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ARNAUD CHÉRON, ANTHONY TERRIAU

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Training and Job-to-Job Mobility with Transfer Fees

Arnaud Chéron[*] & Anthony Terriau[†]

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Abstract

This study examines the potential impact of introducing a transfer system, similar to the one used in the soccer players' labor market, into the standard labor market. We first develop a toy model to highlight the theoretical properties of transfer fees. We demonstrate that, unlike non-compete clauses, which create a trade-off between training and mobility, transfer fees encourage investment in training without limiting mobility to more productive firms. Next, we develop a life-cycle model with endogenous job creation and destruction, on-the-job search, and training. Using data from the French Labor Force Survey, we estimate the model parameters and conduct counterfactual experiments to assess the potential effects of implementing a transfer system in the French labor market. Our results indicate that a time-limited entitlement to compensation, similar to what exists in the soccer players' labor market, would significantly boost employment and welfare.

JEL Classification: J24, J41, J63

Keywords: Training; On-the-Job Search; Transfer Fees; Life Cycle

[*]GAINS, Le Mans University

[†]GAINS, Le Mans University

1 Introduction

It is now well understood that labor market frictions imply that firms not only invest in specific human capital of workers, but also in general human capital, in opposition to the competitive view of human capital investments as developed by Becker (1962). This echoes empirical studies suggesting that employers primarily invest in general training (Acemoglu and Pischke, 1999; Loewenstein and Spletzer, 1999; Autor, 2001). However, if firm-sponsored training is primarily general, it raises an issue highlighted by Acemoglu (1997). Firms invest in training based on their private returns but fail to account for the fact that general training can increase a worker's productivity in future jobs. This is known as the *poaching externality*. Since firms do not internalize this positive externality, it leads to underinvestment in training compared to what would be socially optimal.

How can optimality be restored? In general, there are two strategies for addressing a positive externality: the Pigouvian strategy and the Coasian strategy. The Pigouvian approach involves implementing a training subsidy that adjusts the private returns to training, ensuring that firms' training decisions align with those of the social planner. This solution was for instance considered in Chéron and Terriau (2018), where the authors proposed a training subsidy based on individuals' age and education level, as these two factors largely determine the magnitude of the poaching externality. While this approach is interesting, the Pigouvian strategy has several limitations. First, the policy's effectiveness depends on how the subsidy is financed. For instance, if the government funds the subsidy through a distortionary tax, it risks deviating from the social optimum. Second, the Pigouvian approach requires accurately measuring the poaching externality for each type of agent in order to properly calibrate the subsidy, which is difficult to achieve in practice.

The Coasian strategy involves assigning property rights to each agent and allowing them to negotiate. According to the Coase theorem, if property rights are well-defined and transaction costs are sufficiently low, negotiation should lead to an equilibrium that aligns with the social optimum. In practice, the social optimum is rarely achieved due to the presence of asymmetric information, limited enforceability of certain contractual clauses, or high transaction costs. An example of a Coasian policy is the non-compete clause,[1] which can be seen as a property right held by the employer over the worker. Shi (2023) developed a model incorporating on-the-job search, training, and non-compete clauses. The model, calibrated for the U.S. economy, shows that while NCCs stimulate investment in training, they also hinder mobility to more productive firms. The negative impact on mobility outweighs the positive effect on training, sug-

[1] A non-compete clause (NCC) is a contractual provision that restricts an employee from working for, or becoming a competitor to, their former employer for a specified period of time.

gesting that banning NCCs would be preferable to increase welfare. Notably, in April 2024, the Federal Trade Commission passed a final rule to ban most NCCs in employment agreements.[2]

In this paper, we first develop a toy model to demonstrate that NCCs create a trade-off between training and mobility, and that under certain conditions, banning them is preferable, aligning with the conclusions of Shi (2023). Next, we explore an innovative policy and analyze the impact of implementing a transfer system similar to that used in soccer. Our results show that, in such a system, there is no trade-off between training and mobility: transfer fees encourage investment in training without limiting mobility to more productive firms. We then develop a life-cycle model with endogenous job creation and destruction, on-the-job search, and training to assess the effects of implementing a transfer system in the French labor market. We find that introducing a time-limited entitlement to compensation would significantly boost employment and welfare without generating additional public costs.

The remainder of the paper is organized as follows: Section 2 presents a toy model in which we compare training and mobility decisions across three different economies (a laissez-faire economy, an economy with non-compete clauses, and an economy with transfer payments). Section 3 introduces a more sophisticated model to assess the effects of implementing a transfer system in the standard labor market. Section 4 details the estimation of the model parameters and compares the moments generated by the model with those observed in the data. Section 5 presents the results of the counterfactual experiments (considering both time-limited and unlimited entitlement to compensation). The final section concludes.

2 Toy model

We begin by developing a toy model to compare training and mobility decisions in three different contexts: a laissez-faire economy (LF), an economy with non-compete clauses (NCC), and an economy with transfer fees (TF).[3] The theoretical framework common to all three economies is presented in subsection 2.1. The specific elements of each economy are detailed in subsections 2.2, 2.3, and 2.4

2.1 Environment

We consider a two-period model without discounting. There are no hiring frictions and no nonemployment. We differentiate between two types of firms: *hiring firms*, which

[2] By early 2024, approximately 20% of American workers, or about 30 million people, were subject to non-compete clauses.

