

Flexicurity and Job Reallocation*

THOMAS DAVOINE AND CHRISTIAN KEUSCHNIGG

University of St. Gallen (IFF-HSG)

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Abstract

This paper develops a general equilibrium model with safe and risky jobs where unemployment is concentrated in a highly productive but volatile sector. Frictional unemployment arises in the process of job creation, firing and retraining for alternative employment. The paper derives an optimal welfare policy which combines the design of the tax schedule with three pillars of the ‘flexicurity’ model. The optimal policy is characterized by (i) a progressive wage tax schedule; (ii) a wage subsidy to re-employed workers; (iii) unemployment insurance benefits; (iv) job protection to contain firing; and (v) active labor market policy to facilitate labor reallocation.

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

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Address: University of St.Gallen, IFF-HSG, Varnbuelstr.19, CH-9000 St.Gallen, Switzerland. Email: Christian.Keuschnigg@unisg.ch, Thomas.Davoine@unisg.ch.

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1 Introduction

For decades, high unemployment has plagued welfare states especially in Europe. The causes of unemployment are manifold, and each one probably requires its own remedy. It is often argued that increasing globalization and the faster pace of technological progress lead to more volatile employment relationships, shorter job tenure and an increasing need for retraining of previously acquired skills (e.g. Brown, Merkl and Snower, 2009a, and Ljungqvist and Sargent, 1998). Part of unemployment thus results from an increasing speed of labor reallocation across different tasks with different skill requirements. Given the need to facilitate and speed up reallocation towards alternative employment, a successful policy might be the flexicurity model consisting of three pillars: *insurance* of the unemployed, *active labor market policy* (ALMP) to speed up transition into new jobs, and firing *flexibility* to close down unproductive jobs and replace them with new ones. Denmark's success in reducing its unemployment rate from about 10% to 5% over the 1990's is often attributed in good part to the flexicurity model.

The three pillars of flexicurity address separate channels of the labor market impact of welfare policies. Unemployment insurance (UI) is a central pillar of the welfare state and addresses a market failure due to missing private insurance markets for labor income risk. Developed countries spend up to 2% of GDP on UI (see OECD, 2009). Gruber (1997) estimated that the reduction in an unemployed workers' consumption would be three times larger without UI (a 22.2% drop instead of 6.8%). Using a 'sufficient statistics' approach that avoids functional form assumptions, Chetty (2008) estimated that the current level of UI (replacement rate near 50%) is close to optimal in the US. There is consensus on the negative sign of the effect of UI on employment, but less so on its magnitude (see Holmlund, 1998). In their survey, Krueger and Meyer (2002) consider that a fair summary value for the effect of UI on employment is an elasticity of unemployment duration with respect to benefits of 0.5. There seems to be no or a positive impact of UI on wages or reservation wages.¹

¹Ten studies on wage effects (5 reported by Addison and Blackburn, 2000, and the study itself, plus

The most immediate effect of employment protection (EP), independent of whether it comes as an administrative cost or as a firing tax, is to reduce job separation and, thereby, contribute to lower unemployment. On the negative side, EP makes firms reluctant to hire workers in the first place if they find it difficult and costly to separate again when prospects become unfavorable. For this reason, high levels of EP have long been blamed for high European unemployment rates. The flexicurity model advises a low level of EP, at least lower than in many generous European welfare states, since it is argued that the positive effect of more hiring on the unemployment rate outweighs the negative effect of a higher separation rate.

This ambiguity is reflected in empirical research on how EP affects the labor market. Empirical studies consistently find that EP reduces flows into unemployment, but fail to report a reliable effect of EP on employment levels which points to a negative effect on hiring. The survey by Addison and Teixeira (2003) documents the heterogeneity of empirical findings since the original study by Lazear (1990). For instance, the summary table in Boeri and Jimeno (2005) shows only 5 significant coefficients out of 24. Heckman and Pages (2000) find significant positive effects of EP on unemployment. They estimate that the average 3 months of firing costs in Latin America amounts to a loss of 5.5% points of employment (for an average of 7.4% of unemployment). On the other end, OECD (1999) reports no significant effects of EP. Based on their empirical estimates, Belot, Boone and van Ours (2007) calculate an optimal level of employment protection which is positive and moderate: for instance, the growth maximizing level of protection for open-ended contracts is around 0.37 (on a scale from 0 to 1), corresponding to 1999 levels of protection in countries like Italy, Switzerland or the UK.

Active labor market policy (ALMP) mostly aims to support job search effort of unemployed workers, to develop their skills and make them more attractive to potential

3 reported by Petrongolo, 2008, and the study itself) arrive at different conclusions. They either find no statistically significant effect (in 6 cases) or statistically positive effects (higher UI benefits raise wages) which are often moderate or significant only for some subgroups (in the 4 other cases). Higher UI either raises wages or has no effect. The theoretical model below excludes wage effects.

employers, and to retrain for different jobs with alternative skill requirements. Total spending on labor market policies has grown to significant levels over the years. According to OECD (2009), member countries spent on average 1.5 % of GDP in 2006 with some countries spending up to 3.4%. The fraction devoted to some form of active measures has grown from 35% in 1985 to 42% in 2007 (Martin and Grubb, 2001; and OECD, 2009). Several empirical studies show that monitoring and sanctions increase search efforts by unemployed workers more than the reduction in unemployment benefits (reported by Nunziata, 2008). Early empirical studies find negative or no significant effects of ALMP training programmes in the short-run (e.g. see the surveys Heckman, Lalonde and Smith, 1999; Martin and Grubb, 2001; Kluve, 2006), mostly due to a lock-in effect, but recent studies have data to focus on long-run effects. For instance, Lechner, Miquel and Wunsch (2010) find that the re-employment probability increases by 20 to 40% and monthly earnings are higher by 0 to 550 Euro, depending on the training type.

There has been extensive theoretical research on different causes of unemployment and ways to reduce it. Economists have often studied the effects of different policies in isolation or in pairs. Using a combination of instruments makes theoretical models more complicated. However, it is important to analyze all three pillars simultaneously to capture the full potential of the flexicurity model as well as the interactions and complementarities between labor market policies and the wage tax schedule. Andersen and Svarer (2007) argue that low EP alone does not explain the decline of unemployment in Denmark. Low EP and generous UI were already in place well before the rise in unemployment, following the mid-1970's oil shock. Only when Denmark implemented activation measures for the unemployed, did unemployment start to come down.

Most of the previous theoretical work includes some, but not all of the three policy instruments. For instance, some papers consider EP and UI together (such as Pissarides 2001; Blanchard and Tirole 2008; Cahuc and Zylberberg, 2008), but do not include ALMP. In this vein, Blanchard and Tirole (2008) show that it may be preferable to finance UI with firing taxes rather than wage taxes or contributions. However, they neither include job

creation nor ALMP. Some of the macroeconomics literature assumes risk-neutral workers to isolate the incentive effects of UI but misses gains from insurance which are, after all, the prime motivation for providing social insurance in the first place. Most theoretical literature on ALMP also considers UI (reviewed in Fredriksson and Holmlund, 2006). Even though some of these ALMP and UI papers have other policy instruments (e.g. welfare in Pavoni and Violante, 2007), none explicitly includes EP.

Three recent papers focus on the flexicurity model but do not explore all possibilities afforded by the three policy instruments. Andersen and Svarer (2008) consider UI and ALMP but assume policy makers commit to no EP. With a simulation, they show that using workfare (ALMP) may be one way to improve labor market performance without reducing UI benefits. Brown, Merkl and Snower (2009b) limit EP to firing costs and do not use it as a firing tax which could be used to finance UI as suggested in Blanchard and Tirole (2008) and which is, in fact, partly implemented in the U.S., for example. In Brown, Merkl and Snower (2009b), one can also note that numerical results are sensitive to one parameter (the probability that a firm hires temporary workers from a secondary labor market when its own workers go on strike due to a too low wage offer) which has never been estimated and, arguably, is unusual in the wage bargaining process. With this caveat in mind, their simulation shows that unemployment in Germany could be reduced by 50% if it adopted the same UI, ALMP and EP policies as Denmark. Algan and Cahuc (2009) do not explicitly analyze ALMP. Extending the Blanchard and Tirole (2008) framework to the case of moral hazard, they show that only countries with high levels of civic attitude would benefit from flexicurity, as in Denmark.

Theoretical studies of EP have reached contradictory conclusions, too: early studies with EP alone find opposing effects in simulation exercises. Bertola (1990) as well as Blanchard and Portugal (2001) show that higher EP can boost employment, under certain circumstances. Hopenhayn and Rogerson (1993) find the opposite. More recent studies with UI as a second policy instrument also arrive at different conclusions. Blanchard and Tirole (2008) conclude that firing taxes, not wage taxes should be used to finance UI, and

EP should be as high as necessary to internalize firing externalities. Andersen and Svarer (2008) assume flexible hiring and firing by keeping EP at zero. Unlike Gruber (1997), but for a value closer to Chetty (2008), Andersen and Svarer (2008) show that unemployment can still be reduced with values of the replacement rate that would be considered high in the theoretical literature (around 0.5).

Models with few instruments have the virtue of simplicity and unambiguous theoretical predictions but cannot capture the full meaning of a flexicurity policy. The aim of this paper is to investigate the joint effects of the three pillars of the flexicurity model and rationalize it as an optimal policy outcome together with the design of the tax benefit scheme in labor income taxation. A second benefit of our model is that we can look at factor supply and efficient utilization at the same time while other models do it separately. For instance, the Baily (1978) family of papers (including Gruber, 1997, and Chetty, 2008) look at the impact of UI on search behavior which is an aspect of labor supply while Acemoglu and Shimer (1999) investigate the impact of UI on the job match quality and thereby explain labor productivity by the efficiency in the allocation of labor. But each stream does it separately. A third novel feature of our model is the distinction of more and less volatile sectors with differing incidence of unemployment, an idea borrowed from Cunat and Melitz (2007) which makes the aggregate unemployment rate a function of the economy's sectoral composition.² We specifically introduce the notion of retraining and job search to show how an optimal welfare policy should facilitate ongoing structural change and support the reallocation of labor. Similar to the probabilistic modeling of education investments in Konrad (2001), we assume that retraining of sector specific skills and search for re-employment in the second sector is risky. A larger effort spent

²At the firm level, Comin and Philippon (2005) and references in this paper show that firm volatility is a 'good predictor of both unemployment risk and wage inequality'. At the industry level, Davis, Faberman, Haltiwanger, Jarmin and Miranda (2008) find results that 'supports the view that industry differences in the intensity of idiosyncratic shocks are a major reason for industry differences in the incidence of unemployment', where industry volatility (idiosyncratic shock) is measured by variation of firm size (number of employees).

on retraining and job search raises the likelihood to find employment in the alternative sector. If unsuccessful, the worker remains unemployed and collects benefits.

