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Thomas Davoine





INSTITUT FÜR HÖHERE STUDIEN  
INSTITUTE FOR ADVANCED STUDIES  
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**Author(s):**

Thomas Davoine

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Josefstädter Straße 39, A-1080 Wien

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# **A theoretical rationale for flexicurity policies based on education**

**Thomas Davoine<sup>1</sup>**

<sup>1</sup>Institute for Advanced Studies

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# A theoretical rationale for flexicurity policies based on education

Thomas Davoine \*

March 30, 2015

## Abstract

The paper provides a theoretical rationale for flexicurity policies, which consist of low employment protection, generous unemployment insurance and active labor market programmes. It analyzes in which conditions flexicurity can be optimal. Low employment protection encourages costly education efforts to access high productivity and high innovation sectors, with firms more likely to survive and thus not exposing much their workers to unemployment risk. Activation programmes support the reallocation flow from unproductive to productive firms, helping to reduce unemployment. Low employment protection thus provides incentives for costly self-insurance against unemployment risk through education, mitigating the moral hazard cost of unemployment insurance and activation programmes. The paper provides realistic numerical illustrations where flexicurity is optimal, and where it is not optimal.

**Keywords:** flexicurity, unemployment insurance, job protection, active labor market policy, education.

**JEL-Classification:** J64, J65, J68, J32, H30

## 1 Introduction

Unemployment remains high in many developed countries. Flexicurity, based on low employment protection, generous unemployment benefits and active labor market policies, has been associated with encouraging signs of unemployment reduction, in Denmark and the Netherlands. Policy analysis present flexicurity as a viable

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\*Institute for Advanced Studies, Vienna, Stumpergasse 56, 1060 Vienna, Austria. Contact: [davoine@ihs.ac.at](mailto:davoine@ihs.ac.at). For useful comments, I am grateful to Christian Keuschnigg, Martin Kolmar, Volker Grossmann and participants in seminars at the Universities of Dortmund, Munich and St.Gallen, and at the L.A. Gerard-Varet conference in Marseille.

option (Bovenberg and Wilthagen, 2009). It is also an example of policy moving ahead of science. This paper provides a theoretical rationale for flexicurity based on education. I show flexicurity can help speed up the job reallocation process due to negative productivity shocks and labor market frictions, encouraging self-insurance through education, balancing low unemployment with high output growth and delivering utilitarian welfare gains.

With one exception, there are no complete theoretical analysis of flexicurity. There exists a large number of studies which consider a subset of the three policy instruments of flexicurity. For instance, unemployment insurance and employment protection have been jointly considered by Pissarides (2001). Most theoretical analysis of active labor market policies also consider unemployment insurance, including Fredriksson and Holmlund (2006) and Andersen and Svarer (2014).

Using a combination of instruments makes theoretical models more complicated. To capture interactions and complementarities of the labor market policies and the full potential of flexicurity, one needs however to analyze all three instruments simultaneously. Andersen and Svarer (2007) remind for instance that low protection and generous unemployment benefits were already in place well before the rise in unemployment in Denmark, following the mid-1970's oil shock. Only after implementation of active labor market policies did unemployment start to decrease.

Brown, Merkl and Snower (2009) is the only joint analysis of the three policy instruments of flexicurity. They however treat employment protection as a firing cost and miss the potential complementarity effect of firing taxes and unemployment benefits highlighted by Blanchard and Tirole (2008).

This paper builds on Davoine and Keuschnigg (2010) and considers firing taxes (as employment protection), unemployment insurance and active labor market policies, without any preconception of what their optimal level is. Its main contribution is a theoretical rationale for flexicurity. I analytically show that the optimal public policy is flexicurity, under certain conditions related to endogenous education decisions. With a plausible calibration, numerical examples where flexicurity is the optimal policy, and where it is not, are provided. A companion paper Davoine and Keuschnigg (2015) performs an analysis to investigate the benefits of coupling flexicurity with redistribution or re-employment wage subsidies.

I use a model where low productivity firms may have to downsize or shut down and fire workers. To be hired by high productivity and innovative firms, which reduces exposure to unemployment risk, households need to educate, at a cost. Firing, job search and education decisions are endogenous. I follow Blanchard and Tirole (2008) to model firing decisions, Hopenhayn and Nicolini (1997) as well as Chetty (2008) for job search decisions and Heathcote, Storesletten and Violante (2010) for education decisions.

Government offers unemployment benefits to the unemployed, financed by labor income taxes and, if any, firing taxes. Unemployed are enrolled in active labor market programmes, which help them retrain and find jobs, but are time consuming and reduce benefits of home production. Each policy instrument comes with a trade-off. High unemployment insurance increases the welfare of the unemployed but reduces the incentive to search for a job. High firing taxes reduces the inflow

into unemployment but reduces the incentive to educate and join safer, innovative and productive firms. Large active labor market programmes speed up reallocation but are costly, both for the unemployed and for the state.

The paper shows that flexicurity - low firing taxes, high unemployment benefits and large active labor market programmes - is optimal under conditions related to education and job search behavior. In particular, optimal unemployment insurance and firing taxes are substitutes if education efforts decrease with firing taxes and other conditions are satisfied. Intuitively, low firing taxes reduce employment protection in risky, low-productivity but free access firms while they increase education efforts and access into safer, innovative and productive firms. A marginal decrease of employment protection thus allows for a marginal increase of unemployment benefits, as more households join safer firms. Flexicurity in this case encourages self-insurance against unemployment risk through education, mitigating the moral hazard cost of public unemployment insurance.

The next section presents the model. Section 3 contains analytical results. A numerical illustration is provided in section 4 and a conclusion in section 5.

## 2 Model

Policy instruments which are part of flexicurity impact both firms and household decisions. Consistent with empirical evidence, employment protection influences firing decisions by firms (see for instance Boeri and Jimeno, 2005) while unemployment benefits and active labor market policy impacts the effort and the success of job search (see respectively Krueger and Meyer, 2002; Card, Kluve and Weber, 2010).

Endogenous firm and household decisions responding to the three flexicurity policy instruments create modelling complexity. To maintain tractability and obtain analytical results, I keep the model simple in some dimensions. In particular, the model is static, labor supply is inelastic and I use some reduced-form specifications. The impact of these simplifications is discussed in section 5.

**Firms and sectors** Workers affected by firms closures need to seek jobs in surviving firms. To analyze worker reallocation flows and their dependence on policy, I separate firms in two sectors. In the first sector, I regroup firms which innovate little, have a low productivity and face a high risk of closure. The second sector consist of firms which innovate, install new production process, are more productive and more likely to survive. The precise definition and characteristics of sectors follows.

All firms employ exactly one worker and produce the same good, which I take as numeraire<sup>1</sup>. In a static framework with inelastic labor supply normalized to unity, production is Ricardian.

Innovation allows firms from the second sector to produce at a cheaper cost. For

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<sup>1</sup>Extending the model to multiple goods, one could also integrate a simple form of Schumpeterian creative destruction (Schumpeter, 1942; Aghion and Howitt, 1994). Sector 1 firms which do not innovate may see their market stolen by sector 2 firms, which offer new products. If this happens to a sector 1 firm, it needs to close down and sends its workers into unemployment.

simplicity, I assume that firms in the second sector always survive and that they are equal (that is, there is a representative firm). While there is uncertainty in the first sector, there is none in the second sector.

Uncertainty and firm behavior in the first sector is taken from Blanchard and Tirole (2008). There are four phases in the life of a sector 1 firm. First, an investor decides to create a firm<sup>2</sup>. Second, the firm hires one worker at an agreed wage. Assuming free entry, expected profits are driven down to zero, so that the wage will be equal in all firms,  $w_1$ . Third, the firm learns about the level of competition from innovative firms. Relative to the representative firm in sector 2, it is given a productivity which is high or low. The relative productivity shock  $x \in [0, \infty)$  is drawn from a given distribution with density  $g(x)$ . Four, the firm decides to operate or close down. If its relative productivity  $x$  is high, it can survive and expects a profit  $x - w_1$ . If it is too low, it will make no profit. The firm has to pay a tax  $t_s$  if it decides to downsize, close down and fire the worker<sup>3</sup>.

The firm decides to operate if and only if  $x - w_1 \geq -t_s$ . The level  $x_1 \equiv w_1 - t_s$  is the cut-off productivity above which the firm continues to operate and below which it closes down. Clearly policy influences firms decisions: the higher the firing tax, the lower the rate of firm exits and the flow of workers into unemployment. The tax thus can be used as employment protection (EP). Given these definitions, the separation rate is

$$s = s(x_1) = \int_0^{x_1} g(x) dx. \quad (1)$$

I assume that firm owners are risk-neutral and operate a portfolio of firms<sup>4</sup>. Then, owners start with several firms and pay firing taxes for these firms which need to close down with the profit they make from surviving firms. Taking into account policy on firing and the level of competition, expected profits upon entry are

$$\pi = \int_{x_1}^{\infty} (x - w_1) g(x) dx - st_s = (1 - s)(x^a - w_1) - st_s \geq 0, \quad (2)$$

where  $x^a \equiv \int_{x_1}^{\infty} xg(x) dx / (1 - s)$  is the average productivity of surviving firms.

Free entry drives expected profits to zero. Given the relative productivity distribution  $g(x)$  and firing taxes  $t_s$ , this pins down the sector 1 wage  $w_1$ . Higher firing taxes thus not only reduces the separation rate  $s$  but also the average productivity level  $x^a$  and thus the equilibrium wage  $w_1$ . Sector 1 workers thus both lose and win from higher firing taxes.