[3] In Section 3, we then develop a more sophisticated model to more accurately assess the gains associated with implementing a transfer system.

recruit workers at the beginning of period 1 and can produce in both periods 1 and 2 (provided the worker is not poached by another firm), and *poaching firms*, which poach workers at the end of period 1 and produce only in period 2. Each firm is characterized by an idiosyncratic productivity p, drawn from the uniform distribution $G(p)$ over the interval $[0, 1]$.

When matched with a firm of productivity p, workers without human capital produce p. At the time of hiring (and only at this time), the firm can choose to pay a training cost z to increase the worker's productivity from p to $(1 + \Delta)p$, where $\Delta > 0$. The worker is trained only if $p \geq F$, where F is a productivity threshold. This threshold depends on the contractual environment and is denoted F^{LF}, F^{NCC}, and F^{TF} for the laissez-faire economy, the economy with non-compete clauses, and the economy with transfer fees, respectively.

We assume there is on-the-job search. At the end of period 1, the worker receives an outside offer at rate λ. The idiosyncratic productivity of the outside firm, denoted p', is drawn from the distribution G. Human capital is assumed to be transferable, so if the worker was trained at the beginning of period 1 and is poached by a firm with productivity p' at the end of period 1, the poaching firm's production in period 2 will be $(1 + \Delta)p'$. If the worker was not trained in period 1, the poaching firm's production in period 2 will simply be p'. The worker moves from the p-firm to the p'-firm only if $p' \geq \tilde{p}$, where $\tilde{p}$ is a productivity threshold. This threshold depends on the contractual environment and is denoted $\tilde{p}^{LF}$, $\tilde{p}^{NCC}$, and $\tilde{p}^{TF}$ for the laissez-faire economy, the economy with non-compete clauses, and the economy with transfer fees, respectively.

Training and mobility decisions are therefore summarized by the productivity thresholds F and $\tilde{p}$, which depend on the distribution G. We denote $S_1(p)$ as the expected joint surplus in period 1 for a firm with productivity p and a worker. This joint surplus depends on the contractual environment and is denoted $S_1^{LF}(p)$, $S_1^{NCC}(p)$, and $S_1^{TF}(p)$ for the laissez-faire economy, the economy with non-compete clauses, and the economy with transfer fees, respectively. In the following subsections, we will show that training decisions at the beginning of period 1 depend solely on the size of this joint surplus. Finally, in line with Thomson et al. (2006) that characterize solutions of bargaining process with N agents, and Amand et al. (2023) that consider this process for the labor market and three agents, we distinguish the bargaining power of hiring firms, denoted α, poaching firms, β, and workers, γ, with $\alpha + \beta + \gamma = 1$.

2.2 Laissez-faire (Bertrand competition)

We begin by describing a laissez-faire (LF) economy in which there are no contractual clauses. As in Aghion and Bolton (1987), Amand et al. (2023), and Shi (2023), we assume that if a worker employed by a p-firm receives an acceptable outside offer from a p'-firm, the p-firm and the p'-firm engage in Bertrand competition to retain or attract the worker.

The expected joint surplus of the firm-worker pair in period 1 within the laissez-faire economy is:

$$S_1^{LF}(p) = 2(1+\Delta \mathbb{1}_{F^{LF}})p + \lambda(1+\Delta \mathbb{1}_{F^{LF}})[1-\beta/(1-\alpha)]\int_{\tilde{p}^{LF}}^{1}(p'-p)dp' \qquad (1)$$

$$\text{where } \mathbb{1}_{F^{LF}} = \begin{cases} 1 & \text{if } p \geq F^{LF} \\ 0 & \text{if } p < F^{LF} \end{cases}$$

In each period, the firm-worker pair can produce $(1+\Delta \mathbb{1}_{F^{LF}})p$, depending on the training decision. Additionally, at the end of period 1, the worker may receive an outside offer at rate λ. The worker accepts the offer if and only if $p' \geq \tilde{p}^{LF}$. In the event of poaching, the p-firm receives no compensation. Due to Bertrand competition between employers, the worker captures the entire surplus of the p-firm, plus a share of the surplus differential proportional to their relative bargaining power, $\gamma/(\beta+\gamma)$. Since $\alpha+\beta+\gamma = 1$, this relative bargaining power can be rewritten as $[1-\beta/(1-\alpha)]$.[4] In period 1, the expected net gain from poaching for the firm-worker pair is $\lambda(1+\Delta \mathbb{1}_{F^{LF}})[1-\beta/(1-\alpha)]\int_{\tilde{p}^{LF}}^{1}(p'-p)dp'$.[5]

Note that in the laissez-faire economy:

$$\tilde{p}^{LF} = p \qquad (2)$$

Equation (2) implies that any firm with $p' > p$ can poach the worker. In the laissez-faire economy, the worker always moves to the most productive firm.