This paper presents a model with three instruments of labor market policy, UI, ALMP and EP, together with a possibly progressive wage tax schedule including tax credits and wage subsidies to support retraining. In line with empirical evidence, we assume that EP directly affects hiring and firing of firms while UI and ALMP affect retraining and job search efforts of dismissed workers. Search effort as well as job creation and job destruction are endogenously defined, the last two being driven by productivity shocks. To address the importance of endogenous job reallocation in a volatile environment, the model uses two sectors with *retraining* of sector specific skills after separation and *reemployment* of workers in another sector. The first sector may be thought of as an innovative industry with volatile employment relationships. In the event of separation from a sector 1 job, workers can retrain and search for a job in a second sector offering safe employment relationships. In the spirit of Ljungqvist and Sargent (1998), we assume that job separation leads to a loss of (sector specific) skills so that the next best job pays a lower wage, which is empirically supported.³ Once a job is obtained in this sector, the worker is never fired again. Skills are sector specific; a worker who invested in skills specific to the volatile industry but got fired, needs to spend effort on retraining and search to find a job in the second sector. The amount of search effort and, in turn, successful job reallocation, depends on the levels of ALMP and UI. The last assumption refers to the welfare increasing role of ALMP. These services might partly have the characteristics of a public good (e.g. increasing market transparency and providing information about job opportunities to reduce private search costs), or they might be a publicly provided private good (training services, consulting to improve job applications etc.) for which markets do not exist for reasons outside the model.⁴

³Jacobson, LaLonde and Sullivan (1993) find that after a mass lay-off in a distressed economic environment, workers settle for wages that are 25% lower (6 years after the lay-off, in the new job). In a less turbulent environment, Couch and Placzek (2010) find that wages are 12 to 15% lower.

⁴An unproductive, sanctions based ALMP cannot be part of an optimal policy in our framework.

To sum up, this paper analyzes the design of the wage tax schedule jointly with a ‘flexicurity’ policy, consisting of flexibility in job separation, UI and ALMP. Apart from redistributive goals, the policy instruments need to address three market failures: missing markets for UI, firing externalities, and absence of private supply of job search assistance. Our analysis yields five results on an optimal tax and flexicurity program. First, tax progressivity is motivated by redistribution from workers in highly paid volatile jobs to those with lower wages in more stable employment relationships. Second, the tax schedule is complemented by tax credits or subsidies to encourage retraining and search for alternative employment. Third, public UI is necessary due to missing private markets. Fourth, negative firing externalities create a need for an optimal degree of job protection. And fifth, active labor market policy is an essential ingredient of a large welfare state if it is sufficiently productive in stimulating reemployment and raising individual welfare by reducing private search costs.

The next section sets up the model, Section 3 derives optimal policies, Section 4 considers piecemeal reform and Section 5 illustrates numerically how optimal policies adjust to changing structural parameters. Section 6 concludes.

2 The Model

2.1 Sectoral Production

The economy is populated by a mass 1 of risk-averse workers and consists of two sectors producing the same numeraire good. The volatile industry is more productive on average but job turnover and the unemployment risk are larger. Sector 2 is less productive, Although effective in raising job search, these policies reduce private utility and are, in addition, costly to the government. Only a productive, welfare increasing form of ALMP can be rationalized. However, when workers are heterogeneous and job search behavior is private information, sanctions might possibly be a way to separate different worker types similar workfare requirements as in Besley and Coate (1995) and Kreiner and Traenes (2005) and might thus become part of a welfare optimal program.

pays lower wages but offers safe jobs. A part N of workers invests in sector specific skills and seeks employment in the volatile industry. The remaining part $1 - N$ does not invest and accepts a lower paying, but safe job in sector 2. Initially, the sectoral allocation of labor results from occupational choice with a discrete skill investment. After a productivity shock, a share of workers in the volatile industry is fired because the job turned out unproductive. Fired workers can retrain and search for a sector 2 job. All this is anticipated when investing in one's sector specific skills.

Figure 1 illustrates how retraining leads to reallocation of labor. When the outcome of the productivity shock is unfavorable, employment in sector 1 is terminated, leading to job separation with probability s and continuation with probability $1 - s$. When fired, the worker can retrain and search for a sector 2 job. When job search is not successful, she remains unemployed. When entering the volatile industry, a worker may thus end up in three states. They ultimately keep their job in sector 1 with probability $1 - s$, are reallocated to jobs in sector 2 with probability se , and end up unemployed with probability $s(1 - e)$. Given independent risks, the ex ante probabilities correspond to ex post fractions. Initial and final labor allocation must satisfy the resource constraint,

$$L_1 = (1 - s)N, \quad L_2 = (1 - N) + esN, \quad \delta \equiv (1 - e)sN = 1 - L_1 - L_2. \quad (1)$$

The unemployment rate δ reflects job creation N , firing s in the volatile industry and unsuccessful job search $1 - e$ for new employment. Since the unemployment risk is high in the volatile sector 1 and low (zero) in sector 2, the average unemployment rate necessarily reflects the sectoral composition of the economy.

As a result of initial training, sector 1 workers are more skilled and, on average, more productive. Skills are sector specific to some extent so that separation and reallocation leads to a wage loss. Keeping a job in sector 1 earns a higher wage than reemployment, $w_1 > w_r$. We further assume that sector 2 technology is Ricardian with fixed productivities $w_r > w_2$. Workers separated from a skill intensive sector 1 job are more productive than those who have spared initial training and started a job in sector 2 right from the beginning. After reallocation, employment in sector 2 consists of $1 - N$ unskilled and

esN retrained workers, earning fixed wages w_2 and w_r , respectively. If a sector 1 worker becomes unemployed, she generates low income h from home production. To sum up, we assume $w_1 > w_r > w_2 > h$, where the lower index r indicates re-training.

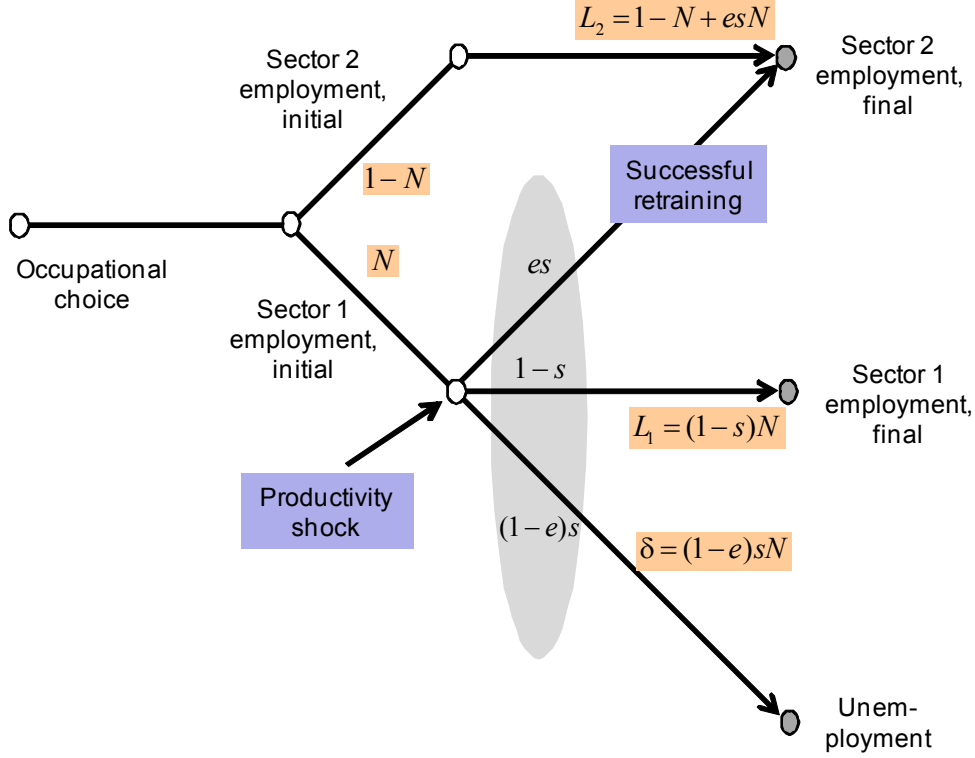


Fig. 1: Reallocation of Labor

We consider social protection in the context of a possibly progressive wage tax schedule and allow for different proportional tax rates t_1 , t_r and t_2 in each earnings class with wages $w_1 > w_r > w_2$. While $t_1 > t_2$ naturally describes a progressive tax schedule since sector 1 workers on average earn more. Whenever $t_r < t_1$, we associate the difference $t_1 - t_r$ with a wage subsidy. A priori, these tax rates are unrestricted. In addition, the government sets unemployment benefits b , may impose a firing tax t_s to reduce job separation and spend on ALMP m to support retraining and assist job search. Taking policy instruments as given, workers decide whether to invest in sector 1 specific skills and, in the event of separation, choose a level of retraining and job search effort. Firms decide whether to employ a worker and, after the productivity shock materializes, whether to close down or continue the employment relationship.

Sector 1 production is organized by risk-neutral firms, each hiring one worker. With perfect competition, firm entry and job creation continue until profits are zero. After hiring, firms are subject to a productivity shock $x \in [0, \infty)$, leading to output Ax of the job. Once productivity is known, the firm decides whether to continue with earnings $Ax - w_1$ or close down, fire the worker and accept a loss t_s equal to the firing tax. The firm continues if $Ax - w_1 \geq -t_s$. The cut-off productivity is

$$x_1 = (w_1 - t_s) / A. \quad (2)$$

When the productivity shock yields a better result $x \geq x_1$, the firm continues the employment relationship, in the other case, the job is terminated. Given a density $g(x)$ and cumulative distribution $G(x)$, the separation rate is

$$s(x_1) = \int_0^{x_1} g(x) dx, \quad 1 - s(x_1) \equiv \int_{x_1}^{\infty} g(x) dx. \quad (3)$$

A higher cut-off value x_1 raises the firing rate s and reduces the continuation probability $1 - s$. Note that $1/s$ is interpreted as the length of job tenure in the volatile industry. High volatility means a high firing rate and short job duration, i.e. high job turnover.

Entry and job creation give rise to a fixed cost or start-up investment f (see Fonseca et al., 2001). Anticipating the firing decision, firms create jobs if the net present value is non-negative. Define average productivity after entry by $x^a \equiv \int_{x_1}^{\infty} x dG(x) / (1 - s)$,

$$\pi = \int_{x_1}^{\infty} (Ax - w_1) dG(x) - st_s - f = (1 - s)(Ax^a - w_1) - st_s - f \geq 0. \quad (4)$$

Employment relations also break up when a worker prefers to leave. To prevent this, the firm must pay a high enough wage. Utility of staying in the firm is $u((1 - t_1)w_1)$. Expected utility of leaving and searching for a sector 2 job, subject to unemployment risk, is u^e , see the next subsection. The firm is able to keep the worker only if the wage satisfies the participation constraint $u((1 - t_1)w_1) \geq u^e$. We assume productivity and the competitive wage to be high enough so that this constraint is slack.