Firms in sector 2 are innovative and safe. They are identical and offer an exogenously given wage  $w_2$  to workers. I assume that sector 2 is big enough to ensure a level of competition due to innovation such that (via the sector 1 productivity

<sup>2</sup>In reality, investors often have to pay sunk investment costs. I add these costs in the numerical illustration.

<sup>3</sup>Notice periods, firing rules and severance payments are more common than firing taxes as a mean of employment protection in OECD countries. Even though not widespread, firing taxes remain a realistic policy instrument. The US for instance uses firing taxes (via the so-called *experience rating* system for financing unemployment insurance). Blanchard and Tirole (2008) identify an optimal complementarity of firing taxes and unemployment insurance, which can play an important role in the optimality (or not) of flexicurity. One can also think of severance payments as a bundled firing tax with unemployment insurance.

<sup>4</sup>Alternatively, we could assume that there is a financial intermediation sector with perfect competition and which is costless.

distribution  $g$ )

$$w_1 < w_2. \quad (3)$$

Intuitively, it makes sense that the innovating sector has higher productivity and thus can offer higher wages. With free entry of firms into sector 2 and no uncertainty, there are no profits so the output of each firm equals the wage  $w_2$ . While entry is free for firms, it is costly for workers: development and operation of high productivity processes depends on innovation performed by skilled workers, who went through a costly education. Workers entry into sectors will be presented below.

**Labor market** The labor market is imperfect, due to relocation costs, skill mismatch, search and other frictions. Unproductive firms from sector 1 fire their workers, who become unemployed. During unemployment, workers engage in home production<sup>5</sup>  $h$ , retrain to acquire the skills needed for sector 2 and search for a job in that sector. If the retraining and search are successful, they leave unemployment. Otherwise, they remain unemployed.

As Chetty (2008), I borrow from Hopenhayn and Nicolini (1997) the modelling of search effort decisions, based on reduced-form specifications. Let  $e \in [0, 1]$  be the individual retraining and search efforts by unemployed workers<sup>6</sup>. By a suitable normalization and the law of large numbers,  $e$  also represents the probability of finding a job in sector 2 after separation from sector 1. The reduced form specification  $\zeta(e)$  captures search effort costs, in utility terms. I assume that utility costs increase with effort and that finding a job becomes increasingly difficult with effort,  $\zeta' > 0$  and  $\zeta'' > 0$ . A rapidly increasing function  $\zeta(e)$  also captures the difficulty of finding a job due to adverse labor market conditions, such as job rationing (Michaillat, 2012).

Government provides unemployment insurance (UI) benefits  $b$  to unemployed workers and enrolls them in active labor market programmes (ALMP). These programmes include job search assistance, retraining courses and can also include monitoring and sanctions (for a recent overview, see Card, Kluve and Weber, 2010). Whether or not they include monitoring and sanctions, participation in these programmes takes time, reducing the output or benefit unemployed workers derive from home production<sup>7</sup>. Figure 1 provides an overview of the labor market and reallocation flows.

Let  $m \geq 0$  be the amount of active labor market programmes provided to unemployed workers and let the reduced forms  $\psi(m)$  and  $\phi(m)$  capture the two essential dimensions of these programmes. The first dimension reduces the output or benefit from home production to  $\psi(m)h$ , with  $\psi(m) \in [0, 1]$ ,  $\psi(0) = 1$ , and  $\psi' < 0$ : the larger the provision of activation measures, the lower the time for or the enjoyment of home production. Monitoring and sanctions can also be part of these measures. The second dimension increases the likelihood of finding a job,

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<sup>5</sup>Aguiar, Hurst and Karabarbounis (2013), among other empirical studies, find that home production increases during unemployment. For simplicity I assume employed workers do not engage in home production.

<sup>6</sup>For ease of presentation, I will only refer to search efforts in the continuation.

<sup>7</sup>In their joint analysis of unemployment insurance and workfare (a special type of active labor market policy), Fredriksson and Holmlund (2006) as well as Andersen and Svarer (2014) also assume that workfare reduce the time available for home production (or leisure).

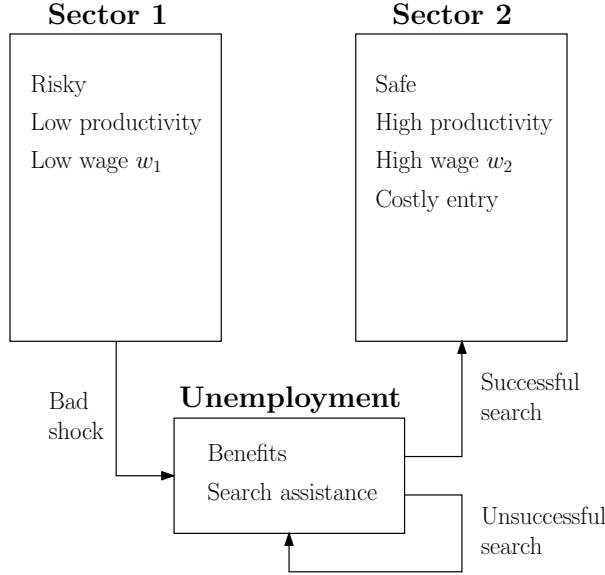


Figure 1: Labor market and reallocation flows

reducing the retraining and search effort to  $\phi(m) \zeta(e)$ , with  $\phi(m) \in [0, 1]$ ,  $\phi(0) = 1$ ,  $\phi' < 0 < \phi''$ : the larger the amount of job search assistance and retraining courses, the more likely to find a job; however, activation programmes become increasingly less efficient.

**Households** Households are heterogenous in their learning capacity. Education is costly but gives access to the safe, productive and high paying sector 2, consistent with the empirical assortative matching literature (see for instance, Haltiwanger, Lane and Spletzer, 1999). By design, non educated workers are exposed to unemployment risk while educated workers are not, consistent with empirical evidence (Nickell, 1979).

Endogenous education decisions are made as in Heathcote, Storesletten and Violante (2010). Households are arranged by their innate learning ability  $n \in [0, 1]$ , uniformly distributed. Education is a costly process requiring efforts, in small amount for high ability households and in large amounts for low ability ones. The effort cost  $i(n)$  function captures the utility cost of becoming educated, assumed to be continuous and increasing  $i' > 0$ , with  $i(0) = 0$  and  $i(n) \rightarrow \infty$  for  $n \rightarrow 1$ . Low  $n$  indicates low effort cost and high ability. At low ability, efforts cost become very large, reflecting the need of a minimum intellectual capacity for higher education.

The decision to educate or not, equivalently to join sector 2 or sector 1, depends on learning ability, the utility value derived from income in each sector and unemployment risk.

Households are risk averse and, in a static environment, consume their income. With a concave increasing utility function  $u$ , labor income tax  $t_l$ , the utility after joining sector 2 is

$$V_2 = u((1 - t_l) w_2). \quad (4)$$

Given unemployment risk, utility from joining sector 1 is expressed in expected

terms:

$$\begin{aligned} V_1 &= (1-s) \cdot u((1-t_l)w_1) + s \cdot u^e, \\ u^e &= \max_e e \cdot u((1-t_l)w_2) + (1-e) \cdot u(\psi(m)h+b) - \phi(m)\zeta(e). \end{aligned} \quad (5)$$

With probability  $1-s$ , a worker joining sector 1 is hired by a firm having a large survival chance (drawing a large relative productivity shock), in which case the worker keeps its job, earn wages  $w_1$  and pay taxes at rate  $t_l$ . With probability  $s$ , the worker is hired by a firm with low productivity and subsequently closing down. In this case, the worker is fired and enjoys expected utility  $u^e$ . As seen previously and for a given amount of active labor market programmes  $m$ , fired workers spend efforts  $e$  at net utility cost  $\phi(m)\zeta(e)$  to retrain and find a job in sector 2. By the law of large number and via renormalization,  $e$  also represents the probability of finding a job. If unsuccessful, fired workers remain unemployed, consuming welfare benefits  $b$  and home production  $\psi(m)h$ , net of activation measures<sup>8</sup>.

The endogenous allocation of workers to sector takes place as follows. Individuals born with high learning ability (low  $n$ ) will spent (low) efforts  $i(n)$  to educate and join the safe and high paying sector 2. Individuals with low ability find education efforts too large, will not educate and join the risky and low paying sector 1. In between, there is a household with ability  $N$  who is indifferent between the two sectors,

$$V_1 = V_2 - i(N). \quad (6)$$

Households with ability  $n \leq N$  will educate and join sector 2. Those with ability  $n > N$  will not educate and join sector 1. With a population size normalized to one and recalling that ability  $n$  is uniformly distributed,  $N$  also measures the entry rate into the costly<sup>9</sup> but safe and high paying sector 2.

**Aggregates** Taking separation and reallocation flows into account, households can end up in one of three states: employed in sector 1, employed in sector 2 or unemployed. The respective size of each group is given by

$$L_1 = (1-s)(1-N) \quad L_2 = N + es(1-N) \quad \delta = (1-e)s(1-N), \quad (7)$$

with  $\delta$  the unemployment rate. Since each firm hires exactly one worker, the final number of firms in each sector is given by  $L_1$  and  $L_2$ . Given the Ricardian production technology, inelastic labor supply and sector 1 average productivity  $x^a$ , the total production in each sector and gross domestic product are respectively

$$X_1 = (1-s)x^a(1-N) \quad X_2 = w_2L_2 \quad X = X_1 + X_2 \quad (8)$$

<sup>8</sup>I assume that the level  $b$  of unemployment benefits is non-degenerate, in the sense that being hit by the unemployment shock is worse than not being hit by the shock,  $u((1-t_l)w_1) > u^e$ . An alternative assumption to prevent spontaneous quits from sector 1 workers is that the search effort costs  $\zeta$  are large and active labor market programmes  $\phi$  quickly inefficient.

