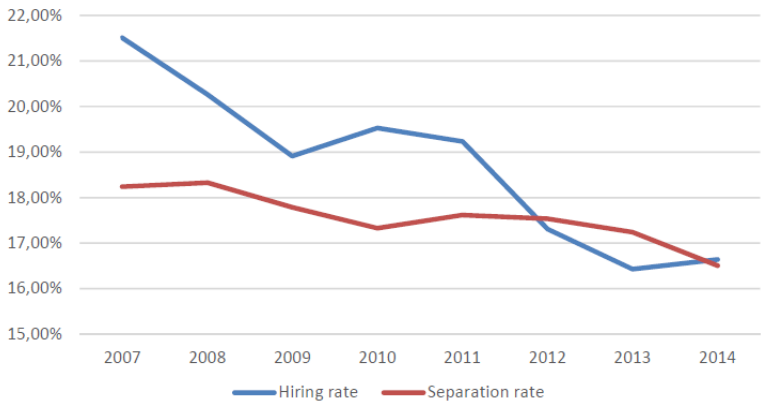
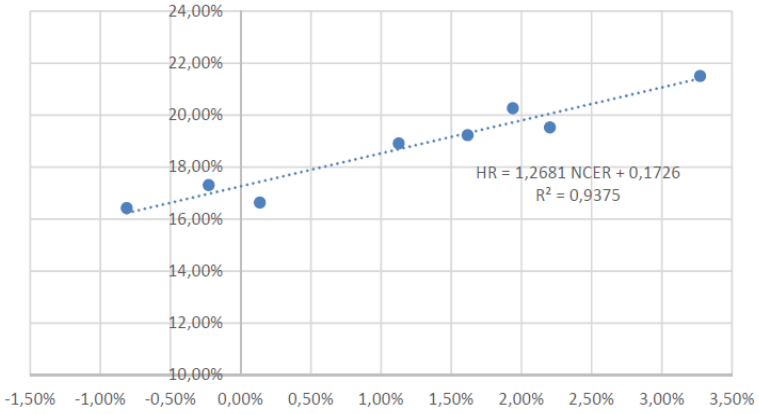


Figure 2 pictures the scatter plot relating the Walloon hiring rate and the rate of the net change in Walloon employment, as well as OLS estimation results of regressing equation (9).

Figure 2 - hiring rate (HR) versus net change in employment rate (NCER)



A strong and positive relation between the two variables is econometricaly confirmed. Both estimated coefficients are checked to be statistically significant at a 95% level of confidence and the explanatory power of the model lies above 93%. The equilibrium rate α is

estimated at a level of 17.3% and the linear parameter turns out to exceed one ($\widehat{\sigma} = 1.27$), meaning that hirings and separations are synchronized with the cycle of employment. Let us also point out that 2014 proves to be a year associated with a very low employment growth rate in the region, see the third point starting from the left in figure 2.

Calibration of the model.—Table 2 provides the values assigned to the variables and the parameters of the model. The calibration stage consists in a trade-off between the data coming from Dynam − linked to dynamic employment indicators − and those coming from regional accounts − linked to average or static indicators, see also Verschueren, 2015. It rests on year 2014, the most recent year available at the time simulations were performed.

Table 2a - calibration of the model: wages, policy instruments and employment

	Education level		
(yearly basis, 2014)	All	Low	High
Average gross wage	36,374 €	30,890 €	37,686 €
ESS contribution rate	35%	35%	35%
Employment subsidy	1,800 €	1,800 €	1,800 €
Hiring subsidy	–	6,000 €	–
Average employment (macro definition)	1,006,000	194,158	811,842
Average employment (Dynam definition)	1,005,749	194,109	811,639
Period-start employment level	1,004,743	193,915	810,827
Period-end employment level	1,006,754	194,304	812,451
Hirings:	167,690	32,416	135,144
From targeted unemployed	68,391	13,199	55,192
Job-to-job transitions	99,569	19,217	80,352
Separations:	165,949	32,028	133,921
Moving to unemployment	66,379	12,811	53,568
Net change in employment	2,011	388	1,623
Hiring rate	16.7%	16.7%	16.7%
Separation rate	16.5%	16.5%	16.5%
Net change in employment rate	0.20%	0.20%	0.20%