Job creation under perfect competition pushes up the wage until profits are zero. When firing is optimally chosen as in (2), the derivative of the profit function with respect to

cut-off productivity is zero, $d\pi = -(Ax_1 - w_1 + t_s)g(x_1)dx_1 = 0$. By the envelope theorem, $d\pi/dw_1 = -(1 - s)$ and $d\pi/dt_s = -s$. Hence, the zero profit condition pins down the competitive wage as a function of the firing tax and other fundamental parameters. Solving $d\pi = -(1 - s)dw_1 - sdt_s = 0$ yields

$$\frac{dw_1}{dt_s} = -\frac{s}{1 - s}, \quad \frac{ds}{dt_s} = -\sigma s, \quad \sigma \equiv \frac{g(x_1)}{(1 - s)sA}. \quad (5)$$

Hence, a firing tax puts a cost on firms and forces them, in zero profit equilibrium, to cut the wage. For the same reason, the tax also reduces the separation rate.

Sector 2 uses a linear Ricardian technology. Competitive producers pay wages equal to exogenous labor productivities w_2 and w_r of a specialized sector 2 worker and a retrained sector 1 worker, and earn zero profits. These wages are fixed constants while w_1 is endogenous. Since each firm hires exactly one worker, the number of firms is determined by the number of workers entering sector 1. Since only $1 - s$ new jobs survive, and s close down, the number of productive jobs (or mature firms) is $(1 - s)N$. Given average productivity x^a , total sector 1 output X_1 net of entry costs amounts to

$$X_1 = [(1 - s)Ax^a - f]N, \quad X_2 = w_2(1 - N) + w_re sN. \quad (6)$$

Sector 2 output is produced by two types of workers, specialized sector 2 and retrained sector 1 employees, each generating an output per capita equal to w_2 and w_r , respectively.

2.2 Labor Market Behavior

There are four realizations of income, $y^i \in \{w_1, w_r, h, w_2\}$. Net of tax income depends on the tax benefit schedule summarized by $\{t_1, t_2, t_r, b\}$. A sector 2 worker earns a safe wage, giving utility $V_2 = u((1 - t_2)w_2)$. A sector 1 worker either keeps her initial job or is fired. When fired, she may retrain and get another job with probability e , or end up unemployed with probability $1 - e$ (see Konrad, 2001, for a probabilistic model of human capital investment). Taking account of a utility loss (stigma) χ of remaining unemployed,

expected utility of entering sector 1 is

$$\begin{aligned} V_1 &= (1-s) \cdot u((1-t_1)w_1) + s \cdot u^e, \\ u^e &= \max_e e \cdot u((1-t_r)w_r) + (1-e) \cdot [u(h+b) - \chi] - \phi(m)\zeta(e). \end{aligned} \quad (7)$$

Henceforth, we define $u_1 \equiv u((1-t_1)w_1)$, $u_r \equiv u((1-t_r)w_r)$, $u_h \equiv u(h+b)$ as well as $u_2 \equiv u((1-t_2)w_2)$ for using as a short-hand. Parameter m illustrates how active labor market policy (ALMP) facilitates retraining by reducing individual effort cost. We assume $\phi(0) = 1$, $\phi' < 0 < \phi''$ and $\lim_{m \rightarrow \infty} \phi(m) = \phi_0 > 0$. When the policy is scaled up, it becomes less and less effective. For given m , effort costs are convex increasing, $\zeta' > 0$ and $\zeta'' > 0$, and are assumed strictly positive in the relevant range. The level search effort costs $\phi\zeta$ may also be interpreted as ‘stigma of job loss’ because it reduces utility value outside of sector 1 employment while χ reflects a ‘stigma of unemployment’. These two concepts are not the same since a fraction of separated workers successfully retrain but may not enjoy the new job to the same extent.⁵ Finally, the negative cross-derivative $\phi'\zeta'$ means that ALMP reduces marginal effort cost and stimulates job search.

The utility cost $\phi\zeta$ might also be interpreted as *skill specificity* since these individuals have previously invested in sector 1 skills and must now retrain to obtain another job in sector 2. Another aspect of skill specificity is the assumption of $w_1 > w_r$. A specialized sector 1 worker is not as productive in a sector 2 job after retraining and, as a result, must accept an earnings loss (see Lundquist and Sargent, 1998, on the loss of skills due to unemployment). The effort spent on retraining and job search for employment elsewhere is a matter of incentives. After job separation, individuals choose effort according to

$$u((1-t_r)w_r) - u(h+b) + \chi = \phi(m)\zeta'(e). \quad (8)$$

Anticipating subsequent events, workers must decide in the beginning whether to undertake a sector specific skill investment or go to sector 2 right away. Suppose agents

⁵Blanchard and Tirole (2008) and Algan and Cahuc (2009) similarly assume a fixed utility cost of unemployment. Since they abstract from reemployment and allow for only one state after separation, they do not differentiate the utility loss from separation

are arranged by the innate ability $n \in [0, 1]$ of performing sector 1 jobs. The discrete effort cost $i(n)$ of acquiring sector 1 skills differs by ability according to $i'(n) > 0$, $i(0) = 0$ and $i(n) \rightarrow \infty$ for $n \rightarrow 1$. Low n indicates low effort cost and high ability. Suppose ability is uniformly distributed so that the pivotal value $N \in [0, 1]$ is also the fraction of individuals with ability $n < N$. Given that expected utility of entering sector 1 is higher than that in sector 2, $V_1 > V_2$, highly able individuals with low cost expect $V_1 - i(n) > V_2$ and, thus, invest in a sector 1 specific qualifications. In the other case, type n opts for sector 2 and does not invest. The pivotal agent, identified by the occupational choice condition, determines the initial labor allocation across sectors,

$$V_1 - i(N) = V_2, \quad V_2 \equiv u((1 - t_2)w_2). \quad (9)$$

Initially, N workers opt for sector 1, and $1 - N$ go to sector 2. After firing, this allocation is partly revised by retraining, leading to a final allocation L_1 and L_2 as in (1). If there were no firing ($s = 0$), there would be no reallocation, $L_1 = N$, and no unemployment. Unemployment results from productivity shocks, frictions in retraining and reallocation which only arise in the volatile industry.

2.3 Equilibrium

Government spends $b\delta$ on unemployment benefits and $mksN$ on ALMP, where mk is spending per capita of fired persons in need of a new job. Fiscal budget balance requires

$$T = t_2w_2(1 - N) + t_1w_1(1 - s)N + t_rw_re sN + t_s sN - b(1 - e)sN - mksN - C = 0, \quad (10)$$

where C is an exogenous and constant level of other public spending.

Aggregate disposable income stems from earnings of employed and retrained sector 1 workers (first two terms below), benefits collected by unemployed persons, and earnings of specialized sector 2 workers. Since h is income from non-market activity, it does not show up in disposable income,

$$Y = (1 - t_1)w_1(1 - s)N + (1 - t_r)w_re sN + b(1 - e)sN + (1 - t_2)w_2(1 - N). \quad (11)$$

Using the fiscal budget to replace benefits, profits $\pi = (1 - s)(Ax^a - w_1) - st_s - f$ to eliminate w_1 and substituting the definitions X_j yields $(Y + C + mksN - X_1 - X_2) + \pi N + T = 0$, where the bracket is excess demand. Total demand for market goods includes not only private and public consumption $Y + C$ but also the resource use of ALMP spending. Solving for $\pi = T = 0$ clears the product market by Walras' Law.

The solution of the untaxed, free market equilibrium is as follows. Parameters w_r and h determine u^e . Suppose that the lowest possible sector 1 wage, $u(w_1^*) = u^e$, implies positive expected profits $\pi(w_1^*) > 0$, reflecting high factor productivity A and x^a . This wage also induces a labor allocation N^* , satisfying $V(w_1^*) - i(N^*) = u(w_2)$. Profits attract new firms which bid up the wage rate $w_1 > w_1^*$. Expected utility V_1 rises, attracting more workers such that $N > N^*$ satisfying $V(w_1) - i(N) = u(w_2)$. This process continues until profits are zero, $\pi(w_1) = 0$. At this equilibrium wage, the participation constraint is not binding, $u(w_1) > u^e$. We ‘calibrate’ the model such that $w_1 > w_r > w_2 > h$.

3 Optimal Flexicurity

In the present model, policy should address three market distortions, arising from firing externalities, missing private insurance markets, and frictions in retraining and job search. ALMP could be interpreted as a non-rival public good providing market transparency and public information about employment opportunities that are useful to guide individual training and job search effort and to facilitate transition into new jobs. Or it could be a publicly provided private good such as advice on how to apply for jobs, or subsidized training if new skills are required in alternative occupations. We first analyze how firms and households react to policy changes and then characterize optimal policy.

3.1 Behavioral Effects and Fiscal Impact

Wages and separation rates in sector 1 depend exclusively on the firing tax as in (5), but are independent of the tax benefit schedule for workers. Taking the differential of (7-8)

reveals the policy impact on expected utility u^e and job search after separation,

$$\begin{aligned} du^e &= -u'_r \cdot w_r e dt_r + u'_h \cdot (1 - e) db - \phi' \zeta \cdot dm, \\ de &= -\varepsilon_r \cdot w_r e dt_r - \varepsilon_b \cdot (1 - e) db + \varepsilon_m \cdot dm, \end{aligned} \quad (12)$$

where behavioral elasticities are all defined positive,

$$\varepsilon_r \equiv \frac{u'_r}{e \phi \zeta''} > 0, \quad \varepsilon_b \equiv \frac{u'_h}{(1 - e) \phi \zeta''} > 0, \quad \varepsilon_m \equiv -\frac{\phi' \zeta'}{\phi \zeta''} > 0.$$

In reducing private effort costs, ALMP spending boosts retraining and job search. Taxes and benefits discourage job search and retraining. The tax distortions are measured by the participation tax $\tau^E \equiv t_r w_r + b$ which consists of the sum of the wage tax plus the benefits lost when an individual switches from unemployment into a job.⁶ Expected utility rises with more generous benefit levels and a more intensive ALMP but falls with a higher tax burden on employment.

At the beginning, when seeking employment in sector 1, agents anticipate the separation risk and expect utility $V_1 = (1 - s) u_1 + s u^e$. Using $\nabla \equiv (u_1 - u^e) / u'_1$,

$$\begin{aligned} dV_1 &= u'_h (1 - e) s db - u'_r w_r e s dt_r - \phi' \zeta s dm \\ &\quad - u'_1 w_1 (1 - s) dt_1 - (1 - t_1 - \nabla \sigma) u'_1 s dt_s. \end{aligned} \quad (13)$$

After starting employment in the volatile industry, individuals expect to be fired and remain unemployed with probability $(1 - e) s$. Expected utility rises by the marginal welfare gain $u'_h db$ from more generous benefits, scaled by the probability of unemployment. Other taxes and benefits are interpreted similarly. More intensive ALMP becomes useful in the event of job separation which is expected with probability s . Importantly, a higher firing tax affects workers via two offsetting channels and leaves an a priori ambiguous net effect. On the one hand, the tax reduces firing by $ds = -\sigma s dt_s$ which boosts expected utility by $\nabla u'_1 (-ds) = (u_1 - u^e) (-ds)$. Less firing allows workers to enjoy more often high utility u_1 from sector 1 employment instead of low utility u^e as expected after separation.

⁶The participation tax is implicit in (8). To see this, substitute the Taylor expansion $u_r = u_h + u'_h [(1 - t_r) w_r - b - h]$ and note the definition of τ^E , yielding $[w_r - \tau^E - h] u'_h + \chi = \phi \zeta' (e)$.