<sup>9</sup>Note that entry costs into sector 2 can include other costs than education. For instance, they can represent foregone consumption opportunities in a static model (or liquidity constraints in a dynamic model) or restrictions to higher education (such as numerus clausus). For ease of presentation, I continue the presentation with education costs only, but may refer to entry costs in general.

**Government** To each unemployed worker, the government provides unemployment insurance benefits  $b$  and active labor market programmes in quantity  $m$  at unit cost  $k$ . The government also has own consumption  $C$ . It finances expenditures with labor income taxes at rate  $t_l$  and firing taxes  $t_s$ . Ruling out government debt by imposing balance in the budget, the net fiscal balance satisfies

$$T = t_l w_2 L_2 + t_l w_1 L_1 + t_s s (1 - N) - [\delta b + m k s (1 - N) + C] = 0 \quad (9)$$

### 3 Theoretical analysis

I start by characterizing firms and households behavior and continue with properties of optimal policy. I finish with the main theoretical result, an identification of flexicurity as optimal, or non-optimal, policy.

To obtain compact formulas, I use the notation  $u_1 \equiv u((1 - t_l) w_1)$ ,  $u_h \equiv u(\psi(m)h + b)$  as well as  $u_2 \equiv u((1 - t_l) w_2)$ . The index refers to the final state of the worker, employed in sector 1, engaged in home production while unemployed or employed in sector 2. Further notations will be presented in due time.

#### 3.1 Behavior

**Firms behavior** The only uncertainty lies in sector 1: low productivity firms are threatened by competition and may decide to fire their workers and close down if their relative productivity level is too low. High productivity firms, in sector 2, face no uncertainty. The only decision by firms is firing, in sector 1.

Under free entry expected profit  $\pi$  is driven to zero, defining the firing behavior and pinning down the equilibrium wage  $w_1$ . Using (1) and (2), the sensitivity of profit to firing and the cut-off productivity  $x_1$  are given by  $d\pi/dx_1 = -(x_1 - w_1 + t_s)g(x_1)$ . By the envelope theorem,  $d\pi/dw_1 = -(1 - s)$  and  $d\pi/dt_s = -s$ . Combining and using the chain rule, the policy sensitivity of the equilibrium wage  $w_1$  and the separation rate  $s$ , characterizing firing decisions, are given by

$$\frac{dw_1}{dt_s} = -\frac{s}{1 - s}, \quad \frac{ds}{dt_s} = -\sigma s, \quad \sigma \equiv \frac{g(x_1)}{(1 - s)s}. \quad (10)$$

As expected, a larger firing tax  $t_s$  reduces the separate rate. Because more unproductive jobs are kept alive with a larger tax, the average productivity in sector 1 is lower. Free entry and zero expected profits then requires a lower equilibrium wage.

**Household behavior** In our static and inelastic labor supply framework, households take only two decisions: education and, if unemployed, search efforts. I characterize search efforts decisions first.

If unemployed, workers choose search efforts to maximize the likelihood of finding a job in the safe sector, taking into account the effort cost of searching, the support  $m$  from active labor market programmes and the value of unemployment benefits  $b$ . Formally, they choose effort  $e$  to maximize expected utility  $u^e$ , defined in (5). Differentiating and equating to zero, job search efforts satisfy

$$\phi(m) \zeta'(e) = u((1 - t_l) w_2) - u(\psi(m)h + b) \quad (11)$$

Total differentiation then characterizes search response to policy changes,

$$de = -\varepsilon_w w_2 e \cdot dt_l - \varepsilon_b (1 - e) \cdot db + \varepsilon_m \cdot dm, \quad (12)$$

where

$$\varepsilon_w \equiv \frac{u'_2}{e\phi\zeta''} > 0, \quad \varepsilon_b \equiv \frac{u'_h}{(1 - e)\phi\zeta''} > 0, \quad \varepsilon_m \equiv -\frac{\phi'\zeta' + u'_h\psi'h}{\phi\zeta''} > 0.$$

Elasticity parameters  $\varepsilon_i$  capture the strength of the search response to policy changes. For instance, when unemployment benefits  $b$  are small and increased, by concavity of the utility function  $u$ , the elasticity  $\varepsilon_b$  is large and the search response  $e$  drops much.

I continue with education decisions, characterized by the fraction  $N$  of households who choose to become educated.

The fraction  $N$  is defined by  $i(N) = V_2 - V_1$ , as per (6). Total differentiation of (5) provides the variation of expected utility  $V_1$  with policy changes,

$$\begin{aligned} du^e &= -u'_2 w_2 e dt_l + u'_h (1 - e) db + [(1 - e) u'_h \psi' h - \phi' \zeta] dm, \\ dV_1 &= u'_h (1 - e) s db - u'_2 w_2 e s dt_l + [(1 - e) u'_h \psi' h - \phi' \zeta] sdm \\ &\quad - u'_1 w_1 (1 - s) dt_l - (1 - t_l - \nabla \sigma) u'_1 s dt_s, \end{aligned}$$

with the notational shortcut  $\nabla \equiv (u_1 - u^e)/u'_1$ , positive by assumption on labor market policy. An increase in unemployment benefits  $db > 0$  increases the expected utility  $u^e$  of unemployed workers and thus the ex-ante utility  $V_1$  of workers who choose the risky sector 1. Active labor market programmes have ambiguous effects: more activation measures  $dm > 0$  increases ex-ante utility  $V_1$  as long as the job search assistance component  $-\phi'\zeta > 0$  dominates the reduction of home production benefits component  $(1 - e) u'_h \psi' h < 0$ . Employment protection also has ambiguous effects. A higher firing tax  $dt_s > 0$  reduces firing by  $ds = -\sigma s dt_s$ , thus increasing expected utility by  $(u_1 - u^e)(-ds) = \nabla u'_1(-ds)$ . It also reduces the wage rate by  $dw_1 = -\frac{s}{1-s} dt_s$ . As this event takes place with ex-ante probability  $1 - s$ , expected utility is reduced by  $(1 - s) u'_1 (1 - t_l) dw_1$ .

Total differentiation of  $i(N) = V_2 - V_1$  leads to the following response equation for education decisions,

$$\begin{aligned} dN &= \eta_1 w_1 (1 - s) (1 - N) dt_l - \eta_2 w_2 (1 - es) dt_l \\ &\quad - \eta_h (1 - e) s (1 - N) db + \eta_s s (1 - N) dt_s - \eta_m s (1 - N) dm, \end{aligned} \quad (13)$$

where

$$\begin{aligned} \eta_1 &\equiv \frac{u'_1}{(1 - N) i'} > 0, \quad \eta_2 \equiv \frac{u'_2}{i'} > 0, \quad \eta_h \equiv \frac{u'_h}{(1 - N) i'} > 0 \\ \eta_s &\equiv (1 - t_l - \nabla \sigma) \eta_1, \quad \eta_m \equiv \frac{(1 - e) u'_h \psi' h - \phi' \zeta}{(1 - N) i'}. \end{aligned}$$

Higher unemployment benefits  $db > 0$  reduce the loss due to sector 1 separation so decreases education efforts. The signs of  $\eta_s$  and  $\eta_m$  may be positive or negative: additional employment protection  $t_s$  and active labor market programmes  $m$  have

ambiguous effects, mirroring the  $dV_1$  variations discussed above. In particular, education efforts are increased with activation programmes ( $\eta_m < 0$ ) if and only if the home production benefit reduction effect ( $(1 - e) u'_h \psi' h < 0$ ) dominates the assistance effect ( $-\phi' \zeta > 0$ ) for workers losing their sector 1 jobs.

**Fiscal impacts** Labor markets and the fiscal balance (9) are impacted by education decisions  $dN$ , firing (separation) decisions  $ds$  and job search decisions  $de$ . Effective tax rates  $\tau^N$ ,  $\tau^S$  and  $\tau^E$  for each margin capture the influence of behavior on net tax revenue,

$$\begin{aligned} dT = & (N + es(1 - N)) w_2 dt_l + (1 - s)(1 - N) \cdot w_1 dt_l + (1 - t_l) s(1 - N) \cdot dt_s \\ & - (1 - e) s(1 - N) \cdot db - ks(1 - N) \cdot dm \\ & + \tau^N \cdot dN + \tau^S \cdot (1 - N) ds + \tau^E \cdot s(1 - N) de, \end{aligned}$$

where

$$\tau^E \equiv t_l w_2 + b, \quad \tau^S \equiv t_s + [et_l w_2 - (1 - e)b] - km - t_l w_1, \quad \tau^N \equiv t_l w_2 - t_l w_1 - s\tau^S.$$

$\tau^E$  represents the effective tax rate on labor market participation,  $\tau^S$  the effective tax rate on firing and  $\tau^N$  the effective tax rate on sector 2 entry. For every unemployed person who finds a new job, there is a fiscal gain  $\tau^E$ , summing up extra revenue  $t_l w_2$  and spared unemployment benefits  $b$ . The fiscal impact of job separation  $\tau^S$  sums up the firing tax  $t_s$  paid by firms and the average tax revenue gain from separation  $et_l w_2 - t_l w_1$  minus the unemployment insurance spending  $(1 - e)b$  and active labor market policy spending  $km$ . Net tax revenue rises by  $\tau^N$  for each additional person who educates, adding the differences in workers' tax bills  $t_l w_2 - t_l w_1$  across sectors and removing the average tax revenue  $\tau^S$  from firing, which occurs with probability  $s$ .