Substituting the value of $\tilde{p}^{LF}$ from Equation (2) into Equation (1) yields:

$$S_1^{LF}(p) = (1+\Delta \mathbb{1}_{F^{LF}})\left[2p + [1-\beta/(1-\alpha)]\frac{\lambda}{2}(1-p)^2\right] \qquad (3)$$

[4] Note that $\gamma/(\gamma+\beta) = (1-\alpha-\beta)/(1-\alpha) = 1-\beta/(1-\alpha)$.

[5] See Aghion and Bolton (1987), Amand et al. (2023), and Shi (2023) for more details on the poaching gains for each agent in this context.

From Equation (3), the hiring firm trains the worker in period 1 if:

$$\Delta\left[2p + [1-\beta/(1-\alpha)]\frac{\lambda}{2}(1-p)^2\right] > z \tag{4}$$

The productivity threshold F^{LF} required for training is such that:

$$\Delta\left[2F^{LF} + [1-\beta/(1-\alpha)]\frac{\lambda}{2}(1-F^{LF})^2\right] = z \tag{5}$$

2.3 Non-compete clauses

We now consider an economy where hiring firms can use non-compete clauses to prevent workers from joining competing firms. Following Aghion and Bolton (1987) and Shi (2023), we assume that the pair formed by the period-1 employer and the worker acts as a monopolist seller who does not observe the willingness to pay of the potential buyer (the poaching firm).[6]

The expected joint surplus of the firm-worker pair in period 1 within the economy with non-compete clauses is:

$$S_1^{NCC}(p) \quad = \quad 2(1+\Delta\mathbb{1}_{FNCC})p + \lambda(1+\Delta\mathbb{1}_{FNCC})[1-G(\tilde{p}^{NCC})](\tilde{p}^{NCC}-p) \tag{6}$$

In each period, the firm-worker pair can produce $(1+\Delta\mathbb{1}_{FNCC})p$, depending on the training decision. Additionally, at the end of period 1, the worker may receive an outside offer at rate λ. The firm-worker pair accepts the offer if and only if $p' \geq \tilde{p}^{NCC}$. Note that in an economy with non-compete clauses, the p-firm and the worker form a coalition that acts as a non-discriminating monopolist with respect to the poaching firm. In period 1, the expected net gain from poaching for the firm-worker pair is $\lambda(1+\Delta\mathbb{1}_{FNCC})[1-G(\tilde{p}^{NCC})](\tilde{p}^{NCC}-p)$.[7]

The firm-worker pair determines the value of $\tilde{p}^{NCC}$ that maximizes the expected joint surplus $S_1^{NCC}(p)$ in period 1. The first-order condition for this maximization problem

[6] As in Aghion and Bolton (1987) and Shi (2023), we assume that p' is not observable, but both parties are aware of the distribution G.

[7] See Aghion and Bolton (1987) and Shi (2023) for more details on the poaching gains for each agent in this context.

is:

$$
\begin{aligned}
&\lambda(1+\Delta\mathbb{1}_{F^{NCC}})[1-G(\tilde{p}^{NCC})-(\tilde{p}^{NCC}-p)g(\tilde{p}^{NCC})]=0\\
&\Leftrightarrow 1-G(\tilde{p}^{NCC})-(\tilde{p}^{NCC}-p)g(\tilde{p}^{NCC})=0\\
&\Leftrightarrow \tilde{p}^{NCC}=p+\frac{1-G(\tilde{p}^{NCC})}{g(p)} && (7)\\
&\Leftrightarrow \tilde{p}^{NCC}=\frac{p+1}{2} && (8)
\end{aligned}
$$

Equation (7) implies that $p' > p$ is no longer a sufficient condition for the worker to accept the outside offer. In particular, the worker will refuse to move to some firms that are more productive, but not productive enough to offset the non-compete clause, i.e. when $\tilde{p}^{NCC} > p' > p$. In this sense, the non-compete clause hinders mobility towards more productive firms.

Substituting the value of $\tilde{p}^{NCC}$ from Equation (8) into Equation (6) yields:

$$
S_1^{NCC}(p) \quad = \quad (1+\Delta\mathbb{1}_{F^{NCC}})\left[2p+\frac{\lambda}{4}(1-p)^2\right] \tag{9}
$$

From Equation (9), the hiring firm trains the worker in period 1 if:

$$
\Delta\left[2p+\frac{\lambda}{4}(1-p)^2\right] > z \tag{10}
$$

The productivity threshold F^{NCC} required for training is such that:

$$
\Delta\left[2F^{NCC}+\frac{\lambda}{4}(1-F^{NCC})^2\right] = z \tag{11}
$$

2.4 Transfer fees

We now consider an economy with a transfer system similar to that used in football. Following Amand et al. (2023), we assume that, in the case of poaching, the worker's new wage and the transfer fee paid by the p'-firm to the p-firm are determined through a three-agent Nash bargaining process between the current firm, the worker, and the poaching firm.[8] As shown by Amand et al. (2023), this bargaining process accurately replicates the distributions of transfer fees and wages in the presence of a transfer system.

[8]See Thomson et al. (2006) for the solution of a Nash bargaining problem with N agents.