On the other hand, the tax reduces the gross wage by $dw_1 = -\frac{s}{1-s}dt_s$. Since this occurs with probability $1 - s$ ex ante, expected welfare declines by $(1 - s) u'_1 (1 - t_1) dw_1$.

The willingness to pursue employment in the volatile industry and invest in sector specific skills depends on expected utility V_1 relative to welfare $V_2 = u((1 - t_2) w_2)$ from a safe sector 2 job. Taking the differential of the occupational choice condition in (9) yields the entry response,

$$\begin{aligned} dN = & -\eta_1 w_1 (1 - s) N dt_1 - \eta_r w_r e s N dt_r + \eta_h (1 - e) s N db \\ & - \eta_s s N dt_s + \eta_m s N dm + \eta_2 w_2 (1 - N) dt_2, \end{aligned} \quad (14)$$

where entry elasticities are defined positive,

$$\begin{aligned} \eta_1 &\equiv \frac{u'_1}{N i'}, & \eta_2 &\equiv \frac{u'_2}{(1 - N) i'}, & \eta_m &\equiv -\frac{\phi' \zeta}{N i'}, \\ \eta_r &\equiv \frac{u'_r}{N i'}, & \eta_h &\equiv \frac{u'_h}{N i'}, & \eta_s &\equiv (1 - t_1 - \nabla \sigma) \eta_1. \end{aligned}$$

A higher tax t_2 on sector 2 earnings pushes workers into sector 1 employment. Conversely, all policies raising the present value of net taxes on sector 1 earnings discourages employment in the volatile sector. Clearly, higher unemployment benefits reduce the present value of *net* taxes and, thus, make volatile employment more acceptable. More intensive ALMP improves labor market prospects in the event of job separation and, thus, similarly encourages sector 1 employment.

Employment effects on different margins determine the tax yield and the net result on the fiscal constraint in (10). In the present model, all labor market effects are discrete in the sense of people switching from one state to another, either via discrete skill investment dN , job separation ds or retraining with successful job search de . For each of these margins, we define effective tax rates τ^N , τ^S and τ^E , which capture the impact of behavioral changes on *net* tax revenue,

$$\begin{aligned} dT = & (1 - N) \cdot w_2 dt_2 + (1 - s) N \cdot w_1 dt_1 + e s N \cdot w_r dt_r + (1 - t_1) s N \cdot dt_s \\ & - (1 - e) s N \cdot db - k s N \cdot dm + \tau^N \cdot dN + \tau^S \cdot N ds + \tau^E \cdot s N de, \end{aligned} \quad (15)$$

where effective tax rates on the extensive margins of employment are defined as

$$\tau^E \equiv t_r w_r + b, \quad \tau^S \equiv t_s + [e t_r w_r - (1 - e) b] - k m - t_1 w_1, \quad \tau^N \equiv t_1 w_1 - t_2 w_2 + s \tau^S.$$

Using these rates, we can write the GBC as $T = t_2 w_2 + \tau^N N = 0$. If one more person switches from sector 2 employment into sector 1, net tax revenue rises by τ^N . The net impact consists of the differential tax liability of sector 1 over sector 2 employees plus the additional net tax revenue τ^S that is collected when a sector 1 worker gets fired, an event which occurs with probability s . The ‘effective’ firing tax τ^S captures the fiscal consequences of job separation. It consists of the firing tax paid by firms, plus the average net tax liability of a worker after separation, equal to $e t_r w_r - (1 - e) b$, minus spending km on ALMP per capita of a fired worker, minus the foregone tax $t_1 w_1$ when this person is no longer employed in sector 1. Writing the net tax liability after separation as $e t_r w_r - (1 - e) b = e \tau^E - b$ reveals the fiscal gain τ^E of putting one more person back to work, consisting of the wage tax $t_r w_r$ of this reemployed person plus the savings in UI spending when the same person no longer collects benefits.

Using these effective tax rates and substituting the behavioral changes given above yields a change in *net* fiscal revenue equal to

$$\begin{aligned} dT = & (1 + \tau^N \eta_2) w_2 (1 - N) dt_2 + (1 - \tau^N \eta_1) w_1 (1 - s) N dt_1 \\ & + (1 - \tau^N \eta_r - \tau^E \varepsilon_r) w_r e s N dt_r - (1 - \tau^N \eta_h + \tau^E \varepsilon_b) (1 - e) s N db \\ & + (1 - t_1 - \tau^S \sigma - \tau^N \eta_s) s N dt_s - (k - \tau^N \eta_m - \tau^E \varepsilon_m) s N dm. \end{aligned} \quad (16)$$

For example, spending on more intensive ALMP rises by $k \cdot s N dm$ which obviously is a loss of *net* tax revenue. Since the policy attracts $\eta_m s N dm$ more workers to sector 1 as in (14), and each one adds τ^N in expected value to the government budget, net tax revenue rises by $\tau^N \eta_m s N dm$. The budget further improves since ALMP brings a larger portion of all fired persons back to work and raises the number of reemployed sector 1 workers by $\varepsilon_m s N dm$. Each of these persons who were previously unemployed and now get a job, pays tax and stops claiming benefits, adding τ^E to the budget. Adding up all these consequences, the net fiscal cost of more intensive ALMP is only $(k - \tau^N \eta_m - \tau^E \varepsilon_m) s N dm$ instead of $ks N dm$. The difference reflects self-financing due to the beneficial labor market consequences of the policy.

3.2 Welfare Optimal Policy

Expected utility ex ante, prior to entry, equals average welfare ex post. An optimal policy maximizes social welfare $V = \max_{t_1, t_r, b, t_s, m, t_2} NV_1 + (1 - N) V_2 - \int_0^N i(n) dn + \lambda T$ where λ is the Lagrange multiplier relating to the fiscal constraint $T = 0$. Due to occupational choice, a variation of N yields $dV = (V_1 - V_2 - i) dN = 0$. Welfare maximization thus implies $dV = NdV_1 + (1 - N) dV_2 + \lambda dT = 0$. Substituting (13) and (16) yields

$$\begin{aligned}
dV/dt_1 &= -[u'_1 - (1 - \tau^N \eta_1) \lambda] w_1 (1 - s) N = 0, \\
dV/dt_r &= -[u'_r - (1 - \tau^N \eta_r - \tau^E \varepsilon_r) \lambda] w_r e s N = 0, \\
dV/db &= [u'_h - (1 - \tau^N \eta_h + \tau^E \varepsilon_b) \lambda] (1 - e) s N = 0, \\
dV/dt_s &= -[(1 - t_1 - \nabla \sigma) u'_1 - (1 - t_1 - \tau^S \sigma - \tau^N \eta_s) \lambda] s N = 0, \\
dV/dm &= [-\phi' \zeta - (k - \tau^N \eta_m - \tau^E \varepsilon_m) \lambda] s N = 0, \\
dV/dt_2 &= -[u'_2 - (1 + \tau^N \eta_2) \lambda] w_2 (1 - N) = 0.
\end{aligned} \tag{17}$$

Taking ratios to eliminate the shadow price λ leaves five optimality conditions which, together with the fiscal constraint, implicitly determine the optimal values of the six unknown policy variables.

Consider first **unemployment insurance** (UI) of dismissed workers. Dividing the second and third conditions yields

$$\frac{u'_r}{u'_h} = \frac{1 - \tau^N \eta_r - \tau^E \varepsilon_r}{1 - \tau^N \eta_h + \tau^E \varepsilon_b} < 1. \tag{18}$$

The left side reflects the marginal rate of substitution between consumption in the reemployed and the unemployed state (equal to $-\frac{e}{1-e} \frac{u'_r}{u'_h}$) which indicates how much extra consumption an agent would need in the bad state to compensate for one unit given up in the good state. The right side is proportional to the marginal rate of transformation (equal to the fraction times $-\frac{e}{1-e}$) which states the rate at which government can shift consumption from the good to the bad state. If effort were inelastic (ε -elasticities zero), optimal policy would implement full consumption smoothing between retraining and unemployment, $u'_r = u'_h$ and, in turn, $\eta_r = \eta_h$. This is shown by the tangency point on the

45°-line in the right panel of Figure 2 where consumption in each state is denoted by c_j , i.e. $c_r = (1 - t_r) w_r$. However, insurance diminishes incentives for job search and retraining. Providing insurance becomes more costly when it contributes to higher unemployment. It inflates social spending and simultaneously loses tax revenue when an agent switches from work to unemployment. The net effect on the fiscal budget is proportional to the participation tax τ^E in both cases. Given that insurance becomes more costly, optimal policy advises limited insurance, leaving an income gap $(1 - t_r) w_r > b + h$ and $u'_r < u'_h$.

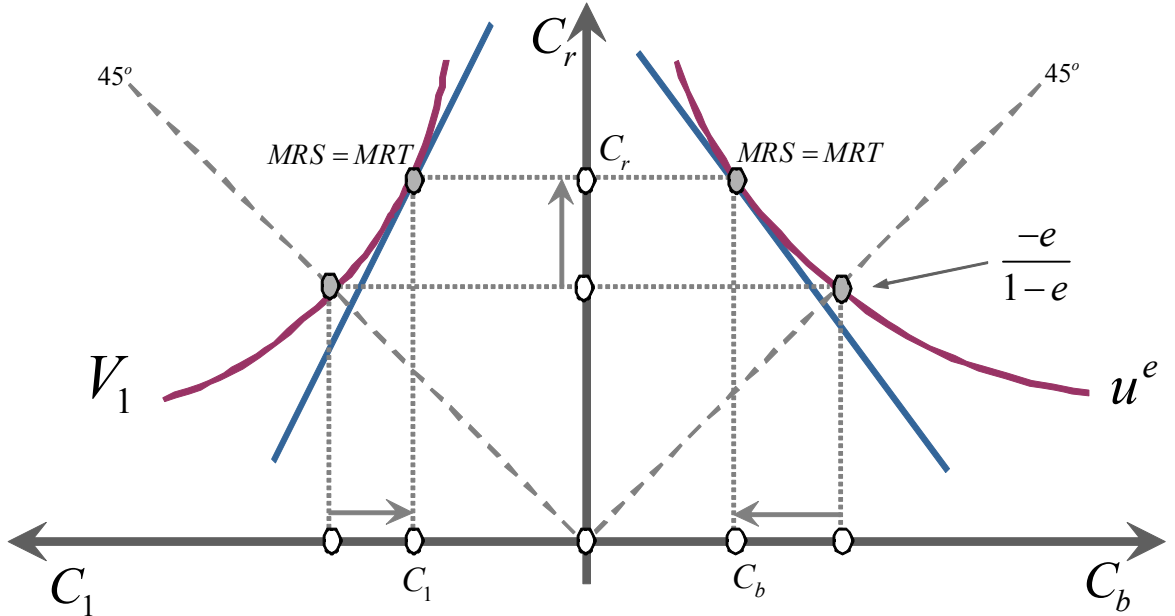


Fig. 2: Insurance and Job Search

We have assumed that job separation in the volatile industry leads to a depreciation of sector specific skills. In consequence, the next best job opportunity pays only a lower wage, $w_1 > w_r$. In other words, firing leads to an uninsured wage loss even if another job is found. Policy should thus provide to some extent **insurance for earnings risk** which is different from UI. Dividing the first and second conditions yields

$$\frac{u'_r}{u'_1} = \frac{1 - \tau^N \eta_r - \tau^E \varepsilon_r}{1 - \tau^N \eta_1} < 1. \quad (19)$$