Using these effective tax rates and substituting (10), (12) and (13) yields a change in *net* fiscal revenue equal to

$$\begin{aligned} dT = & (L_2 - \tau^N \eta_2 (1 - es) - \tau^E \varepsilon_w s (1 - N) e) w_2 dt_l \\ & + (1 + \tau^N \eta_1) w_1 (1 - s) (1 - N) dt_l \\ & - (1 + \tau^N \eta_h + \tau^E \varepsilon_b) (1 - e) s (1 - N) db \\ & + (1 - t_l - \tau^S \sigma + \tau^N \eta_s) s (1 - N) dt_s \\ & - (k + \tau^N \eta_m - \tau^E \varepsilon_m) s (1 - N) dm. \end{aligned} \tag{14}$$

The expression decomposes the effect of public policy and behavioral responses on fiscal revenue. To illustrate, additional active labor market programmes  $dm$  increases direct expenditures by  $k \cdot s(1 - N) dm$ . Net fiscal revenue is further impacted by education responses, as per (13). There are  $\eta_m s(1 - N) dm$  less households choosing to educate into sector 2, each one reducing by  $\tau^N$  their tax contribution. On the other hand, the policy supports job finding at rate  $\varepsilon_m s(1 - N) dm$ , as per (12). Each person who stops claiming benefits and pays taxes adds  $\tau^E$  to government revenue. The net fiscal cost of active labor market programmes thus sums up to  $(k + \tau^N \eta_m - \tau^E \varepsilon_m) s(1 - N) dm$ .

### 3.2 Welfare maximization

This section derives some properties of welfare maximizing policy.

Throughout the paper, I use a utilitarian welfare criteria. Because of free entry, firms make no profit so the social welfare function restricts to welfare  $V_i$  of entrants in sector  $i$  and the cost of entry in sector 2:

$$V = (1 - N) \cdot V_1 + N \cdot V_2 - \int_0^N i(n) dn. \quad (15)$$

Due to occupational choice (6), a variation of entry  $N$  yields  $dV/dN = -V_1 + V_2 - i(N) = 0$  so welfare variations are  $dV = (1 - N) dV_1 + N dV_2$ . Substituting expressions from section 3.1,

$$\begin{aligned} dV = & -u'_1 w_1 (1 - s) (1 - N) dt_l - u'_2 w_2 L_2 dt_l \\ & + u'_h (1 - e) s (1 - N) db + [(1 - e) u'_h \psi' h - \phi' \zeta] s (1 - N) dm \\ & - (1 - t_l - \nabla \sigma) u'_1 s (1 - N) dt_s. \end{aligned} \quad (16)$$

The following technical characterization helps analyze optimal policy:

**Lemma 1. (*optimality conditions*):** *the policy which maximizes utilitarian welfare (15) and satisfies the government budget constraint (9) verifies:*

$$\begin{aligned} dV/db &= [u'_h - (1 + \tau^N \eta_h + \tau^E \varepsilon_b) \lambda] (1 - e) s (1 - N) = 0, \\ dV/dt_s &= -[(1 - t_l - \nabla \sigma) u'_1 - (1 - t_l - \tau^S \sigma + \tau^N \eta_s) \lambda] s (1 - N) = 0, \\ dV/dm &= [(1 - e) u'_h \psi' h - \phi' \zeta - (k + \tau^N \eta_m - \tau^E \varepsilon_m) \lambda] s (1 - N) = 0, \end{aligned}$$

where  $\lambda$  is the Lagrange multiplier related to the fiscal constraint.

*Proof:* see appendix A.

Several properties of optimal policy can be derived from lemma 1, including moral hazard limitations. These are compiled in the following result:

**Proposition 1. (*optimal policy characteristics*):** *the social welfare maximizing policies have the following properties:*

(a) *an economy without government and social security policy is not optimal, as unemployment insurance financed with labor taxes increases welfare:*

$$\frac{dV}{db} > 0 \quad \text{when} \quad t_l = t_s = b = m = 0$$

(b) *unemployment insurance is limited:*

$$\frac{u'_1}{u'_h} = \frac{1}{1 + \tau^E \varepsilon_b} < 1 \quad u_1 > u_h$$

(c) *employment protection internalizes firing cost externalities:*

$$t_s = t_l w_1 + [(1 - e) b - t_l w_2 e] + km + \nabla$$

(d) active labor market policies depend on costs and search behavior:

$$\frac{du^e/dm}{du_1/dc_1} = \frac{(1-e)u'_h\psi'h - \phi'\zeta}{u'_1} = k - \tau^E\varepsilon_m$$

*Proof*: in part (a), small unemployment benefits  $db > 0$  are financed with taxes  $dt > 0$  to satisfy the budget constraint  $dT = 0$ . Using (14) and (16) at  $t = b = 0$  yields  $dV/dt > 0$  and thus  $dV/db > 0$ . Parts (b) to (d) are derived from first order conditions in lemma 1. Details are contained in appendix A. QED.

I discuss each part of the proposition in turn.

Start from an economy without government and social security policy ( $t_l = t_s = b = m = 0$ ). Part (a) of the proposition shows that a moderate introduction of unemployment insurance ( $db > 0$ ) financed with a labor income tax ( $dt > 0$ ) to keep the public budget balanced ( $dT = 0$ ) is welfare improving. An economy without social security policy is thus not optimal. The result is intuitive: public insurance discourages job search efforts  $e$  and increases unemployment  $\delta$ ; however, since tax distortions on search behavior are initially small, the gains from insurance dominate, raising aggregate welfare  $V$ .

Part (b) of the proposition illustrates the moral hazard cost of unemployment insurance. The less elastic job search efforts are (the closer to zero the  $\varepsilon$ -elasticities), the smaller the moral hazard cost, the closer insurance is to full consumption smoothing ( $u_1 = u_h$ ) between workers in the good state (sector 1 workers not hit by the unemployment shock) and the bad state (sector 1 workers hit by the shock). Low public finance costs of insurance (low tax revenue losses and unemployment benefits,  $\tau^E = t_l w_2 + b$ ) also push towards full consumption smoothing.

Part (c) of the proposition shows that using a firing tax as employment protection is optimal, as it internalizes negative firing externalities. It plays the same role as in Blanchard and Tirole (2008). Firms who fire a worker create a fiscal externality, as there is one person less paying taxes  $t_l w_1$ , one person more who collects an average net benefit  $(1-e)b - t_l w_2 e$  and extra spending  $km$  on active labor market policies. Firing also creates a utility loss  $\nabla = (u_1 - u^e)/u'_1$ , expressed in income equivalent terms. All these externalities justify the use of a firing tax.

Note that part (b) and part (c) generalize the optimality results<sup>10</sup> from Blanchard and Tirole (2008) to the case of moral hazard. Indeed, in the special case of a single sector 1 ( $N = 0$ ), no moral hazard ( $\varepsilon_b = 0$ ) nor reallocation ( $e = 0$ ) and no active labor market policies ( $m = 0$ ), full insurance is optimal ( $h + b = (1 - t_l)w_1$ ) and it is financed by firing taxes only ( $t_l = 0$ ).

Finally, part (d) of the proposition shows that active labor market optimal policy also depends on other policies. The leftmost part of the optimality conditions represents the marginal welfare benefit of the policy  $m$ , measuring expected welfare utility gains of a fired worker relative to a retained worker. The optimality condition equates the marginal welfare benefit of the policy, on the left, with its marginal cost, on the right. Larger unemployment benefits  $b$  increase the participation tax  $\tau^E = t_l w_2 + b$  and thus decrease the net marginal cost of active labor market policy: every persons put back to work thanks to spending  $m$  saves costs  $b$  and brings revenue

<sup>10</sup>Specifically, propositions 1 and 2 from Blanchard and Tirole (2008).

$t_1 w_2$ . The larger the unemployment insurance benefits, the more attractive active labor market programmes, typical of flexicurity arrangements. This can explain why flexicurity measures were first introduced by Northern European countries in the 1990's, who started with high unemployment benefits levels and subsequently introduced large-scale activation measures. In the next subsection, I will perform a formal analysis of the complementarity of all the policy instruments which are part of flexicurity.

### 3.3 Flexicurity as optimal policy

This section contains the main analytical result. I show that flexicurity is the optimal policy combination under certain circumstances, providing criterias which separate cases where flexicurity is optimal from cases where it is not.

Flexicurity is a combination which exploits policy complementarity. In its most general policy discussion sense and its etymological basis, flexicurity compensates workers for the loss generated by low employment protection (flexibility) with generous insurance and assistance programmes (security): security is provided in *exchange* for flexibility.

I therefore analyze complementarity of the three instruments of flexicurity in welfare maximization. Flexicurity corresponds to the case of job protection and unemployment insurance being substitutes; job protection and activation measures being substitutes; while unemployment insurance and activation measures are complement.

I provide three preliminary results to characterize policy complementarities, discuss each of them and conclude with a general result<sup>11</sup>.

**Unemployment insurance and active labor market programmes** Complementarity of unemployment benefits  $b$  and activation measures  $m$  is characterized by the following result.