The expected joint surplus of the firm-worker pair in period 1 within the economy with transfer fees is:

$$S_1^{TF}(p) \quad = \quad 2(1+\Delta \mathbb{1}_{F^{TF}})p + \lambda(1+\Delta \mathbb{1}_{F^{TF}})(1-\beta)\int_{\tilde{p}^{TF}}^{1}(p'-p)dp' \tag{12}$$

In each period, the firm-worker pair can produce $(1+\mathbb{1}_{F^{TF}})p$, depending on the training decision. Additionally, at the end of period 1, the worker may receive an outside offer at rate λ. The three agents agree on a transfer if and only if $p' \geq \tilde{p}^{TF}$. Due to the three-agent Nash bargaining, the agreement is mutually beneficial. Each agent receives their outside option plus a share of the surplus differential proportional to their relative bargaining power. The firm-worker pair thus captures a share of the surplus differential equal to $(\alpha+\gamma)/(\alpha+\beta+\gamma)$. Since $\alpha+\beta+\gamma=1$, this relative bargaining power can be rewritten as $1-\beta$. In period 1, the expected net gain from poaching for the firm-worker pair is $\lambda(1+\Delta \mathbb{1}_{F^{TF}})(1-\beta)\int_{\tilde{p}^{TF}}^{1}(p'-p)dp'$.[9]

Note that in the economy with transfer fees:

$$\tilde{p}^{TF} = p \tag{13}$$

Equation (13) implies that any firm with $p' > p$ can poach the worker. This indicates that, unlike non-compete clauses, transfer fees do not restrict mobility to more productive firms.

Substituting the value of $\tilde{p}^{TF}$ from Equation (13) into Equation (12) yields:

$$S_1^{TF}(p) \quad = \quad (1+\Delta \mathbb{1}_{F^{TF}})\left[2p + (1-\beta)\frac{\lambda}{2}(1-p)^2\right] \tag{14}$$

From Equation (14), the hiring firm trains the worker in period 1 if:

$$\Delta\left[2p + (1-\beta)\frac{\lambda}{2}(1-p)^2\right] > z \tag{15}$$

The productivity threshold F^{TF} required for training is such that:

$$\Delta\left[2F^{TF} + (1-\beta)\frac{\lambda}{2}(1-F^{TF})^2\right] = z \tag{16}$$

[9] See Amand et al. (2023) for more details on poaching gains for each agent in this context.

2.5 Corollaries

Corollary 1: $\tilde{p}^{NCC} > \tilde{p}^{LF} = \tilde{p}^{TF}$

The productivity threshold above which a worker accepts an outside offer is higher in an economy with non-compete clauses than in a laissez-faire economy, but remains the same in an economy with transfer fees as in a laissez-faire economy.

Proof: See Equations (2), (7) and (13)

Corollary 2: $F^{NCC} < F^{LF}$ if $\beta/(1-\alpha) > 1/2$

The productivity threshold required for training is lower in an economy with non-compete clauses than in a laissez-faire economy if the bargaining power of poaching firms is relatively high ($\beta/(1-\alpha) > 1/2$).

Proof: See Equations (5) and (11)

Corollary 3: $F^{NCC} < F^{TF}$ if $\beta > 1/2$

The productivity threshold required for training is lower in an economy with non-compete clauses than in an economy with transfer fees if the bargaining power of poaching firms is relatively high ($\beta > 1/2$).

Proof: See Equations (11) and (16)

Corollary 4: $F^{TF} < F^{LF}$

The productivity threshold required for training is always lower in an economy with transfer fees than in a laissez-faire economy.

Proof: See Equations (5) and (16)

Corollaries (1) and (2) demonstrate that non-compete clauses create a trade-off between training and mobility. On the one hand, non-compete clauses can, under certain conditions, stimulate investment in training by lowering the required productivity threshold (see Corollary (2)). On the other hand, they hinder mobility to more productive firms (see Corollary (1)). Shi (2023) suggests that, in the U.S. economy, the negative impact of non-compete clauses on mobility outweighs their positive effect on training, indicating that NCCs should be banned. This result supports the U.S. Federal Trade Commission's April 2024 decision to ban NCCs nationwide.

However, Corollaries (1) and (4) show that this trade-off between training and mobility does not exist under a transfer system. In fact, transfer fees stimulate investment in training (Corollary (4)) without hindering reallocations to more productive firms (see Corollary (1)). This may explain why, in soccer, unlike in other sports, we observe both significant investments in training and high player mobility (Amand et al., 2023).

Why are transfer fees a better tool than non-compete clauses? NCCs have two key drawbacks: i) NCCs must be defined *ex-ante* (before the training occurs), without knowing who the buyer will be or their willingness to pay. Asymmetric information causes the firm-worker pair to act as a non-discriminating monopoly. ii) NCCs must be limited in time and space, and must target a specific activity, making them difficult to enforce (Kinsey, 1991; Kafker, 1993). These two issues mean that the Coase theorem cannot be applied, and the resulting equilibrium is far from the social optimum. In contrast, these drawbacks do not exist in a transfer system because: i) Negotiation takes place *ex-post* (after the training has occurred). By this stage, the three parties know each other and can negotiate to reach a mutually beneficial agreement. ii) There is no enforcement issue. As a result, the equilibrium achieved under a transfer system is much closer to the social optimum (Amand et al., 2023).

In the next section, we develop a more sophisticated model to assess the potential gains of implementing a transfer system in the standard labor market.