Without moral hazard in UI ($\varepsilon_r = 0$), optimal policy aims at complete consumption smoothing between primary and reallocated employment, $u'_1 = u'_r$ and $\eta_r = \eta_1$, giving

$(1 - t_1)w_1 = (1 - t_r)w_r$. Full insurance requires a progressive rate structure, $t_1 > t_r$. If there is moral hazard, it becomes optimal, for given UI benefits, to strengthen incentives for retraining by shifting relatively more income towards reallocated employment. This calls for a higher tax rate on primary employment and an even more progressive tax system. With optimal policy, we thus have $(1 - t_1)w_1 < (1 - t_r)w_r$. The left panel of Figure 2 illustrates.⁷

Another policy concern is **redistribution** between sector 1 workers who are in well paying, but risky jobs, and sector 2 workers where wages are safe but low (we assumed $w_1 > w_r > w_2 > h$). Dividing the first and last conditions yields

$$\frac{u'_1}{u'_2} = \frac{1 - \tau^N \eta_1}{1 + \tau^N \eta_2} < 1. \quad (20)$$

Clearly, if the skill distribution were exogenous and a result of pure luck, $\eta_j = 0$, and investment in sector 1 skills were thus completely inelastic, optimal policy would also implement full redistribution, $u'_1 = u'_2$ and $(1 - t_1)w_1 = (1 - t_2)w_2$. Due to $w_1 > w_2$, and ignoring for the moment other taxes and spending, the fiscal constraint $t_1 w_1 N + t_2 w_2 (1 - N) = 0$ requires a tax on sector 1 workers and a transfer t_2 to sector 2 workers. In general, we can write the fiscal budget as $t_2 w_2 = -\tau^N N$ where the effective tax τ^N on sector 1 workers finances a transfer $t_2 w_2 < 0$ to sector 2 workers. Imperfectly elastic skill investment prevents perfect income smoothing since such redistribution diminishes incentives for initial skill investment and, thus, becomes increasingly costly. Hence, with positive η -elasticities, $u'_1 < u'_2$ and $(1 - t_1)w_1 > (1 - t_2)w_2$.

The government may use a firing tax to implement an optimal degree of **job protection**. Noting $\eta_s \equiv (1 - t_1 - \nabla \sigma) \eta_1$, the first and fourth conditions yield

$$\tau^S = \nabla = (u_1 - u^e) / u'_1 \quad \Rightarrow \quad t_s = t_1 w_1 + [(1 - e)b - t_r w_r e] + km + \nabla. \quad (21)$$

The firing tax performs the same role as in Blanchard and Tirole (2008), even though the tax has new redistributive implications and additionally affects job creation and hiring. Its

⁷We assume that a job loss reduces utility so much that the participation constraint $u_1 > u^e$ is slack. With full consumption smoothing, $u_1 = u_r = u_h$, the utility loss, $u_1 - u^e = (1 - e)\chi + \phi\zeta(e)$ is positive if ζ and χ are positive, where e is determined by $\chi = \phi\zeta'(e)$.

purpose is to internalize negative firing externalities. When dismissing a worker, the firm imposes an income equivalent utility loss ∇ on that person. In addition, creates a fiscal externality consisting of several components. First, there is one person less paying the tax t_1 , and there is one person more who collects on average a net subsidy $(1 - e) b - t_r w_r e$, and there is extra spending km per capita on ALMP. All these components might justify a substantial level of the firing tax.

Finally, **active labor market policy** (ALMP) can usefully complement other instruments. In raising m , the government spends a larger amount km per capita of the sN dismissed workers who are in need to be reallocated to another job. Dividing the fifth by the first condition, noting $\eta_m = (-\phi'\zeta/u'_1)\eta_1$ and rearranging yields⁸

$$\frac{du^e/dm}{du_1/dc_1} = \frac{-\phi'\zeta}{u'_1} = k - \tau^E \varepsilon_m. \quad (22)$$

The left side states the marginal benefit of ALMP which raises expected utility u^e of a fired relative to a retained worker. The social cost of ALMP consists of the marginal resource cost k per capita and is reduced by the budget savings $\tau^E \varepsilon_m$ if ALMP puts a larger fraction of fired workers back to work. The elasticity ε_m measures how effective ALMP is to support job reallocation and boost reemployment among dismissed workers. The budget savings are proportional to the participation tax $\tau^E = t_r w_r + b$. Immervoll et al. (2007) found participation tax rates in Europe to vary mostly between 50 to 70% of gross wages, and up to 80% in Nordic countries. The upshot is that the participation tax and, in turn, the fiscal savings from ALMP are large in a generous welfare state with high benefits. These savings reduce the social cost of ALMP and lead to larger programs. ALMP programs thus become an essential ingredient of an advanced welfare state.

Finally, to put our analysis of flexicurity into perspective, we reproduce two central results of Blanchard and Tirole (2008), henceforth BT, as a special case of the present

⁸ALMP is productive since $du^e/dm = -\phi'\zeta > 0$ by the envelope theorem. Instead of reducing search cost, ALMP could raise earnings on the next job, $w'_r(m) > 0$, which boosts search and utility as well, $du^e/dm = e(1 - t_r)w'_r u'_r > 0$. However, a purely sanctions based system which reduces utility during unemployment, e.g. $\chi'(m) > 0$, cannot be part of an optimal program since $du^e/dm = -(1 - e)\chi' < 0$.

model. Excluding entry and job creation, we fix the mass of sector 1 workers at $N = 1$. Further, BT abstracted from job reallocation so that $e = 0$ and firing always results in unemployment. With these margins fixed, the ε - and η -elasticities are all zero. Social welfare is $V_1 = (1 - s)u_1 + s(u_h - \zeta)$. The fiscal constraint reduces to $T = t_1w_1(1 - s) + (t_s - b)s = t_1w_1 + s\tau^S = 0$, where $\tau^S \equiv t_s - b - t_1w_1$ is the effective firing tax, or subsidy. The optimality conditions in (17) with respect to t_1 , b and t_s are reduced to

$$u'_1 = \lambda = u'_h, \quad \tau^S = \nabla. \quad (23)$$

The optimal policy in BT assures full consumption smoothing $(1 - t_1)w_1 = \lambda = h + b$. The stigma ζ of a job loss thus leads to a utility differential between work and unemployment equal to $\nabla = (u_1 - u_h + \zeta)/u'_1 = \zeta/u'_1$. Now suppose first that stigma is absent, so that $\tau^S = \nabla = 0$. The fiscal constraint $t_1w_1 = -s\tau^S$ then implies $t_1 = 0$, and $t_s = b$. Benefits are exclusively financed with a firing tax with no other tax on wages. Full consumption smoothing implies $w_1 = h + b$. Substituting this into (2) leads to a firing threshold $Ax_1 = w_1 - t_s = h + b - t_s = h$, i.e. $Ax_1 = h$ as in Proposition 1 of BT. If there is a positive stigma, the effective firing tax $\tau^S = \nabla$ is positive, implying $t_s = b + t_1w_1 + \nabla$. The fiscal budget leads to a wage subsidy $t_1w_1 = -s\nabla < 0$. Substituting t_s into the firing rule and noting full insurance yields $Ax_1 = h - \nabla < h$. If there is stigma of job loss, the firing externality becomes larger. Optimal policy thus raises the firing tax to reduce job separation. Since this also depresses wages, workers are compensated by an employment subsidy $t_1w_1 < 0$. These results replicate Proposition 2 of BT.

4 Policy Reform

In optimizing a social welfare function reflecting the allocative and distributive goals of public policy, the last section has derived an optimal flexicurity policy as part of the overall tax benefit schedule. The optimal policy with six policy instruments, t_1, t_r, b, t_s, m and t_2 , is only implicitly determined by six conditions, i.e. (18-22) together with the fiscal

constraint. This section considers piecemeal reform. We aim to show how a small policy reform implementing steps towards an optimal policy leads to beneficial labor market and sectoral adjustment and, thereby, promises welfare gains. The first experiment starts out with an untaxed, free market equilibrium and introduces a flat rate UI scheme where all workers pay the same proportional contribution rate to finance benefits of unemployed workers. This experiment resembles most current UI schemes which have largely flat contribution rates and often contain cross-subsidization between groups with different unemployment risks. In subsequent scenarios, we ‘improve’ on this scheme by adjusting the structure of tax rates and by complementing the tax benefit schedule with ALMP and with job protection by means of a firing tax. All scenarios must fulfill the fiscal constraint in (16), $dT = 0$, where effective tax rates are defined in (15). Inserting the welfare change of sector 1 employees in (13), social welfare changes by $dV = NdV_1 + (1 - N) dV_2$, or

$$\begin{aligned} dV = & -u'_r w_r e s N dt_r - u'_1 w_1 (1 - s) N dt_1 - u'_2 w_2 (1 - N) dt_2 \\ & + u'_h (1 - e) s N db - \phi' \zeta s N dm - (1 - t_1 - \nabla \sigma) u'_1 s N dt_s. \end{aligned} \quad (24)$$

Flat Unemployment Insurance: Suppose the government finances benefits with a flat tax, $t_1 = t_r = t_2 = t$, and abstains from any other labor market intervention, i.e. $t_s = m = 0$. Since there are gains from insurance, the policy must be welfare improving, at least if it is operated at a small scale. In this experiment, the wage structure is exogenous to the policy change since the wage w_1 is fixed by $t_s = 0$. Starting from a free market equilibrium with zero taxes implies $\tau^j = 0$. Financing small UI benefits and satisfying the constraint in (16) requires a small increase in the uniform tax rate of

$$\Gamma dt = (1 - e) s N db, \quad \Gamma \equiv w_1 (1 - s) N + w_r e s N + w_2 (1 - N), \quad (25)$$

where Γ is the tax base consisting of average wage earnings of individuals in different jobs. Substituting into the welfare differential and evaluating at $t = b = 0$ yields

$$\left. \frac{dV}{dt} \right|_{b=0} = \left[1 - \frac{u'_1 w_1 (1 - s) N}{u'_h \Gamma} - \frac{u'_r w_r e s N}{u'_h \Gamma} - \frac{u'_2 w_2 (1 - N)}{u'_h \Gamma} \right] \Gamma u'_h > 0. \quad (26)$$

The income distribution is characterized by $w_1 > w_r > w_2 > h$, implying marginal rates of substitution all smaller than one. Since the weights of these ratios add up to unity, the

square bracket is positive. Offering small UI clearly raises welfare when private insurance markets are missing. Since tax distortions are initially small, the gains from insurance more than justify the tax cost.

The flat UI scheme, by assumption, does not make use of the firing tax, so that the wage and the separation rate in the volatile industry, w_1 and s , remain constant. Substituting (25) into (12) shows that the policy reform diminishes employment,

$$de/dt = -[ew_r\varepsilon_r + (\Gamma/sN)\varepsilon_b]. \quad (27)$$

Clearly, UI benefits and the contribution tax discourage retraining and search effort so that job reallocation slows down and unemployment among dismissed workers rises.