**Lemma 2.** *at the optimum, the*

$$\text{sign} \left( \frac{d}{dm} \frac{d}{db} V \right)$$

*is equal to the sign of*

$$u_h'' \psi' h \left\{ 1 - \frac{\lambda \tau^E}{(1-e)\phi \zeta''} \right\} + \frac{\lambda \varepsilon_b \tau^E}{(1-e)\phi} \left\{ \frac{1}{\zeta_1} \phi' + \frac{1}{\zeta'} \left( \frac{1}{\zeta_1} - (1-e) \right) u_h' \psi' h \right\} + \lambda \eta_h \left\{ s (\varepsilon_m \tau^E - k) - \tau^N \frac{u_h'' \psi' h}{u_h'} \right\}$$

*Proof:* at the optimum and using lemma 1,  $\frac{d}{db} V = [u_h' - (1 + \tau^N \eta_h + \tau^E \varepsilon_b) \lambda] (1-e) s (1-N) = 0$ , so  $\frac{d}{dm} \frac{d}{db} V = (1-e) s (1-N) \frac{d}{dm} [u_h' - (1 + \tau^N \eta_h + \tau^E \varepsilon_b) \lambda]$ . The sign of  $\frac{d}{dm} \frac{d}{db} V$  is thus equal to the sign of  $\frac{d}{dm} [u_h' - (1 + \tau^N \eta_h + \tau^E \varepsilon_b) \lambda]$ ,

<sup>11</sup>For ease of presentation, I provide the results with specifications for certain reduced-forms, namely  $\zeta(e) = \zeta_0 + (\zeta_2 - \zeta_0) e^{-\zeta_1(1-e)}$  and  $i(n) = i_0 - i_1 \cdot \ln(1-n)$ . Results with general specifications and different labor income tax rates in the two sectors are contained in appendix B.

which, after differentiation and substitutions, equals the expression given in the lemma. QED.

The following two observations discuss cases where unemployment insurance and active labor market programmes are complements and when they are substitutes. Two further cases are discussed in appendix C.

First, when entry is exogenous ( $dN = \eta_h = 0$ ) and the difficulty of finding a job increases rapidly ( $\zeta_1$  and thus  $\zeta'$  and  $\zeta''$  are large), unemployment insurance and active labor market programmes are complements<sup>12</sup>,  $\frac{d}{dm} \frac{d}{db} V > 0$ . The intuition for this result is the following. There is a point where the transition from the bad state (being unemployed) to the good state (finding a job in sector 2) becomes very difficult without further assistance. As activation measures also reduce home production benefit ( $\psi' < 0$ ), welfare in the bad state can only be maintained when unemployment benefits follow assistance.

Second, consider the case of endogenous entry ( $\eta_h > 0$ ) with large response to policy variations ( $\eta_h$  is large) and net tax revenue depending little on education decisions ( $\tau^N$  is small). Then, if activation measures are cost-effective ( $k$  small) or unemployment benefits large ( $\varepsilon_m \tau^E - k > 0$ , given  $\tau^E = t_l w_2 + b$ ), activation measures and unemployment insurance are complements<sup>13</sup>,  $\frac{d}{dm} \frac{d}{db} V > 0$ . If activation measures are not cost-effective and benefits are small ( $\varepsilon_m \tau^E - k < 0$ ) on the other hand, they are substitutes,  $\frac{d}{dm} \frac{d}{db} V < 0$ . The intuition is the following. If unemployment benefits and the entry response are large, many households avoid the costly entry into the safe sector 2: choosing the easy-access but risky sector 1 is attractive, as generous benefits are provided in case of unemployment. The quantity  $\varepsilon_m \tau^E - k$  represents the marginal gain of one more unit of activation measures, taking tax gains of re-employment into account. When this marginal gain is positive, strong activation measures complements large benefits: putting more people back to work with large assistance helps reduce the aggregate costs of high unemployment benefits.

**Unemployment insurance and employment protection** Complementarity of optimal unemployment benefits  $b$  and firing taxes  $t_s$  is characterized by:

**Lemma 3.** *at the optimum,*

$$\text{sign} \left( \frac{d}{dt_s} \frac{d}{db} V \right) = \text{sign} (\eta_s)$$

*Proof:* Similar to the proof of lemma 2,  $\frac{d}{dt_s} \frac{d}{db} V$  has the sign of  $(1 - e) s (1 - N) \frac{d}{dt_s} [u'_h - \lambda \tau^N \eta_h - \lambda \tau^E \varepsilon_b]$ . In the first order condition  $\frac{d}{db} V = u'_h - (1 + \tau^N \eta_h + \tau^E \varepsilon_b) \lambda = 0$  in lemma 1,  $u'_h$  represents the marginal gain of one extra unit of unemployment insurance and  $-(1 + \tau^N \eta_h + \tau^E \varepsilon_b)$  its marginal public finance cost. As the former is positive and the latter negative,  $\lambda > 0$ . Since  $\frac{d}{dt_s} u'_h = \frac{d}{dt_s} \tau^E = \frac{d}{dt_s} \varepsilon_b = 0$ , the sign of  $\frac{d}{dt_s} \frac{d}{db} V$  equals the sign of  $\frac{d}{dt_s} [-\tau^N \eta_h]$ , a derivative which, after algebraic manipulation, is shown to equal  $\eta_h s (1 - t - \sigma \tau^S)$ . From the first

<sup>12</sup>Indeed, in this case, the sign of  $\frac{d}{dm} \frac{d}{db} V$  is equal to the sign of  $u''_h \psi' h$ , positive.

<sup>13</sup>In this case, the sign of  $\frac{d}{dm} \frac{d}{db} V$  is equal to the sign of  $\lambda \eta_h s (\varepsilon_m \tau^E - k)$ , positive.

and second conditions from lemma 1 follows that  $1 - t - \tau^S \sigma$  and  $1 - t - \nabla \sigma$  have the same sign. Then  $\eta_s = (1 - t - \nabla \sigma) \eta_1$  and  $\eta_1 > 0$  imply that  $\eta_h s (1 - t - \sigma \tau^S)$  has the same sign as  $\eta_h s \eta_s$ . Noting that  $\eta_h > 0$  concludes. QED.

I discuss complementarity of insurance and protection in two noteworthy cases.

First, when entry is exogenous ( $dN = \eta_s = 0$ ), optimal unemployment insurance and optimal employment protection are independent,  $\frac{d}{dt_s} \frac{d}{db} V = 0$ . The sequencing of events provides the intuition in this case. Households only choose search efforts, which take place after firing. Whether employment protection is high or low, whether the flow into unemployment is low or large, public insurance impacts search efforts of *each* unemployed the same way. Protection regulates the flow into the bad state (unemployment) and insurance the flow out of the bad state (into re-employment), independently. In contrast, when entry is endogenous, the household choice of sector is jointly impacted by the likelihood of entering the bad state if sector 1 is chosen (regulated by employment protection) and by the comfort in this state (impacted by unemployment insurance).

Second, when entry is endogenous ( $\eta_s \neq 0$ ), unemployment insurance and employment protection are substitutes,  $\frac{d}{dt_s} \frac{d}{db} V < 0$ , if entry in the safe sector increases with lower protection ( $\eta_s < 0$ ), and vice-versa. I discuss the case where entry into the safe sector increases with lower protection in the risky sector ( $\eta_s < 0$ ), more intuitive. The idea is to reduce employment protection to attract more people into the costly but safe and productive sector, (partially) curbing inflows into unemployment and allowing higher welfare (through unemployment insurance) for workers remaining in the bad state. Low protection invites increased self-insurance against the unemployment risk through education and reduces the moral hazard cost of high public insurance: a marginal decrease of employment protection allows for a marginal increase of unemployment benefits, as more households join the safe sector<sup>14</sup>.

**Active labor market programmes and employment protection** Complementarity of activation measures  $m$  and firing taxes  $t_s$  is characterized by:

**Lemma 4.** *at the optimum,*

$$\text{sign} \left( \frac{d}{dt_s} \frac{d}{dm} V \right) = \text{sign} (\eta_m \eta_s)$$

*Proof:* following the same steps as in the proof of lemma 3, one has that  $\frac{d}{dt_s} \frac{d}{dm} V$  has the sign of  $\eta_m s (1 - t_l - \sigma \tau^S)$ . Noting that  $1 - t - \tau^S \sigma$  and  $1 - t - \nabla \sigma$  have the same sign, that  $\eta_s = (1 - t - \nabla \sigma) \eta_1$ , that  $\eta_1 > 0$  but that  $\eta_m$  and  $\eta_s$  can be positive or negative concludes. QED.

Two cases are discussed. First, when entry is exogenous ( $dN = \eta_m = \eta_s = 0$ ), optimal employment protection and activation measures are independent  $\frac{d}{dt_s} \frac{d}{dm} V =$

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<sup>14</sup>Education as self-insurance against the unemployment risk illustrates a less visible channel of employment protection. Often, the literature focuses on job creation and separation effects. In this paper, the self-insurance and separation channels apply, not the job creation one.

0. The intuition is the same as for lemma 3, activation measures impacting household decisions during the same phases as unemployment insurance.

Second, consider the case of endogenous entry where entry in the costly but safe sector increases with low employment protection in the easy-access but risky sector ( $\eta_s < 0$  and  $\eta_m \neq 0$ ). Then optimal employment protection and activation measures are substitutes,  $\frac{d}{dt_s} \frac{d}{dm} V < 0$ , if entry in the safe sector decreases with lower activation ( $\eta_m > 0$ ), and vice-versa. The intuition is similar to the endogenous entry case in lemma 3, with a variation. When the assistance part of activation measures dominates ( $\phi' < 0$  large in absolute value, so  $\eta_m > 0$ ), these measures generate a similar moral hazard effect as unemployment insurance. Low employment protection encourages higher entry into the costly but safe sector as self-insurance against unemployment risk, reducing the moral hazard cost of activation measures and allowing to provide more assistance. When the sanction part of activation measures dominates ( $\psi' < 0$  large in absolute value, so  $\eta_m < 0$ ), they have the opposite incentive effects as unemployment insurance. Increase of self-insurance with low protection allows to reduce the discomfort of activation measures, which are reduced.