3 A life-cycle model with endogenous job creation and destruction, on-the-job search, and training

The toy model presented in Section 2 demonstrates that the transfer system can encourage investment in training and, unlike non-compete clauses, it does not hinder reallocations to more productive firms. In this section, we develop a life-cycle model featuring endogenous job creation and destruction, on-the-job search, and training, and outline the model's key properties. In the subsequent sections, we will estimate the model's parameters and assess the impact of implementing a transfer system on the standard labor market.

3.1 Main assumptions

Compared to the toy model, we introduce the following elements:

i) **Workers' age t:** Workers are now characterized by a deterministic age $t \in [1, T]$. They enter the labor market at age 1 as nonemployed (and can therefore be employed from age 2) and retire at age T (and can therefore be employed until age $T-1$). The productivity thresholds that determine training and mobility decisions are now age-dependent, denoted by F_t and $\tilde{p}_t$, respectively.

ii) **General human capital and workers' type j:** In the toy model, workers enter the labor market without any general human capital and can only receive training from hiring firms during the first period. As a result, hiring firms cannot recruit workers who have already acquired general human capital through training. In a life-cycle framework, however, newly hired workers can, at least theoretically, be trained at any age. Therefore, we now need to differentiate between three types of workers:

- *untrained workers ($j = 0$)* who have no general human capital and are employed by a firm that is not sufficiently productive to provide training ($p < F_t$)
- *trainees ($j = 1$)* who have no general human capital and are employed by a firm that is sufficiently productive to provide training ($p \geq F_t$)
- *trained workers ($j = 2$)* who have general human capital and therefore do not need to be trained

Following Ljungqvist and Sargent (1998), we assume that general human capital may depreciate during periods of nonemployment with a probability ϕ. Accordingly, the term *untrained workers* ($j = 0$) refers to either workers who have never been trained or those who have lost their general human capital during a nonemployment spell.

iii) **Specific human capital and workers' type** s**:** Workers are characterized not only by their level of general human capital but also by their level of specific human capital, which they can accumulate through learning-by-doing. This process is entirely exogenous but helps improve the model's fit to the data, ensuring a more accurate assessment of policy reforms. Let s represent the level of specific human capital, which can be either low ($\underline{s}$) or high ($\overline{s}$). By definition, new matches begin with $s = \underline{s}$. At the end of the period, the worker may transition from $s' = \underline{s}$ to $s' = \overline{s}$ with probability ρ. Specific human capital increases a worker's productivity from p to $(1+s)p$ if they have no general human capital, and from $(1+\Delta)p$ to $(1+\Delta)(1+s)p$ if they do. It is important to note that workers lose their specific human capital if they change employers or lose their jobs.[10] See Appendix B for more details.

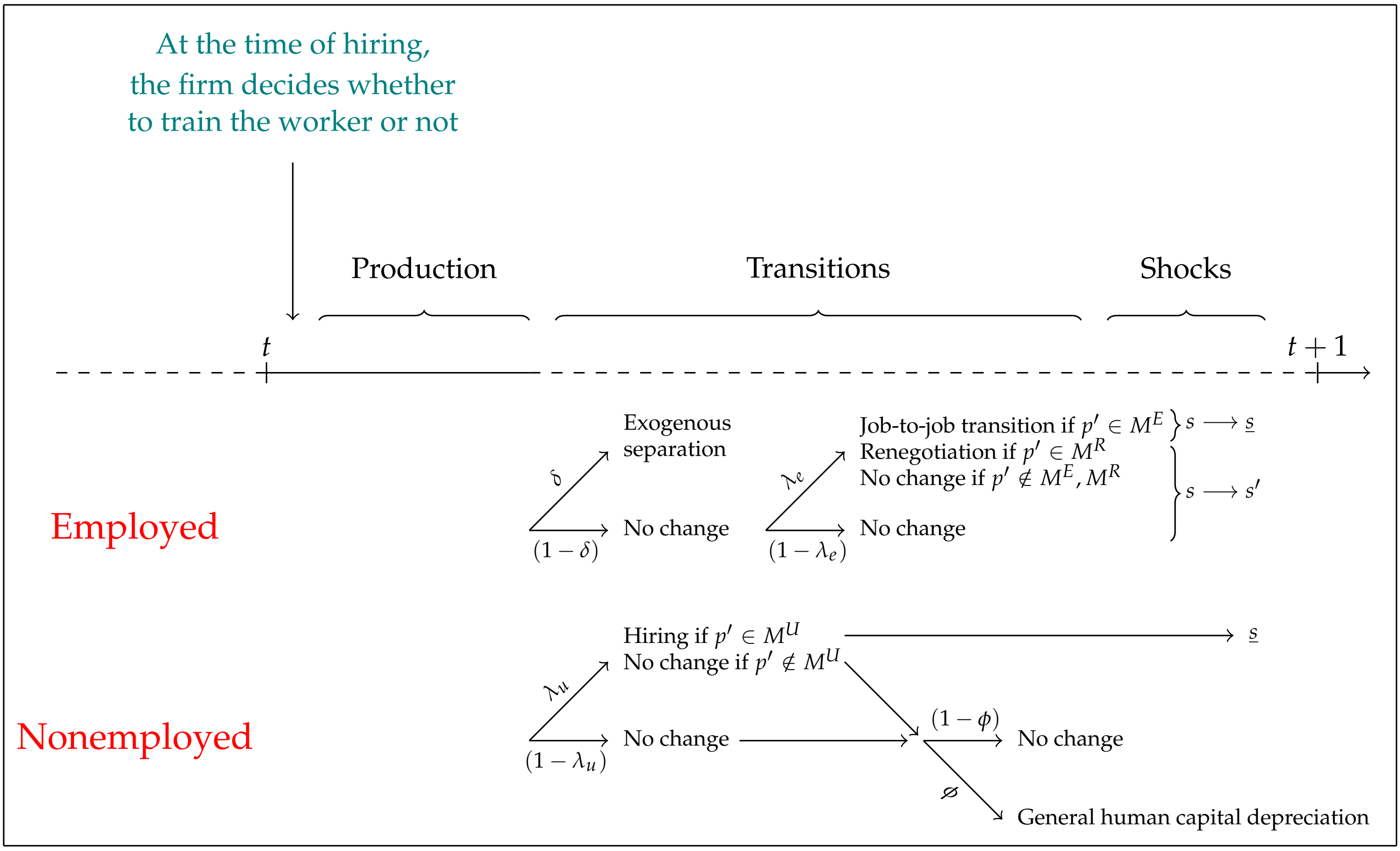
iv) **Firms' productivity** p**:** Firms are characterized by an idiosyncratic productivity $p \in [\underline{p}, \overline{p}]$, drawn from the distribution $G(p)$.