Table 2b - calibration of the model: structure of labour cost

	Education level		
(yearly basis, 2014)	All	Low	High
Total labour costs:	47,569.2 M€	7,727.4 M€	39,841.8 M€
Total gross wages	36,592.4 M€	5,997.5 M€	30,594.9 M€
Total ESS contributions:	10,976.8 M€	1,729.9 M€	9,246.9 M€
Legal ESS contributions	12,807.4 M€	2,099.2 M€	10,708.2 M€
Total ESS reductions:	1,830.6 M€	369.3 M€	1,461.3 M€
Structural (employment subsidies)	1,810.8 M€	349.5 M€	1,461.3 M€
Target group (hiring subsidies)	19.8 M€	19.8 M€	–
Average labour cost	47,286 €	39,800 €	49,076 €
Maginal labour cost	46,753 €	37,039 €	49,076 €

Simulation results.—Table 3 presents the estimated effects on the low educated of a 10% increase in the Walloon target group hiring subsidy. Specifically, the second column provides results that would be obtained in case of the adoption of the policy change in 2014, and the next two columns express the results with respect to the reference scenario (i.e. no policy change, see table 2), both in difference and in percentage difference. Let us recall that the numbers obtained only relate to direct and long run effects.

Table 3a - simulation results of the Walloon policy variant (part 1)

(results for low educated only)	New levels in the variant	Δ w.r.t. reference absolute	relative
Average gross wage	36,374 €	*no change*	
ESS contribution rate	35%	*no change*	
Employment subsidy	1,800 €	*no change*	
Hiring subsidy	6,600 €	+600 €	+10%
Average employment (macro definition)	195,501	+1,343	+0.69%
Average employment (Dynam definition)	195,184	+1,074	+0.55%
Hirings:	35,601	+3,185	+9.83%
From targeted unemployed	15,763	+2,563	+19.42%
Job-to-job transitions	19,838	+622	+3.23%
Separations:	33,064	+1,036	+3.23%
Moving to unemployment	13,226	+414	+3.23%
Net change in employment	2.537	+2,149	+555.55%
Hiring rate	18.24%	+1.54p%	+9.22%
Separation rate	16.94%	+0.44p%	+2.67%
Net change in employment rate	1.30%	+1.10p%	+549.96%

Table 3b - simulation results of the Walloon policy variant (part 2)

	New levels in	Δ w.r.t. reference	
(results for low educated only)	the variant	absolute	relative
Total labour costs:	7,774.8 M€	+47.4 M€	+0.61%
Total gross wages	6,039.0 M€	+41.5 M€	+0.69%
Total ESS contributions:	1,735.8 M€	+5.9 M€	+0.34%
Legal ESS contributions	2,111.7 M€	+14.5 M€	+0.69%
Total ESS reductions:	377.9 M€	+8.6 M€	+2.34%
Structural (employment subsidies)	351.9 M€	+2.4 M€	+0.69%
Target group (hiring subsidies)	26.0 M€	+6.2 M€	+31.36%
Average labour cost	39,768 €	−31 €	−0.08%
Marginal labour cost	36,752 €	−286 €	−0.77%
Budget cost per subsidized job:	3,366 €		
Regional level	2,422 €		
Federal level	943 €		

If regional ESS target reductions had been increased by 10% in Wallonia in 2014, regional average low educated employment would have risen by 1,343 units (macroeconomic definition) and by 1,074 units (Dynam definition), representing a respective growth rate of +0,69% and +0,55% in comparison with the reference scenario. As a result of the lowering of the labour cost of the low qualified, an additionnal flow of 3,185 hirings would have been generated in the category, allocated between 2,563 hirings in the population of target unemployed (80.5% of total hirings) and 622 workers in job transition (19.5%). At the same time, 1,036 additional separations would have been observed (414 moving to unemployment and 622 switching jobs), what would have led to a rise in the net change of low educated employment by 2,149 units. Net hirings would thus have been multiplied by 6.5. The worker inflow rate of the vulnerable category would have switched from 16.70% to 18.24%, and

the worker outflow rate would have increased from 16.50% to 16.94% as the regional policy variant would stimulate worker turnover.