Substituting the fiscal balancing rule stated above into the entry response in (14) and noting the definition of Γ yields

$$dN/dt = (\eta_h - \eta_1)w_1(1-s)N + (\eta_h - \eta_r)w_re sN + (\eta_h + \eta_2)w_2(1-N) > 0. \quad (28)$$

The impact is unambiguously positive since $w_1 > w_r > h$ implies $u'_1 < u'_r < u'_h$ and, therefore, $\eta_1 < \eta_r < \eta_h$, when evaluated in the initial untaxed equilibrium. The policy implicitly cross-subsidizes from sector 2 to sector 1 workers and, thus, encourages more people to enter the volatile industry. Entry results from occupational choice and is driven by $V_1 - i(N) = V_2$. Raising the tax rate clearly reduces utility from sector 2 work since the policy extracts tax from sector 2 workers without any compensation. Sector 1 workers also pay tax when employed, but are offered benefits when unemployed. In net terms, sector 1 workers benefit from cross-subsidization so that expected utility V_1 rises. Both effects stimulate investments in sector 1 skills and encourage entry.

Aggregate unemployment reflects job creation as well as firing and job search. The unemployment rate is $\delta = (1-e)sN$. Given a constant firing rate, the scenario changes unemployment by $d\delta = -sNde + (1-e)sdN > 0$. More entry exposes a larger fraction of the population to unemployment risk. Further, reallocation of dismissed sector 1 workers slows down and a larger share of them ends up unemployed. Both factors contribute to

more unemployment. Since occupational choice determines the economy's sectoral composition, the impact of entry on the unemployment rate also reflects structural change which shifts employment from stable to highly volatile sectors or, equivalently, from sectors with low to sectors with high unemployment incidence. Thereby, the aggregate unemployment rate is a function of the economy's sectoral structure.

We now perform further policy experiments, assuming that a flat UI scheme is in place but no other tax or labor market policy is used. The result of this first experiment is that the participation tax on dismissed workers is relatively large, $\tau^E \equiv tw_r + b > 0$. In contrast, even though there is no statutory firing tax, $t_s = 0$, the effective tax on firing is negative, $\tau^S \equiv [etw_r - (1 - e)b] - tw_1 < 0$, since UI among dismissed workers is cross-subsidized by other groups so that the square bracket is negative. If UI were strictly limited to dismissed workers, insurance would be actuarially fair, $etw_r = (1 - e)b$. Given a negative effective tax τ^S , the flat UI scheme ends up subsidizing firing of workers in the volatile industry. Firing thus leads to a loss in the fiscal budget proportional to τ^S . Finally, the policy cross-subsidizes from sector 2 to sector 1 workers and, thereby, encourages entry and job creation in sector 1. This is seen by the fiscal constraint $T = tw_2 + \tau^N N = 0$, which implies $\tau^N < 0$ when $t > 0$. With $\tau^N = tw_1 - tw_2 + s\tau^S$ negative, the effective firing tax τ^S must actually be strongly negative.

Sectoral Redistribution: The flat tax rate structure to finance UI does not satisfy the distributional concerns in policy making. Given concave utility and the fact that earnings are lower in sector 2, a welfare based policy calls for redistribution from sector 1 to sector 2, and not vice versa. Starting from the flat UI scheme, this experiment raises the tax rate on sector 1 workers to cut the tax burden on low wage earners in sector 2. By (16), budget balance dictates a higher tax rate on sector 1 employees when t_2 is reduced,

$$w_1 (1 - s) N dt_1 = - \frac{1 + \tau^N \eta_2}{1 - \tau^N \eta_1} w_2 (1 - N) dt_2. \quad (29)$$

The flat UI scheme redistributes towards sector 1, $\tau^N < 0$, which is the ‘wrong’ direction. Evaluating (24) shows how redistribution towards sector 2 boosts welfare,

$$dV = - \left[\frac{u'_2}{u'_1} - \frac{1 + \tau^N \eta_2}{1 - \tau^N \eta_1} \right] u'_1 w_2 (1 - N) dt_2. \quad (30)$$

Since $w_1 > w_2$, the square bracket is clearly positive. Hence, starting from a flat scheme and moving towards a more progressive rate structure ($dt_1 > dt_r = 0 > dt_2$) is welfare improving. Since this policy reform keeps not only $t_s = m = 0$ constant but also t_r and b , it has no impact on the separation rate s and on job search and labor reallocation e . The only effect is on entry and job creation. Evaluating (14) subject to (29) yields

$$dN = \left[\eta_2 + \eta_1 \frac{1 + \tau^N \eta_2}{1 - \tau^N \eta_1} \right] w_2 (1 - N) dt_2 < 0. \quad (31)$$

Both the lower tax rate on sector 2 and the higher rate on sector 1 employment discourage entry and employment in the volatile industry. Since neither the firing rate nor the rate of job reallocation are affected, the policy also squeezes aggregate unemployment, $d\delta = (1 - e) sdN < 0$. When a smaller part of the population gets employed in the volatile sector, a smaller part is subject to unemployment risk. Structural change contributes to lower unemployment when sectors with high unemployment rates shrink and sectors with a low unemployment incidence expand.

Subsidizing Job Reallocation: While redistribution calls for a progressive tax structure ($t_1 > t_2$), the government might want to reduce the effective rate t_r below t_1 by complementing the wage tax schedule with special tax credits or wage subsidies to reemployed workers in order to encourage retraining, thereby reducing the rate t_r below t_1 . In fact, the tax schedule might actually become non-monotonic with $t_1 > t_2 > t_r$ in spite of $w_1 > w_r > w_2$ as it clearly does in the optimal policy scenarios of the next section. The rationale of this policy rests on the following arguments. Wage taxes and UI discourage retraining and job search of fired workers and reduce the transition rate e into alternative employment. When switching from unemployment into a job, individuals face a very high participation tax τ^E . Bringing down the participation tax and thereby encouraging retraining and job search helps to speed up job reallocation. Since high benefits are needed

to provide insurance, the only way to do so is to reduce the tax rate t_r . This motivates a reform shifting the tax burden from reemployed workers, the middle income wage earners in our model, towards the top (and bottom) income class,

$$w_1 (1 - s) N dt_1 = - \frac{1 - \tau^N \eta_r - \tau^E \varepsilon_r}{1 - \tau^N \eta_1} w_r e s N dt_r. \quad (32)$$

Starting from the flat tax benefit schedule, the policy boosts welfare by

$$dV = - \left[\frac{u'_r}{u'_1} - \frac{1 - \tau^N \eta_r - \tau^E \varepsilon_r}{1 - \tau^N \eta_1} \right] u'_1 w_r e s N dt_r. \quad (33)$$

Since $u'_r > u'_1$ and $\eta_r > \eta_1$ in the initial equilibrium with a flat scheme, the square bracket is clearly positive. Hence, raising t_1 to finance a budget neutral tax cut for reemployed workers, $dt_r < 0$, boosts welfare. Since firing depends neither on t_1 nor on t_r , the separation rate is unchanged. However, the cut in the participation tax stimulates job search and reemployment of dismissed workers by $de = -\varepsilon_r w_r e dt_r$. Substituting (32) into (14) and noting $\eta_r/\eta_1 = u'_r/u'_1$ yields

$$dN = - \left[\frac{u'_r}{u'_1} - \frac{1 - \tau^N \eta_r - \tau^E \varepsilon_r}{1 - \tau^N \eta_1} \right] \eta_1 w_r e s N dt_r. \quad (34)$$

By the same argument as before, the lower tax on reemployed workers, $dt_r < 0 < dt_1$, boosts entry and employment in the volatile industry. The effect on aggregate unemployment $\delta = (1 - e) s N$ is ambiguous since $1 - e$ falls while N rises.

Job Protection: The next reform introduces job protection to complement the flat UI scheme. Since the firing tax is an extra cost, sector 1 firms compete down the wage to break even in zero profit equilibrium. To compensate workers, the scenario cuts the tax rate t_1 subject to fiscal budget balance,

$$w_1 (1 - s) N dt_1 = - \frac{1 - t - \tau^S \sigma - \tau^N \eta_s}{1 - \tau^N \eta_1} s N dt_s. \quad (35)$$

Substituting into the welfare change stated in (24) and using $\eta_s = (1 - t_1 - \nabla \sigma) \eta_1$ yields

$$dV = u'_1 \frac{\nabla - \tau^S}{1 - \tau^N \eta_1} \sigma s N dt_s. \quad (36)$$

Job protection reduces turnover, $ds = -\sigma s dt_s$, so that workers are exposed less frequently to the utility loss $\nabla u'_1 = u_1 - u^e$. The firing tax, however, leads to an a priori ambiguous effect on disposable income of sector 1 employees. Since the flat UI scheme subsidizes firing, i.e. $\tau^S < 0$, the reduced job separation yields a fiscal dividend in proportion to τ^S which allows a relatively larger tax cut t_1 . Disposable earnings and welfare increase on this account. However, the tax also forces firms to cut the gross wage. Depending on the size of the tax cut relative to the wage reduction, the net of tax wage may rise or fall. Using (35) and (5), and making use of $\eta_s = (1 - t_1 - \nabla \sigma) \eta_1$, yields

$$d[(1 - t_1) w_1] = \frac{\nabla \tau^N \eta_1 - \tau^S}{1 - \tau^N \eta_1} \frac{\sigma s}{1 - s} dt_s. \quad (37)$$

Sector 1 employees benefit from job protection since $\tau^S < 0$ at the outset. Despite of a lower gross wage, the compensating tax cut more than offsets this income loss, i.e. u_1 rises while u^e remains constant. The introduction of a firing tax clearly boosts welfare.

Entering sector 1 thus promises higher expected welfare which induces more workers to invest in sector specific skills and allows the volatile industry to expand employment. Evaluating (14) and using the same steps as before results in

$$dN = \frac{\nabla - \tau^S}{1 - \tau^N \eta_1} \sigma \eta_1 s N dt_s. \quad (38)$$

Shifting labor to the volatile sector inflates unemployment $\delta = (1 - e) s N$ since unemployment is concentrated there. Hence, joblessness rises with the expansion of the volatile industry while a lower separation rate reduces unemployment. Since the reemployment rate e is constant in this scenario, unemployment changes by $d\delta = (1 - e) [sdN + Nds]$. Substituting the change in entry and job separation yields an ambiguous net effect of

$$\frac{1}{(1 - e) \sigma s N} \frac{d\delta}{dt_s} = - \left[1 - \frac{\nabla - \tau^S}{1 - \tau^N \eta_1} s \eta_1 \right] = - \frac{1 - (\nabla s + t w_1 - t w_2) \eta_1}{1 - \tau^N \eta_1}, \quad (39)$$

where the second equality uses $\tau^N = t w_1 - t w_2 + s \tau^S$. To identify the conditions favoring a rise or fall in unemployment, one may interpret a large $\nabla = (u_1 - u^e) / u'_1$ as a high degree of sector specificity of skills. High sector specificity means that a worker suffers a large loss in wage and utility ∇ when loosing her job. Further, a high separation rate s

stands for short employment tenure and high job-turnover, characterizing a very volatile industry. Finally, a large value of η_1 means that entry into sector 1 is very elastic.