v) **Frictions:** Workers search for jobs both on- and off-the-job. Wages are restricted to fixed-wage contracts and can be renegotiated only when either party faces a *credible threat*. Employed workers may receive outside offers at an arrival rate of λ_e. Such an event may result in a job-to-job transition and wage renegotiation if $p' \geq p$, or in wage renegotiation without a job change if $p' < p$ but the outside offer improves the worker's bargaining position. Nonemployed workers may receive job offers at an arrival rate of λ_u. We assume that employed workers can transition from employment to nonemployment either endogenously, according to a productivity threshold defined later, or due to exogenous separations, which occur with probability δ.

Figure 1 illustrates the timing of events in this general model. Appendix B provides a detailed description of the value functions and joint surpluses, while Appendix C outlines the labor market flows.

[10] The model presented here assumes a binary representation of human capital: an individual either has no human capital (general or specific) or possesses a fixed level of human capital (general or specific) that does not increase further. In an alternative version, we simulate a model with multiple levels of human capital. While this significantly increases the model's resolution time, it does not alter the results, either qualitatively or quantitatively.

Figure 1: Timing of events



3.2 Joint surplus representation

At first glance, it may seem challenging to combine endogenous job creation and destruction, on-the-job search, and training within a life-cycle model where contracts can be renegotiated each period, especially when incorporating a transfer system. For example, training decisions depend on the expected duration of the job, which in turn is influenced by the worker's age and potential external offers. The decision to accept an external offer depends on the current wage (which reflects the history of all past external offers, as wages can be renegotiated each period) and the external offer received in the current period (which depends on the distribution of firms).

However, the model can be formulated in a very tractable way using a joint surplus representation. Following Bilal et al. (2022), Amand et al. (2023), and Jarosch (2023), we do not need to determine equilibrium wages. What matters for determining agents' decisions and labor market flows is the value of the joint surplus, not the specific way in which the worker and firm share it. All allocations–match acceptance, training, job-to-job mobility, and separation decisions–are uniquely determined by the dynamics of joint surpluses. An initial match is formed if the joint surplus is positive; a worker is trained if the joint surplus is higher with training than without; the worker moves from one job to another if the surplus of the new match exceeds that of the current match; and a job is endogenously destroyed if the joint surplus becomes negative. Thus, all agents' decisions can be made based on surpluses, and the model's parameters can be estimated from labor market flows and training access.

A general overview of this joint surplus representation, including our complete set of assumptions, is provided in Appendix B. The joint surplus depends on the firm's productivity p, the worker's age t, and the worker's specific human capital s. To simplify the presentation of the model, we do not include s as a state variable in the main text, but it is included in the appendix and accounted for in our simulations. Let $S_{j,t}(p)$ represent the joint surplus of a firm with productivity p and a worker of type j and age t.

When an nonemployed worker is hired, their wage is determined through a standard two-agent Nash bargaining process. We then assume that wages remain fixed and can only be renegotiated if one of the parties holds a credible threat. Thus, wages depend on the worker's negotiation benchmark, denoted NB, which corresponds to the maximum between the value of nonemployment and the value of the best outside offer received during the employment period. In the case of poaching, the worker's new wage depends on the contractual environment. In a laissez-faire economy, the current employer and the poaching firm engage in Bertrand competition to retain or attract the worker (Cahuc et al., 2006). In an economy with a transfer system, the worker's new wage and the transfer payment made by the poaching firm to the current employer are determined through three-agent Nash bargaining.[11]

Bargaining power is α for hiring firms, β for poaching firms, and γ for workers. In fact, Cahuc et al. (2006) implicitly assume that $\alpha = \beta$, meaning that hiring firms and poaching firms have equal bargaining power. A recent study by Shi (2023) also adopts this simplification. However, Amand et al. (2023) work on the soccer labor market emphasizes that the bargaining power of poaching employers may differ (be higher) from that of current employers. Accordingly, we allow for $\beta \neq \alpha$. We further show in Section 3.6 that this assumption is crucial for the age dynamics of the labor market equilibrium.