**All three instruments** As a corollary<sup>15</sup> of lemmas 2, 3 and 4, one obtains the following characterization of optimal policy:

**Proposition 2. (*flexicurity as optimal policy*):** *when the costly entry into the safe sector 2 is negatively related to employment protection ( $\eta_s < 0$ ), is negatively related to active labor market policies ( $-\eta_m < 0$ ), active labor market programmes are cost-effective ( $k$  is small), net tax revenue is little affected by education choices ( $\tau^N$  is small) and when the difficulty of finding a job increases rapidly ( $\zeta_1$  is large), the welfare maximizing labor market policy is flexicurity, with large unemployment benefits  $b$ , large active labor market programmes  $m$  and small firing taxes  $t_s$ :*

$$\frac{d}{dm} \frac{d}{db} V > 0 \qquad \frac{d}{dt_s} \frac{d}{db} V < 0 \qquad \frac{d}{dt_s} \frac{d}{dm} V < 0$$

I conclude with four observations. First, conditions in proposition 2 are sufficient but not necessary. There can be other cases where the optimal policy is flexicurity<sup>16</sup>. Discussions of lemmas 2, 3 and 4 provide other such cases.

Second, conditions of proposition 2 are likely to be satisfied for several large European welfare states, but not all. The condition  $\eta_s < 0$  is intuitive, as high employment protection increases the attractiveness of the risky sector. The condition  $\eta_m > 0$  is satisfied if the assistance part of activation measures dominates the sanction part, typical in Europe. Those countries which are able to design low

<sup>15</sup>I take for granted that the combination of high unemployment insurance, large activation measures and low employment protection is the optimal policy, not the combination of low insurance, low activation measures and high protection, which also satisfies the cross-derivative optimality conditions in lemmas 2, 3 and 4. Support is provided by results in section 3.2, showing that the introduction of unemployment insurance increases welfare.

<sup>16</sup>Specifically, proposition 2 only assembles the first and second cases discussed after lemma 2, the second case after lemma 3 and the second case after lemma 4.

cost activation measures ( $k$  small), maintain tax revenue regardless of the education composition of the population ( $\tau^N$  small) and where large persistent unemployment problems indicate rapidly increasing difficulties in finding jobs ( $\zeta_1$  large) fulfill the conditions to benefit from flexicurity policies. Other countries may not.

Third, endogenous entry is key for the result, as the discussion of the self-insurance channel through education in lemmas 3 and 4 makes clear: low protection of jobs in the risky sector invites for more self-insurance against the unemployment risk through costly education, giving access to the safe sector and mitigating the moral hazard cost of public insurance. These results are consistent and complement Andersen and Svarer (2014), where activation measures (workfare) reduce the moral hazard impact of insurance. With exogenous entry, optimal employment protection is independent of both optimal insurance and optimal activation measures, which is far from the idea of policy complementarity at the heart of flexicurity.

Fourth, there is a consistent relationship with the cross-country flexicurity analysis of Algan and Cahuc (2009). Entry decisions in my model are made under expectation of future economic outcomes, including labor income revenue and the likelihood of unemployment. In reality, education decisions are also made for other reasons, such as intellectual satisfaction. When education decisions are solely based on these other reasons, entry becomes exogenous in the model, in which case optimal policy does not exhibit the complementarities of flexicurity. Assume that cultural differences across countries influence education decisions, such that individuals in countries with high civic values feel more responsible for their own economic destiny and thus base more of their education choice on economic prospects than in other countries. Then, entry in high civic values countries is less likely to be exogenous and flexicurity more likely to be optimal. This outcome is consistent with Algan and Cahuc (2009), who find that countries with high civic attitudes are associated with higher unemployment benefits and lower employment protection.

## 4 Numerical illustration

Numerical examples provide an illustration of the theory. I show that flexicurity is the optimal labor market policy in one case and it is not in another case. Both cases use realistic parameter values, differentiated by the job search elasticity parameter.

Ljungqvist and Sargent (1998) argue that human capital losses through unemployment play a role in imperfect labor markets. To reflect their conclusion and deliver more realistic outcomes, I enrich the model. I separate prospects for sector 2 entrants and prospects for sector 1 entrants who were fired, retrained and found a job in sector 2. As the latter suffered from a human capital loss, they are less productive and earn a lower wage,  $w_r < w_2$ . I also assume that sunk investments costs are paid when a firm is created. All theoretical results carry through.

Calibration relies on direct observations or empirical studies. The only exceptions are parameter values for the active labor market policy functions  $\psi$  and  $\phi$ . Sensitivity analysis using different values however lead to the same results, with greater or smaller contrasts. Sensitivity analysis on other parameters also lead to

the same outcomes<sup>17</sup>, with the exception of active labor market policy unitary costs  $k$ : when those costs are large, no active labor market programmes are ever provided. Because such an outcome is unrealistic, I focus on lower costs, using a discipline detailed in appendix D.

To allow comparisons with theoretical results, I use the functional forms for  $\zeta(e)$  and  $i(n)$  from section 3.3. I rely on empirical studies to set the job search elasticity parameter: the key parameter  $\zeta_1$  (see proposition 2) is inversely proportional to the elasticity of re-employment probability with respect to unemployment benefits  $\varepsilon$ . As per the Krueger and Meyer (2002) survey and normalizing,  $\varepsilon$  values between 0.4 and 2 are plausible. The lower value corresponds to empirical studies which take policy endogeneity into account, such as Card and Levine (2000), more appropriate in our general equilibrium setting. I settle for a benchmark value  $\varepsilon = 0.6$  and consider higher values in alternative cases. Appendix D presents the details for the entire calibration.

		<i>Baseline</i>			<i>Low difficulty</i>		
		CONT	FIRE	OPT	CONT	FIRE	OPT
<i>Policy:</i>							
$t_l$	Labor tax	0.115	0.146	0.147	0.110	0.141	0.143
$b_r$	Net replacement rate UI	0.383	0.423	0.430	0.314	0.351	0.256
$t_s$	Firing tax EP	0.500	0.136	0.114	0.500	0.118	0.098
$m$	Programmes ALMP	-	-	1.343	-	-	0.968
<i>Economic impact:</i>							
$N$	Sector 2 entry rate	0.557	0.583	0.586	0.557	0.583	0.586
$s$	Separation rate	0.146	0.220	0.225	0.146	0.224	0.229
$e$	Reemployment rate	0.676	0.665	0.760	0.753	0.738	0.907
$\delta$	Unemployment rate	0.026	0.043	0.032	0.020	0.034	0.012
$\bar{w}$	Avg wage per worker	0.836	0.876	0.879	0.837	0.879	0.882
$X$	GDP, %)	0.000	0.120	1.342	0.000	0.436	2.726
$V$	Welfare, *)	0.000	3.542	4.380	0.000	3.747	4.544

Net replacement rate  $b_r = b/(1 - t_l)$ . %) relative change in percent. \*) Welfare relative change in percent of GDP,  $100 \cdot (V - V_0)/X_0$ . Taxes in all simulations are optimal.

(Baseline): baseline case, with job search elasticity  $\varepsilon = 0.6$  (yielding  $\zeta_1 = 15.9$ )

(Low difficulty): low job search difficulty increase, with elasticity  $\varepsilon = 1.0$  (yielding  $\zeta_1 = 9.5$ )

(CONT): as in typical continental Europe, exogenous high EP, optimal UI, no ALMP

(FIRE): optimal EP (free firing) and optimal UI, no ALMP

(OPT): optimal UI, EP and ALMP policies

Table 1: Comparative statics, various labor market policies

Table 1 presents the results in two main cases. The *baseline* case assumes an elasticity  $\varepsilon = 0.6$ , consistent with difficult job search (larger  $\zeta_1$ ). The *low difficulty*

<sup>17</sup>Sensitivity analysis was performed for risk aversion  $\rho$ , the wage structure  $w_1, w_r, w_2$ , the entry elasticity  $\eta$  (which delivers values for the parameters of the entry cost function  $i(n)$ ), home production  $h$ , dispersion in the productivity shocks  $z$  (which delivers values for the distribution  $g(x)$ ), active labor market assistance  $\phi$ , reduction in home production benefits  $\psi$  and unitary costs  $k$ .

case uses an elasticity  $\varepsilon = 1.0$ , consistent with easier job search (smaller  $\zeta_1$ ). In each case, I compare three labor market policy settings. In the *CONT* column, unemployment insurance is endogenously provided at an optimal level but there are no active labor market programmes and employment protection is fixed exogenously at a moderately high level, corresponding to a stylized continental European country. In the *FIRE* column, employment protection becomes endogenous and free to adjust. In the *OPT* column, active labor market policies are added, so that optimal levels of unemployment insurance, employment protection and activation measures are provided.

The main finding is that flexicurity is the optimal policy in the *baseline* case but it is not in the *low difficulty* case. While low employment protection and large amount of active labor market policies are optimal in both cases, unemployment benefits are maintained at a high level only in the first case. This outcome is consistent with proposition 2, which showed that flexicurity was more likely to be optimal when the difficulty of finding a job increases rapidly (large  $\zeta_1$ ). The intuition is the same as for lemma 2 and proposition 2: in short, when finding a job alone becomes rapidly difficult, job search assistance helps most, high insurance compensating for the drop in home production associated with activation measures.

Other findings relate to Schumpeterian creative destruction. In the absence of active labor market programmes, high employment protection reduces inflows into unemployment but at a welfare cost, under a utilitarian criteria. Although the number of unemployed is smaller, there are more low productivity jobs in sector 1, reducing the average productivity and output capacity of the economy. The average wage per worker jumps from 0.84 to 0.88 when employment protection is reduced, output increases 0.1% but unemployment increases about 1.7 percentage points (*FIRE* versus *CONT* cases).