Starting with a flat UI scheme, a small firing tax changes the unemployment rate as in the last term above. If sector 1 is characterized by a large degree of sector specificity of skills (∇ large), high job turnover (large s), and elastic labor supply (high η_1 , reflecting elastic entry), a firing tax combined with a budget neutral wage subsidy ($dt_s > 0 > dt_1$) could actually raise unemployment. The reason is that all these conditions favor entry and a large expansion of the volatile industry where the sectoral unemployment rate is high, while the stable sector with a low (zero) unemployment rate strongly shrinks. The resulting increase in the unemployment rate could dominate the reduction in unemployment on account of a lower separation rate. However, this is not possible when the firing tax is close to its optimal value, implying $\nabla = \tau^S$, and is further increased.⁹ In this case, the unemployment rate unambiguously falls, see the first equality above.

Active Labor Market Policy: Finally, we analyze the consequences of complementing the flat UI scheme by introducing ALMP to facilitate retraining, search and job reallocation. Again, we raise the wage tax of workers in the volatile industry since the policy benefits them by improving their labor market prospects if they get fired. Spending more an ALMP by raising m thus requires a higher tax on sector 1 employees,

$$w_1 (1 - s) N dt_1 = \frac{k - \tau^N \eta_m - \tau^E \varepsilon_m}{1 - \tau^N \eta_1} s N dm. \quad (40)$$

Welfare rises if the gains from better labor market prospects after firing dominate the welfare loss from a higher tax on sector 1 employment. Using $\eta_m = -\phi' \zeta \eta_1 / u'_1$ yields a welfare change that is related to the optimality condition in (22),

$$dV = \left[\frac{-\phi' \zeta}{u'_1} - (k - \tau^E \varepsilon_m) \right] \frac{u'_1}{1 - \tau^N \eta_1} s N dm. \quad (41)$$

Whether ALMP is welfare improving depends on its potency to raise expected utility of fired workers, $du^e/dm = -\phi' \zeta > 0$, relative to its cost, $k - \tau^E \varepsilon_m$. Obviously, if it is

⁹Note that (35-39) are also valid when t_s is positive at the outset.

too costly (k high), the policy reduces welfare and is not advised. However, if high UI benefits are offered to insure workers, the participation tax τ^E is high and the policy yields large fiscal gains. In bringing more people back to work, the policy boosts tax revenue and contains social spending. Hence, the net fiscal cost of ALMP is greatly reduced in the presence of a large welfare state. This is even more the case if the policy is very effective in reallocating workers, as indicated by a large elasticity ε_m . Given that ALMP is sufficiently productive, it becomes an essential ingredient of the welfare state.

ALMP boosts job search by $de = \varepsilon_m dm$. Given a constant firing tax t_s , the separation rate remains unchanged. If the policy boosts welfare, it also encourages entry. Imposing budget balance and using $\eta_m = -\phi'\zeta\eta_1/u'_1$ yields an entry response in (14) equal to

$$dN = \left[\frac{-\phi'\zeta}{u'_1} - (k - \tau^E \varepsilon_m) \right] \frac{\eta_1}{1 - \tau^N \eta_1} s N dm. \quad (42)$$

ALMP cannot influence unemployment via the firing channel since s is fixed in this scenario. On the positive side, ALMP clearly speeds up job reallocation and reduces the unemployment risk after a job loss. However, by encouraging entry into the volatile sector, it also raises the absolute levels of job separation which adds to unemployment $\delta = (1 - e) s N$. The net effect is a priori ambiguous. However, if ALMP is at its optimal level, the square bracket is zero and ALMP does not affect entry and sectoral composition at the margin. In this case, ALMP reduces unemployment by stimulating job search.

5 Comparative Statics of Optimal Policy

This section numerically illustrates our results and shows how optimal flexicurity changes with risk-aversion, volatility and behavioral elasticities. In all cases, we recalibrate the model to yield the same data. Column ‘Flat’ in Table 1 reports equilibrium values when policy is not optimized and neither a firing tax nor ALMP are used. The tax schedule is flat with a rate of 18%. Revenues finance public consumption equal to 15% of GDP, and UI benefits. Public goods per capita are fixed and, thus, do not affect welfare analysis.

Initially, 60% of the labor force train to become employed in the volatile sector where the separation rate is 25%.¹⁰ After separation, 60% get reemployed in the safe sector, the rest ends up unemployed. Unemployment amounts to 6%, reflecting job creation (entry), job destruction (firing) and the frictions in job reallocation (search). Ultimately, only 45% of the workforce remain employed in the volatile industry and 49% end up in the safe sector. The gdp share of the volatile sector is about 55%.

	Variables	Flat	Base	RA	JS	Vol	Entry	-Alm
<i>Optimal policy:</i>								
t_1	Tax sector 1	0.180	0.149	0.143	0.150	0.138	0.165	0.146
t_2	Tax sector 2	0.180	0.109	0.125	0.110	0.112	0.084	0.109
t_r	Tax retrained	0.180	0.020	0.027	0.022	0.024	0.037	-0.005
b_r	Replacement rate UI	0.500	0.418	0.569	0.579	0.414	0.401	0.525
t_s	Firing tax	0.000	0.885	0.946	0.917	0.861	0.873	0.918
m	Search assistance	0.000	0.394	0.264	0.126	0.392	0.383	0.000
τ^E	Eff. tax search	0.783	0.503	0.686	0.691	0.503	0.503	0.598
τ^S	Eff. tax firing	-0.358	0.415	0.433	0.433	0.414	0.409	0.516
τ^N	Eff. tax entry	-0.017	0.105	0.078	0.104	0.102	0.150	0.106
<i>Economic impact:</i>								
s	Separation rate	0.250	0.074	0.063	0.068	0.114	0.076	0.068
e	Reemployment rate	0.600	0.778	0.653	0.620	0.778	0.779	0.636
N	Entry rate	0.600	0.579	0.580	0.579	0.570	0.575	0.578
δ	Unemployment rate	0.060	0.010	0.013	0.015	0.014	0.010	0.014
es	Reallocation rate	0.150	0.058	0.041	0.042	0.089	0.059	0.043
w_1	Wage rate sector 1	1.400	1.229	1.224	1.226	1.208	1.230	1.226
X_1	Sector 1, % of GDP	0.556	0.603	0.610	0.608	0.577	0.598	0.607
X	GDP, %)	0.000	2.008	1.226	1.200	1.830	1.969	1.224
V	Welfare, *)	0.000	6.492	7.365	6.354	5.396	6.649	6.359

Legend: All values in absolute terms, %) change in percent. *) Welfare change in percent of initial GDP, $100*(V - V_0)/X_0$. (FLAT): flat tax rate and no welfare policy. (BASE): policy with base line parameters $\rho = 1.75$, $\epsilon = .4$, $var(x) = 3$ and $\eta = .8$. (RA): high value of risk-aversion $\rho = 3$. (JS): low elasticity of job search $\epsilon = .2$. (VOL): high volatility $var(x) = 5$. (ENTRY): low elasticity of entry $\eta = .4$. (-ALM): no active labor market policy $m = 0$.

Table 1: Comparative Statics of Optimal Welfare Policy

¹⁰In a dynamic model, the separation rate is the inverse of job tenure, $1/s = 4$ years in our case.

Column ‘Base’ reports the consequences of fully optimizing flexicurity and tax policy. Note first the effective tax rates in the status quo as defined in (15). The effective tax on job search is a high .78 which amounts to 68% of a retrained worker’s wage ($\tau^E/w_r = .68$, which is the sum of the tax rate and UI replacement rate). Such high values are consistent with the calculations of participation tax rates in Europe by Immervoll et al. (2007). More surprisingly, the status quo involves a high firing *subsidy* equal to $\tau^S = -.35$ which amounts to about 25% ($= \tau^S/w_1$) of a worker’s salary. This subsidy consists of the tax loss from each person that is fired ($t_1 w_1 = .25$) plus the net budget cost of a fired worker (equal to $et_r w_r - (1 - e)b = -.1$). Firing imposes a substantial net cost on the fiscal budget. Finally, the initial flat tax equilibrium also involves a small entry subsidy τ^N . Although the tax liability of sector 1 workers exceeds that in sector 2 by $t \cdot (w_1 - w_2)$, this net entry tax is more than offset by the firing subsidy $s\tau^S$ that sector 1 workers receive whenever they loose their job.

With baseline parameter values, moving to a fully optimized policy leads to several adjustments of instruments. First, reflecting distributional concerns, the government moves to a progressive wage tax schedule by raising the tax rate on high sector 1 earnings relative to the tax rate on lower sector 2 earnings, $t_1 > t_2$. Second, it strongly reduces the tax rate t_2 to encourage job search and retraining after separation from sector 1 employment. The difference $t_1 - t_r$ may be interpreted as a wage subsidy to facilitate job reallocation. Third, and for the same reason, the government reduces unemployment benefits of dismissed workers, leading to a lower replacement rate of .41 instead of .5 initially. This means that the initial replacement rate was too high, given the degree of risk-aversion. As a result, the effective tax on job search is much reduced from .78 to .5. Fourth, the government imposes a large firing tax to internalize the negative firing externalities which turns the effective subsidy of $-.36$ into an effective tax on firing equal to .4. In consequence, the separation rate is strongly reduced from 25 to 7% of initially hired workers which, in turn, reduces the reallocation rate es despite of a higher reemployment rate e among fired workers. The firing tax also raises significant public revenues and contributes to an overall lower tax burden. Fifth, the government also introduces an

ALMP program to reduce private search costs and facilitate retraining, and spends .7 percent of GDP for this purpose. Together with the fiscal incentives provided by the lower participation tax τ^E , the policy boosts the reemployment rate e (from 60 to 78%) as a result of successful job search.

Implementing the optimal policy actually raises the entry tax. The definition of τ^N shows that this partly results from moving to a progressive tax structure reflecting distributional concerns so that sector 1 work is subject to an additional tax liability $t_1 w_1 - t_2 w_2$. Another reason is the Pigovian firing tax which leads to a reduction in expected private earnings in sector 1 equal to $s\tau^S$. The firing tax thereby reduces job creation and, together with the progressive wage tax, discourages employment in the volatile sector. Entry is further discouraged by the fact that the firing tax is shifted to workers by squeezing the gross wage from 1.4 to 1.23. The entry rate declines from 60 to 58%. All three behavioral responses taken together lead to a large reduction of the frictional unemployment rate from 6 to 1 percent, down by 5 percentage points. The decline in unemployment not only reflects a lower separation and a larger reemployment rate. Lower entry means a reallocation away from sectors with above average to sectors with below average (zero) unemployment. At the same time, the baseline scenario shows not only an increase in aggregate gdp (plus 2%) but also a larger gdp share of the volatile sector (up by 4 percentage points from 56 to 60% of gdp). Although the policy reduces entry, any given hiring results in much more employment on account of a lower separation rate.