3.3 Laissez-faire (Bertrand competition)

We first consider a laissez-faire economy in which incumbent firms receive no compensation in the case of poaching. In this scenario, if a worker employed by firm p receives an acceptable outside offer from firm p', both the p-firm and the p'-firm engage in Bertrand competition to either retain or attract the worker.

We begin by describing the wage determination process for nonemployed workers. Let $E_{j,t}(p, NB)$ represent the value of employment for the worker, $U_{j,t}$ the value of nonemployment for the worker, and $J_{j,t}(p, NB)$ the value of a filled job for the firm. Let $S_{j,t}(p) = E_{j,t}(p, NB) - U_{j,t} + J_{j,t}(p, NB)$ represent the joint surplus, which is the private net value of the employment relationship between a p-firm and a worker of type j and age t.

It is important to note that the joint surplus value does not depend on the threat point; the negociation benchmark (NB) only affects how the firm and worker share the joint surplus, not its overall value. Throughout the rest of this paper, we will use the following notation:

$$S^{+}_{j,t}(p) = \max\{S_{j,t}(p), 0\}$$

Obviously, for a nonemployed worker, the threat point is the value of nonemployment. Therefore, the worker's negotiation benchmark is type-0 nonemployment for untrained workers (either type 0 or type 1) and type-2 nonemployment for workers who were previously trained. The relative bargaining power of the nonemployed worker compared to the hiring firm is $\gamma/(\gamma + \alpha)$. As a result, the sharing rules that

[11]See Amand et al. (2023) for a detailed presentation of the three-agent bargaining process in the presence of a transfer system. See Thomson et al. (2006) for the resolution of a Nash bargaining process with N agents.

determine the hiring wages of nonemployed workers are:

$$
\begin{aligned}
E_{0,t}(p,u) - U_{0,t} &= \frac{\gamma}{\alpha+\gamma} S_{0,t}(p);\ \forall p \geq R_{0,t} \\
E_{1,t}(p,u) - U_{0,t} &= \frac{\gamma}{\alpha+\gamma} S_{1,t}(p);\ \forall p \geq R_{1,t} \\
E_{2,t}(p,u) - U_{2,t} &= \frac{\gamma}{\alpha+\gamma} S_{2,t}(p);\ \forall p \geq R_{2,t}
\end{aligned}
$$

where $E_{j,t}(p,u)$ is the expected value of employment for a worker of type j and age t who is currently nonemployed and receives a contract with a p-firm. $U_{j,t}$ denotes the value for the worker if they remain nonemployed. $R_{j,t}$ represents the minimum productivity threshold for the joint surplus to be non-negative.

We now examine the wage determination process for a worker employed by a p-firm who receives a job offer from a p'-firm. Specifically, if $p' > p$, the worker's negotiation benchmark is no longer nonemployment. In this case, the current employer and the outside firm engage in Bertrand competition to retain or attract the worker, and this auction framework continues until the worker captures the entire surplus of the less-productive firm, i.e. the current employer. As a result, the worker's new threat point becomes the surplus value in their current firm. The worker can then leverage this new threat point to claim a share of the surplus differential between the current and new employer based on their relative bargaining power with respect to the poaching firm, which is $\gamma/(\gamma+\beta)$. More generally, we can express the following sharing rules for workers transitioning from p-firms to p'-firms:

$$
\begin{aligned}
\text{if } S_{0,t}(p') > S_{0,t}(p) \,\&\, S_{0,t}(p') > S_{1,t}(p') : E_{0,t}(p',p) - U_{0,t} &= S_{0,t}(p) + \frac{\gamma}{\beta+\gamma}[S_{0,t}(p') - S_{0,t}(p)] \\
\text{if } S_{1,t}(p') > S_{0,t}(p) \,\&\, S_{1,t}(p') \geq S_{0,t}(p') : E_{1,t}(p',p) - U_{0,t} &= S_{0,t}(p) + \frac{\gamma}{\beta+\gamma}[S_{1,t}(p') - S_{0,t}(p)] \\
\text{if } S_{2,t}(p') > S_{2,t}(p) : E_{2,t}(p',p) - U_{2,t} &= S_{2,t}(p) + \frac{\gamma}{\beta+\gamma}[S_{2,t}(p') - S_{2,t}(p)]
\end{aligned}
$$

First, it is important to note that although the type-1 situation lasts only one period by definition, we introduce the possibility for type-0 employed workers to become type-1 if they receive an offer from a firm with sufficiently high productivity p'. This case corresponds to the value $E_{1,t}(p',p) - U_{0,t}$. Second, due to Bertrand competition, the worker's surplus is composed of the total surplus captured from the current firm, as well as a share of the surplus differential proportional to the worker's relative bargaining power, i.e. $\gamma/(\beta+\gamma)$.