In this context, activation measures are of particular interest, when cost effective. Supporting job reallocation and the re-employment rate, which climbs 8 percentage points or more, brings the unemployment rate back to low levels, increases aggregate production more than 1% and welfare<sup>18</sup> 4% (*OPT* versus *CONT* cases). The optimal labor market policy, thanks to low employment protection compensated by active labor market programmes, strikes a welfare improving balance between low unemployment and high aggregate productivity<sup>19</sup>.

Table 1 illustrates further theoretical results. Comparing employment protection and insurance policies in the *CONT* and *FIRE* cases show that there is a trade-off between the two policies, consistent with lemma 3. Comparing the level of employment protection and active labor market programmes in the *FIRE* and *OPT* cases exhibits a trade-off between the two policies, as in lemma 4. Although the effect is moderate, lower firing taxes encourages costly education to access the safe sector 2, illustrating the impact of employment protection on self-insurance via education, as discussed in lemmas 3 and 4.

<sup>18</sup>The welfare measure is defined as the percentage variation of GDP,  $100 \cdot (V - V_0)/X_0$ , to remove scale effects. I do not use a measure based on either equivalent or compensating variations because of the absence of a representative agent in the model.

<sup>19</sup>Sensitivity analysis shows that the balancing pattern is always present but the magnitude of the gains depends on parameters. Numerical values presented in the table should thus not be taken literally for policy design.

I finish with another connection to the cross-country analysis of Algan and Cahuc (2009). High  $\zeta_1$  (low  $\varepsilon$ ) can be interpreted as more adverse labor markets or as higher propensity for job search efforts. Assume that cultural differences across countries influence job search behavior, such that unemployed in high civic values countries search hard, whatever the level of unemployment benefits. In these countries, the job search elasticity  $\varepsilon$  is low (baseline case). Consistent with Algan and Cahuc (2009), numerical examples show that flexicurity is more beneficial in countries with high civic values than other countries.

## 5 Concluding remarks

The paper identifies conditions under which flexicurity is an optimal policy combination, which depend crucially on the education behavior of households. If education choices are unrelated to economic conditions, because intellectual satisfaction is the prime objective of education or for other reasons, the optimal level of employment protection is unrelated to the optimal level of unemployment insurance and active labor market programmes. In absence of complementarity, flexibility can not be exchanged for security, the heart of flexicurity. If however education choices depend on economic conditions, flexicurity can be optimal, as low employment protection provides incentives for costly self-insurance against unemployment risk through education, mitigating the moral hazard cost of unemployment insurance and activation programmes.

The analysis has shown that flexicurity is optimal in some cases, but not all. Other analysis related to flexicurity have also reached case-dependent conclusions. Algan and Cahuc (2009) show for instance that civic attitudes play a role, and Boeri, Conde-Ruiz and Galasso (2012), the share of educated households.

The first main general policy conclusion is that the design of labor market policies with employment protection, unemployment insurance and active labor market programmes should take education behavior and policy into account. Countries which consider that higher education financing is an individual responsibility may find flexicurity more attractive, as the incentive for self-insurance through education is larger. The second conclusion is that the difficulty of finding a job, whether coming from frictions or weak demand, plays a role. Flexicurity is of interest mainly when difficulty is established and search efforts high.

To maintain tractability and obtain analytical results despite the number of policy instruments, the model is kept simple: it is static, labor supply by employed workers is inelastic and reduced-form specifications are used. Overall, I believe that simplifications alone do not weaken the case for flexicurity.

Results should indeed hold in a dynamic framework. The self-insurance component of education, encouraged with low employment protection, is still there if households can self-insure against unemployment with savings, even if the education insurance component is smaller. Quantitative analysis by Heathcote, Storesletten and Violante (2010) actually find that self-insurance through education is larger than through savings.

Optimal flexicurity cases should also remain with elastic labor supply. Indeed,

labor income taxes would become more distortive and increase the attractiveness of firing taxes as a financing instrument. Although the wedge would be of different magnitude, a marginal decrease of employment protection will still allow for a marginal increase of unemployment benefits under self-insurance via education.

Finally, the numerical analysis has shown that outcomes are not sensitive to the parameters of the reduced form specifications, except the job finding probability (the job search effort cost function  $\zeta$ ): in the two cases considered, flexicurity is optimal if finding a job is hard, and vice-versa. Parameter values used in the two cases fall in the range of empirical estimates for job search elasticities, so both outcomes are realistic. Beyond parameter values, functional form choices for the job finding probability may impose extra discipline in the model which ignores part of the complexity of imperfect labor markets. As policy trade-offs remain the same however, using alternative specifications should not qualitatively alter conclusions.

Confirming these three predictions is left for future research.

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## A Appendix: additional proofs

Proofs provided in this appendix apply to the general case where labor income tax rates in the first and second sector can differ: the tax in the first sector is  $t_1$  and it is  $t_2$  in the second sector, replacing the unique tax rate  $t_l$ . The model and analysis are adjusted in an intuitive fashion<sup>20</sup>.

Extension of the technical lemma 1 and proofs are provided in continuation.

**Lemma 1 extension**<sup>21</sup>: under the conditions of lemma 1,

$$\begin{aligned} dV/dt_1 &= -[u'_1 - (1 + \tau^N \eta_1) \lambda] w_1 (1 - s) (1 - N) = 0, \\ dV/dt_2 &= -[u'_2 - \lambda (1 - \tau^N \eta_2 (1 - es) / L_2 - \tau^E \varepsilon_w s (1 - N) e / L_2)] L_2 w_2 = 0. \end{aligned}$$

**Proof of lemma 1:** the optimization problem is  $V = \max_{t_1, t_2, b, t_s, m} (1 - N) \cdot V_1 + N \cdot V_2 - \int_0^N i(n) dn + \lambda T$ . Even though the sector choice is discrete, continuity of the entry cost function  $i(n)$  and uniform distribution of ability  $n$  lead to continuous changes in the welfare function  $V$ , ensuring existence of a maximum. The endogenous allocation sector condition (6) leads to  $dV = (1 - N) dV_1 + N dV_2 + \lambda dT$ . Using (16) and (14),  $dV/db = [u'_h - (1 + \tau^N \eta_h + \tau^E \varepsilon_b) \lambda] (1 - e) s (1 - N)$ , and similarly for other conditions. QED.

**Proof part (a) proposition 1:** starting from a free market equilibrium with zero taxes implies  $\tau^j = 0$ . Thus, financing small benefits  $db > 0$  with taxes  $dt > 0$  to satisfy the budget constraint  $dT = 0$  with (14) requires  $\Gamma dt = (1 - e) s (1 - N) db$  with  $\Gamma \equiv w_1 (1 - s) (1 - N) + w_2 L_2$ . Substituting into (16) and evaluating at  $t = b = 0$  yields

$$\left. \frac{dV}{dt} \right|_{b=0} = \left[ 1 - \frac{u'_1 w_1 (1 - s) (1 - N)}{u'_h \Gamma} - \frac{u'_2 w_2 L_2}{u'_h \Gamma} \right] \Gamma u'_h > 0,$$

the sign due to  $w_2 > w_1 > h$ ,  $u'_i/u'_h < 1$  and the fact that the weights of these ratios sum to 1. QED.

**Proof part (b) proposition 1:** dividing the condition of lemma 1  $\lambda = u'_1 / (1 + \tau^N \eta_1)$  by the condition  $\lambda = u'_h / (1 + \tau^N \eta_h + \tau^E \varepsilon_b)$ , using  $\eta_1 = u'_1 / (1 - N) i'$  and  $\eta_h =$

<sup>20</sup>For the sake of completion, adjustments in the model are  $V_1 = (1 - s) \cdot u((1 - t_1) w_1) + s \cdot u^e$ ,  $V_2 = u((1 - t_2) w_2)$ ,  $T = t_2 w_2 L_2 + t_1 w_1 L_1 + t_s s (1 - N) - [\delta b + m k s (1 - N) + C]$ ,  $u_1 = u((1 - t_1) w_1)$ ,  $u_h = u(\psi(m)h + b)$  and  $u_2 = u((1 - t_2) w_2)$ . Search response (12) adjusts to  $de = -\varepsilon_w w_2 e \cdot dt_2 - \varepsilon_b (1 - e) \cdot db + \varepsilon_m \cdot dm$ , while education response (13) changes to  $dN = \eta_1 w_1 (1 - s) (1 - N) dt_1 - \eta_2 w_2 (1 - es) dt_2 - \eta_h (1 - e) s (1 - N) db + \eta_s s (1 - N) dt_s - \eta_m s (1 - N) dm$ , with  $\eta_s = (1 - t_1 - \nabla \sigma) \eta_1$ . The fiscal impact of policy (14) becomes

$$\begin{aligned} dT = & (L_2 - \tau^N \eta_2 (1 - es) - \tau^E \varepsilon_w s (1 - N) e) w_2 dt_2 + (1 + \tau^N \eta_1) w_1 (1 - s) (1 - N) dt_1 \\ & - (1 + \tau^N \eta_h + \tau^E \varepsilon_b) (1 - e) s (1 - N) db + (1 - t_1 - \tau^S \sigma + \tau^N \eta_s) s (1 - N) dt_s \\ & - (k + \tau^N \eta_m - \tau^E \varepsilon_m) s (1 - N) dm, \end{aligned}$$

while welfare variations (16) is

$$\begin{aligned} dV = & -u'_1 w_1 (1 - s) (1 - N) dt_1 - u'_2 w_2 L_2 dt_2 + u'_h (1 - e) s (1 - N) db + \\ & [(1 - e) u'_h \psi' h - \phi' \zeta] s (1 - N) dm - (1 - t_1 - \nabla \sigma) u'_1 s (1 - N) dt_s. \end{aligned}$$

<sup>21</sup>The condition  $dV/dt_s$  is also adjusted by replacing  $t_l$  with  $t_1$ .