Finally, moving to an optimal flexicurity policy yields substantial welfare gains, equal to 6.5% of gdp in the baseline case. Sector 2 workers benefit from a much lower tax. Expected utility V_1 of sector 1 work rises too but ex post utilities change in intricate ways. Workers who remain employed in sector 1, loose despite of a lower tax rate since the firing tax on firms strongly reduces the gross wage w_1 , see (5). Workers reemployed after separation strongly benefit from a reduction in the net tax t_r . Separated workers who remain unemployed, get lower benefits and are worse off, but there are few since unemployment is strongly reduced. Despite of these offsetting changes, expected welfare

after separation clearly rises, also because job search assistance reduces search costs and boosts welfare. In general, the total welfare gain results from reducing excessive UI to a lower optimal level;¹¹ introducing a Pigovian tax to internalize firing externalities; providing job search assistance which yields welfare gains like a public good; and gains from redistribution towards sector 2 workers who enjoy lower utility at the outset.

The last five columns of Table 1 show how optimal policy changes with structural characteristics and should be compared to column ‘Base’. Column ‘RA’ refers to an economy where individuals are more risk-averse. Obviously, a larger degree of risk-aversion calls for more consumption smoothing. Starting out from the equilibrium given in column ‘Flat’, the immediate consequence is a larger replacement rate for UI. To a large part, the fiscal cost is paid for by raising the firing tax because firing now causes a larger externality. More generous UI weakens job search incentives. Interestingly, the optimal policy does not imply larger wage subsidies of reemployed workers to offset these incentives. In fact, the tax rate t_r slightly rises. Compared to the baseline, the optimal policy accepts a larger effective tax rate on job search when risk-aversion is high. Instead, a rise in unemployment is largely prevented by containing job separation. Compared to the base case, the unemployment rate is up from 1 to only 1.3%.

Interestingly, ALMP is significantly scaled back. The intuition follows from the fact that the firing tax is shifted to sector 1 workers by lowering the gross wage, see (5), leading to lower utility of retained workers while the welfare of a fired worker rises both with UI benefits and search assistance, see (12). In trading off utility of retained and fired workers, the government thus cuts back on job search assistance when higher risk-aversion calls for more generous UI benefits to smooth consumption more evenly across states. Optimal policy also shifts towards a less progressive tax schedule, i.e. t_1 is reduced and t_2 increased, compared to the base case. Since employment in sector 1 is risky and safe in sector 2, intuition suggests that higher risk-aversion requires a larger risk-premium

¹¹Obviously, if there were no UI at the outset, there would be strong gains from insurance in a setting with missing private UI markets.

on sector 1 income. All adjustments result in a lower entry tax τ^N , leading to a slight and rather insignificant increase in entry. Overall, Table 1 shows a lower gdp gain from implementing the optimal policy which mainly reflects the reduced effectiveness in job reallocation. Nevertheless, the welfare gains of moving to an optimal policy are larger, reflecting the larger gains from insurance.

Column ‘JS’ differs from the baseline only in that job search is less elastic. Optimal policy adjusts by raising UI benefits, leading to a replacement rate of 58 instead of 42% and to a higher effective tax on job search. Since a higher replacement rate raises the firing externality, the government imposes an even higher firing tax and, to balance utility of retained and fired workers, cuts back on job search assistance. The reemployment rate increases much less compared to the baseline while the separation rate declines only to a moderate extent so that the reallocation rate falls. In consequence, the optimal policy results in a smaller GDP gain of 1.2 instead of 2%. Other changes are negligible.

Keeping other parameters at baseline values, column ‘Vol’ raises the variance of productivity shocks in sector 1 from 3 to 5. The average productivity is increased in a compensating way in order to keep the firing threshold and, thus, the separation and wage rates constant, leaving the flat tax equilibrium unaffected. Table 1 shows that the optimal policy basically remains unchanged. However, since a higher volatility reduces the firing elasticity (the larger dispersion of the uniform distribution implies a smaller density $g(x_1)$ in equation 5), the firing tax increases the separation rate to some extent, to 11% up from 7% in the baseline case. Since the firing tax is paid more often, increasing costs and forcing a somewhat larger reduction in the wage rate in zero profit equilibrium. Therefore, entry into sector 1 is reduced by about 1 percentage point. The higher firing rate magnifies and the lower entry rate shrinks unemployment. On net, unemployment is up by roughly half a percentage point. A higher volatility dampens the gdp and welfare gains from implementing the optimal policy package.

Column ‘Entry’ considers an economy with a lower entry elasticity. Compared to the baseline case, Table 1 indicates that less elastic entry facilitates redistribution between

workers in volatile, high paying jobs, and safe jobs with moderate salaries. Optimal tax rates t_1 and t_r are up by about 1.5 percentage points while the tax on sector 2 workers is reduced from 10.9 to 8.4%. The government thus adopts a more progressive tax structure (with t_r being interpreted as t_1 minus a wage subsidy). The remaining parts of the optimal policy package as well as effective tax rates on search and firing essentially remain unchanged. Reflecting the larger redistribution, the effective entry tax rises from 10.5 to 15% which slightly impairs entry. The larger scope for redistribution also rises the welfare gain from moving towards an optimal policy.

The last column ‘Alm’ repeats the baseline policy scenario except that the use of job search assistance is artificially excluded ($m = 0$). Obviously, this leads an optimizing government to adjust the remaining policy instruments. Instead of raising welfare of fired workers by reducing their effort cost of job search, the government offers higher unemployment benefits and reduces the wage subsidy, i.e. the tax t_r of the reemployed. Since this adjustment inflates the firing externality, the optimal firing tax is increased as well. Effective tax rates on job search and firing are up while the entry tax is essentially unchanged. Compared to the base case, job separation is further reduced and reemployment less frequent. Excluding ALMP thus dampens the gdp gain, mainly due to weaker search incentives and moderately higher unemployment.

6 Conclusions

The process of creative destruction in an advanced economy leads to a constant reallocation of labor and creates frictional unemployment. The experimentation with new production techniques, high job turnover, the riskiness of employment relationships and, therefore, the incidence of unemployment varies across sectors. One may think of highly volatile innovative industries compared to more stable traditional sectors. Technological progress and exposure to international competition may be relatively more concentrated in highly productive manufacturing and internationally traded services while non-traded

sectors and services are less productive but also less volatile with lower sectoral unemployment rates. If high productivity and skill intensity are correlated with volatility, then unemployment, compared to earlier times, should differ less along the high- and low-skilled dimension and more between employment in volatile compared to less volatile sectors.

More turbulent economic times, characterized by increasing globalization, rapid technological progress and ongoing restructuring, create pressure on welfare states. It is often informally argued that the flexicurity model might be a better solution in more turbulent times. Flexicurity is usually defined by three pillars: (i) flexibility in firing if jobs turn out unproductive and labor would be better used somewhere else; (ii) social insurance to protect against the income risk of job separation; and (iii) active labor market policy to facilitate labor reallocation to new employment opportunities. This paper proposes a two sector model to analyze flexicurity where one sector is more productive but highly volatile while the other offers stable employment at lower wages. In consequence, unemployment is concentrated in the volatile industry. Structural change happens on two margins. The first is sector specific skill investment and entry of workers into the volatile industry rather than the safe sector. Retraining of workers fired in the volatile industry for alternative employment in the safe sector is a second channel for structural change.

Within this framework, we have characterized optimal welfare policies combining the design of the wage tax schedule with social insurance, job protection and activation measures. We emphasize five results. First, tax progressivity is motivated by redistribution from workers in highly paid sector 1 jobs to those with lower wages in sector 2. Second, the tax schedule is complemented by special tax credits or subsidies to encourage retraining and search for alternative employment. Third, public unemployment insurance is necessary due to missing private markets. Fourth, negative firing externalities create a need for an optimal degree of job protection. And fifth, active labor market policy is an essential ingredient of a large welfare state if it is sufficiently productive in stimulating reemployment and raising individual welfare by reducing private search costs.

Appendix

The Appendix informs about calibration. Since job separation is concentrated in the volatile sector, the firing rate is much higher than the average value of 10% reported in Blanchard and Portugal (2001), for example. We calibrate the entry cost f_e , the productivity parameter A and the dispersion z of the uniform distribution such that the equilibrium supports the separation rate, the wage structure and the zero profit condition. We normalize the wage structure by setting $w_2 = 1$. Since innovative industries also tend to be more volatile, we assume entry into sector 1 to require specific upfront training. Hence, workers in sector 1 earn the most and, if reemployed and retrained, earn more than workers who avoid the sector specific training and directly go to the safe sector. We calibrate the model to yield $w_1 = 1.4$ in the baseline scenario and set $w_r = 1.15$. The wage loss after job separation is roughly in line with the results noted in Burda and Mertens (2001), among others. They find that workers in the highest earnings quartile loose on average 17% of the last wage in their next job. We use this result to reflect our assumption that the volatile sector is more innovative and skill intensive.¹²

We are not aware of any empirical estimates of the value of home production and set $h = .2 \times w_r$ together with $b = .5 \times w_r$. While the replacement rate in UI benefits is roughly OECD average, the total replacement rate including the value of home production is .7 and, thus, relatively high. We set the firing tax to zero in the initial equilibrium while Table 1 reports optimal firing taxes as a share of annual salary (t_s/w_1) around 71-77%. These optimal values are somewhat higher than actual job dismissal costs equal to 6 months salary (midway from values in Hopenhayn and Rogerson, 1993, and Heckman and Pages, 2000). Surveys on the effect of ALMP find they are small, around one percent of gdp. The optimal values of ALMP spending fluctuate around .7% of gdp in Table 1,

¹²Data from the ILO (2010) show that computer programmers in private insurance companies were paid 20% more than those in public administration (in 2006; US). Burda and Mertens (2001) also report that, on average across all earning classes, workers loose only 3.6% of the last wage in the next job in Germany, compared to a loss of 10-25% in the U.S.

ranging from .2 to 1.1% depending on the specific scenario. With respect to the three behavioral margins, we first note that the firing elasticity $ds = -\sigma s dt_s$ given in equation (5) is .2, meaning that an increase in the firing tax by 10 percentage points ceteris paribus reduces the separation rate by 2 percentage points.

The elasticity of job search is governed by the curvature of the effort cost function, but also by the utility loss of unemployment. Blanchard and Tirole (2008) mention evidence of this being substantial, so we set it at $\chi = .3 \times w_r$. Given this value, we calibrate the concavity of the effort cost function ζ to reflect empirical studies on the elasticity of unemployment spells with respect to UI benefits (.5 in the survey by Krueger and Meyer, 2002). The calibration implies that, ceteris paribus, and starting from a value of $b_r = .5$, an increase in the replacement rate by 1 percentage point reduces the unemployment rate by .5 percentage points. The entry margin can either be interpreted as job creation or as training for sector specific skills. We parameterize the cost function $i(N)$ such that a one percent increase in expected utility of entering sector 1 attracts additional workers of η percentage points of the labor force, $dN = \eta \cdot dV1/|V1|$. We set the semi-elasticity at $\eta = .8$. Finally, results on optimal unemployment insurance are fundamentally driven by the degree of relative risk-aversion. Chetty (2008) uses a value of 1.75 and reports that values up to 5 are not implausible. We settle for a baseline value equal to $\rho = 1.75$.

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