The extra cost of the policy change in terms of ESS targeted reductions would have amounted to 6.2 million euros (+33.4% with respect to the reference scenario). The surge in average low educated employment would also have generated additional ESS structural reductions in the order of 2.4 million euros (+0.69%) as new jobs would also beneficit from employment subsidies. In spite of the tax relief, the regional policy variant would have induced for the low educated a rise both in mandatory ESS contributions (+14.5 million euros) as well as in gross wages (+41.5 million euros) as a result of the upward change in average employment. In the end, the total labour cost of low educated would have been expanded by 47.4 million euros (+0.61%). While the average labour cost of the category would have dropped to a neglegible extent, the marginal labour cost would have decreased more (−486 euros per job, or −0.77%).

The last lines of table 3 care about measures of efficiency calculated as the ratio of the extra budget cost of the policy variant and the additional flow of hirings in targeted low educated. It would amount to an estimated annual cost of $2,422$ euros per beneficiary hired for the regional authority, and of 943 euros for the federal authority, to reach a global budget cost of $3,366$ euros per hiring from the target group. It has to be noted that the first amount cited reflects the simultaneous increase both in the regional lump sum amount for target group and in the number of beneficiaries. It exceeds the level of the hiring subsidy adopted in the policy variant ($1,650$ euros) as one also has to take into account the growth in the subsidies to be paid to recipients already existing in the reference scenario.

Let us recall that the regional policy variant would also have negatively affected high educated labour by a substitution effect and would thus have generated a decrease of public expenses in the federal budget (less structural ESS reductions for that category). Also, feedback effects of the policy change on the three Belgian regional economies are not yet calculated by the model. All these indirect effects are needed to assess the final macroeco-

nomic impact of the reform, which could be estimated as soon as the dynamic labour market module presented here is embedded in the general architecture of the already operational macroeconomic model PREVIEW. This is the next step of the project.

V. Conclusions

This paper has presented the main features of a small dynamic model aimed at evaluating the impact, on alternative indicators of employment, of a change in a hiring subsidy policy that would occur in Wallonia, one of the three main regions of Belgium. It has been developed in the context of the sixth State reform recently implemented in the country, which notably implied the transfer of targeted employment policies from the federal state to the federated entities. The put forward dynamic module rests on a stock-flow structure of the regional labour market. It is intended to improve the simulation accuracy of a more general static macroeconomic model which suffers from the limitation of considering average employment as the single main indicator of employment.

The policy variant simulated here was based on a simplified version of the "Reform of Employment Incentives" recently implemented in Wallonia. Specifically, the regional policy change consisted in reductions in employer's social security contributions in case of recruiting from a single eligible target group, namely the local low educated unemployed workers. The modelling of such a setting has led to obtain two key theoretical results. Firstly, for the vulnerable category benefiting from the hiring subsidy, the marginal cost of labour reveals to be lower than the average cost of labour. Secondly, the elasticity of macroeconomic low educated average employment to the hiring subsidy can be explicitly calculated based on the model parameters, making the connection between a static and a dynamic approach to labour markets.

Regarding the empirical exercice, preliminary results calibrated on the year 2014 suggest that a 10% increase in the level of Walloon target group ESS reductions would generate $3,185$ additional hirings in the category of low educated, including $2,563$ hirings in the population of

unemployed. The 622 remaining hirings would come from job-to-job transitions. At the same time, 1,036 additional separations would be observed, 414 moving to unemployment and 622 switching job, what would lead to a rise in the net change of low educated employment by 2,149 units. The reform would cost 6.2 million euros to the regional budget, but would also bring 12.1 million euros of additional net revenues to the federal budget as a result of the effect of the regional policy change both on mandatory ESS contributions and on structural ESS reductions.

Let us be aware that these calculations do not include the effect of the simplified reform on high educated employment nor the feedback effects on the regional economies and, hence, on the whole country. The measure of this macroeconomic impact is expected to be estimated very soon. Moreover, the calibration of the model still rests on strong assumptions made on the levels of unobserved variables so that the accuracy of the present regional policy evaluation will be improved as soon as relevant statistical information becomes available.

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