$u'_h / (1 - N) i'$ , one has  $u'_1 (1 + \tau^N u'_h / (1 - N) i' + \tau^E \varepsilon_b) = u'_h (1 + \tau^N u'_1 / (1 - N) i')$ , or  $u'_1 (1 + \tau^E \varepsilon_b) = u'_h$ . Thus, using the fact that elasticities  $\varepsilon_j > 0$  and  $\tau^E = t_2 w_2 + b > 0$ ,  $u'_1 / u'_h = 1 / (1 + \tau^E \varepsilon_b) < 1$ . The concavity of the utility function concludes part (b),  $u_1 > u_h$ . QED.

**Proof part (c) proposition 1:** similar proof as for part (b), using the conditions  $\lambda = u'_1 / (1 + \tau^N \eta_1)$  and  $\lambda = (1 - t_1 - \nabla \sigma) u'_1 / (1 - t_1 - \tau^S \sigma + \tau^N \eta_s)$  of lemma 1 and the intermediate result  $\nabla = \tau^S$ . QED.

**Proof part (d) proposition 1:** similar proof as for part (b), using the conditions  $\lambda = u'_1 / (1 + \tau^N \eta_1)$  and  $\lambda = [(1 - e) u'_h \psi' h - \phi' \zeta] / (k + \tau^N \eta_m - \tau^E \varepsilon_m)$  of lemma 1 together with the envelope theorem on  $u^e$  in (5). QED.

## B Appendix: general optimality result

This appendix provides the optimality results from section 3.3 in a general context, without specification assumptions on reduced-forms and when labor tax rates in the two sectors can differ.

**Proposition.** *at the optimum,*

$$\text{sign} \left( \frac{d}{dm} \frac{d}{db} V \right)$$

*is equal to the sign of*

$$\begin{aligned} & u''_h \psi' h \left( 1 - \frac{\lambda \tau^E}{(1-e)\phi \zeta''} \right) + \\ & \frac{\lambda \varepsilon_b \tau^E}{(1-e)\phi \zeta''} \left\{ \left[ \zeta' + (1-e) \left( \zeta'' - \frac{\zeta' \zeta'''}{\zeta''} \right) \right] \phi' + \left( 1 - (1-e) \frac{\zeta'''}{\zeta''} \right) u'_h \psi' h \right\} + \\ & \lambda \eta_h \left\{ s (\varepsilon_m \tau^E - k) - \tau^N \left( \frac{u''_h \psi' h}{u'_h} - \eta_m s \left[ 1 - (1-N) \frac{i''(N)}{i'(N)} \right] \right) \right\}; \end{aligned}$$

*and*

$$\text{sign} \left( \frac{d}{dt_s} \frac{d}{db} V \right) = \text{sign} \left( \eta_s \left[ \frac{1}{\eta_1} - \tau^N \left( 1 - (1-N) \frac{i''(N)}{i'(N)} \right) \right] \right);$$

*and*

$$\text{sign} \left( \frac{d}{dt_s} \frac{d}{dm} V \right) = \text{sign} \left( \eta_m \eta_s \left[ \frac{1}{\eta_1} - \tau^N \left( 1 - (1-N) \frac{i''(N)}{i'(N)} \right) \right] \right).$$

*Proof:* same steps as the proofs of lemmas 2, 3 and 4 with general specifications for  $\zeta(e)$  and  $i(n)$ . When tax rates in the two sectors differ elasticity responses  $\varepsilon_i$ ,  $\eta_j$  and  $\tau^k$  are different but the result remains. QED.

As a verification, one can use specifications of reduced-forms and obtain the results from section 3.3. With  $\zeta(e) = \zeta_0 + (\zeta_2 - \zeta_0) e^{-\zeta_1(1-e)}$  and  $i(n) = i_0 - i_1 \cdot \ln(1-n)$ , one has  $\zeta''(e) = \zeta_1 \zeta'(e)$ ,  $\zeta'''(e) = \zeta_1 \zeta''(e)$  and  $i''(n) = i'(n) / (1-n)$ . Plugging these expressions into the proposition delivers the expected results.

Parameter		Value	Sources
Sector 2 wages	$w_2$	1	Normalization
Retrained wages	$w_r$	0.9	$(w_1 + w_2)/2$
Sector 1 wages (no policy)	$w_1$	0.8	Van Reenen (1996)
Workers' risk-aversion	$\rho$	1.5	Standard
Home production value	$h/w_r$	0.2	Hall and Milgrom (2008)
Productivity shock dispersion	$z$	3	See text
Elasticity of job search	$\varepsilon$	0.6	See text
Semi-elasticity of entry	$\eta$	0.33	See text
ALMP assistance minimum	$\phi_0$	0.2	See text
ALMP assistance curvature	$\phi_1$	2	See text
ALMP home prod cost minimum	$\psi_0$	0.8	See text
ALMP home prod cost curvature	$\psi_1$	2	See text
ALMP unitary cost	$k$	varies	See text
Share of public spending	$C_0/X_0$	0.15	Standard

Table 2: Parameters for numerical illustration.

## C Appendix: UI and ALMP substitutability

This appendix discuss two cases where optimal unemployment insurance and active labor market programmes are substitutes, using lemma 2.

First, when entry is exogenous ( $dN = \eta_h = 0$ ) and home production is small ( $h$  is small), unemployment insurance and active labor market programmes are substitutes,  $\frac{d}{dm} \frac{d}{db} V < 0$ . The intuition is as follows. Because home production is small, most of the impact of activation measures is through assistance, not the reduction of home production benefits. These measures thus mostly impact the transition from the bad to the good state, not the value of the bad state. Lower unemployment benefits make the bad state less attractive, increasing job search efforts and thus further increasing the transition rate to the good state. Active labor market policies and unemployment insurance are substitute. With utilitarian welfare, even though the bad state is worse, less people remain in this state. In contrast, when home production is not small, increased activation measures also reduce much home production and thus the value of the bad state, in which case a reduction in unemployment benefits is detrimental.

Second, when entry is endogenous but only has a small response to policy variations ( $\eta_h$  is small), the first two terms in the lemma dominate and the same outcomes and intuition as exogenous entry apply.

## D Appendix: calibration details

Table 2 provides an overview of the parameter values used in the numerical illustration.

The utility function  $u$  has a CRRA form  $u(c) = c^{1-\rho}/(1-\rho)$ . Other functional forms are chosen to match the requirements of the model and to satisfy Inada-type conditions, ensuring smooth numerical computation.

Productivity is distributed uniformly over  $[\bar{x} - z, \bar{x} + z]$ , where the dispersion

$z$  comes from empirical estimates of the firing elasticity in Garibaldi and Pacelli (2008) and  $\bar{x}$  from a sector 1 separation rate of  $s = 0.25$ , chosen to be consistent with observed economy-wide separation rates of 0.10. The sector 1 wage  $w_1$  is endogenously defined. A value for  $w_1$  is used when there is no policy to pin down  $\bar{x}$ .

The elasticity of job search  $\varepsilon$  provides the key parameter  $\zeta_1$  in the search cost function  $\zeta(e) = \zeta_2 e^{-\zeta_1(1-e)}$ .  $\zeta_2$  is set to match a targeted unemployment rate of 0.06 when there is no policy. The optimality condition (11) and differentiation delivers the link  $\zeta_1 = u'_h w_r / \varepsilon (u_r - u_h)$ . In their survey, Krueger and Meyer (2002) consider that a value of 0.5 for the elasticity  $\epsilon_d$  of unemployment duration with respect to the level of unemployment benefits is a fair summary for the US. Empirical studies taking policy endogeneity into account, such as Card and Levine (2000), find a value close to 0.1. Using the average unemployment duration in the US delivers a relationship between the job search elasticity  $\varepsilon$  and the unemployment duration elasticity  $\epsilon_d$ , namely  $\varepsilon = \epsilon_d \cdot w_r(1 - \delta) / 3bs(1 - N)$ . Hence,  $\varepsilon$  ranges from 0.4 to 2, the lower range corresponding to empirical estimates dealing explicitly with policy endogeneity, more appropriate in a general equilibrium context. I choose a baseline value 0.6.

The semi-elasticity of entry  $\eta$  provides the curvature parameter  $i_1$  in the entry cost function  $i(n) = i_0 - i_1 \cdot \ln(1 - n)$ . The shift parameter  $i_0$  follows directly from (6), which, through differentiation, also delivers  $i_1 = |V_2|(1 - N) / \eta$ . Using estimates of the elasticity of university enrollment with respect to the college wage premium, from Jacob (2002) and other references, delivers values for  $\eta$  comprised between 0.2 and 0.8. I take a conservative value of 0.33 in the baseline case.

Given the diversity of empirical estimates of the effects of active labor market programmes, I choose parameter values for the home production reduction effect  $\psi(m) = \psi_0 + (1 - \psi_0) e^{-\psi_1 m}$  and for the job search assistance effect  $\phi(m) = \phi_0 + (1 - \phi_0) e^{-\phi_1 m}$  in an arbitrary but plausible fashion. I use a range of values to measure the sensitivity of the results to the parameter choices.

Calibration of the unitary cost  $k$  of active labor market programmes targets aggregate expenditures, as Andersen and Svarer (2014). There are no standard units to measure the amount  $m$  of ALMP delivered, which would be consistent for both resource-intensive training courses and cheaper monitoring activities. Similarly, the unitary cost  $k$  of ALMP differ. In the numerical illustration I choose a different value  $k$  in each simulation so that aggregate expenditures  $mk s(1 - N)$  for ALMP are consistent with observations, relative to aggregate expenditures  $\delta b$  for unemployment insurance (targeting a 1/2 ratio, as per OECD, 2009).