3.4 Transfer fees

We now consider the case where a transfer system enables a firm to receive compensation in the event of poaching. Following Amand et al. (2023), we assume that in this scenario, the worker's new wage w and the transfer fee T paid by the poaching firm to the current employer are determined through three-agent Nash bargaining. Once again, our goal here is not to determine the wage distribution, but rather to analyze how sharing rules, joint surpluses, and labor market flows would be affected by the implementation of a transfer fee system.

We begin by considering Nash bargaining for a worker who is initially untrained (type 0) in a p-firm, and who can either remain type-0 or become type-1 if p' is sufficiently high. For $j \in 0, 1$, we define:

$$\underset{T_{j,t},\, w_{j,t}}{\text{argmax}} \Big(\underbrace{T_{j,t}(p',p)}_{\substack{\text{Tranfer}\\ \text{fees}}} - \underbrace{J_{0,t}(p,u)}_{\substack{\text{Current firm's}\\ \text{outside option}}} \Big)^{\alpha} \Big(\underbrace{J_{j,t}(p',p) - T_{j,t}(p',p)}_{\substack{\text{Poaching firm's}\\ \text{net surplus}}} - \underbrace{0}_{\substack{\text{Poaching firm's}\\ \text{outside option}}} \Big)^{\beta} \Big(\underbrace{E_{j,t}(p',p)}_{\substack{\text{New value}\\ \text{of employment}}} - \underbrace{E_{0,t}(p,u)}_{\substack{\text{Worker's}\\ \text{outside option}}} \Big)^{\gamma}$$

where $\alpha + \beta + \gamma = 1$ and where $J_{j,t}(p',p)$ and $E_{j,t}(p',p)$ depend on $w_{j,t}$.

This problem is thus a weighted average of the respective net surplus of the transfer for both firms and the worker. Each party balances the benefits of the transfer against the status quo.

Similarly, for type-2 employed workers, we have:

$$\underset{T_{2,t},\, w_{2,t}}{\text{argmax}} \Big(\underbrace{T_{2,t}(p',p)}_{\substack{\text{Tranfer}\\ \text{fees}}} - \underbrace{J_{2,t}(p,u)}_{\substack{\text{Current firm's}\\ \text{outside option}}} \Big)^{\alpha} \Big(\underbrace{J_{2,t}(p',p) - T_{2,t}(p',p)}_{\substack{\text{Poaching firm's}\\ \text{net surplus}}} - \underbrace{0}_{\substack{\text{Poaching firm's}\\ \text{outside option}}} \Big)^{\beta} \Big(\underbrace{E_{2,t}(p',p)}_{\substack{\text{New value}\\ \text{of employment}}} - \underbrace{E_{2,t}(p,u)}_{\substack{\text{Worker's}\\ \text{outside option}}} \Big)^{\gamma}$$

From these optimization problems, we derive the following rules for determining wages and transfer fees:

$$\begin{aligned}
\text{if } S_{0,t}(p') > S_{0,t}(p) \ \& \ S_{0,t}(p') > S_{1,t}(p') \quad &: \\
E_{0,t}(p',p) - U_{0,t} \quad &= \quad E_{0,t}(p,u) - U_{0,t} + \frac{\gamma}{\alpha+\beta+\gamma}\left[S_{0,t}(p') - S_{0,t}(p)\right] \\
T_{0,t}(p',p) \quad &= \quad J_{0,t}(p,u) + \frac{\alpha}{\alpha+\beta+\gamma}\left[S_{0,t}(p') - S_{0,t}(p)\right] \\
\text{if } S_{1,t}(p') > S_{0,t}(p) \ \& \ S_{1,t}(p') \geq S_{0,t}(p') \quad &: \\
E_{1,t}(p',p) - U_{0,t} \quad &= \quad E_{0,t}(p,u) - U_{0,t} + \frac{\gamma}{\alpha+\beta+\gamma}\left[S_{1,t}(p') - S_{0,t}(p)\right] \\
T_{1,t}(p',p) \quad &= \quad J_{0,t}(p,u) + \frac{\alpha}{\alpha+\beta+\gamma}\left[S_{1,t}(p') - S_{0,t}(p)\right] \\
\text{if } S_{2,t}(p') > S_{2,t}(p) \quad &: \\
E_{2,t}(p',p) - U_{2,t} \quad &= \quad E_{2,t}(p,u) + \frac{\gamma}{\alpha+\beta+\gamma}\left[S_{2,t}(p') - S_{2,t}(p)\right] \\
T_{2,t}(p',p) \quad &= \quad J_{2,t}(p) + \frac{\alpha}{\alpha+\beta+\gamma}\left[S_{2,t}(p') - S_{2,t}(p)\right]
\end{aligned}$$

Notably, these rules show that the transfer fees $T_{j,t}(p', p)$ correspond to the hiring firm's outside option plus a share α of the surplus differential. Recalling that $J_{j,t}(p,u) = \frac{\alpha}{\alpha+\gamma}S_{j,t}(p)$, $E_{j,t}(p,u) - U_{j,t} = \frac{\gamma}{\alpha+\gamma}S_{j,t}(p)$, and that $\alpha+\beta+\gamma = 1$, we can rewrite:

$$\begin{aligned}
T_{j,t}(p',p) &= \frac{\alpha}{\alpha+\gamma}S_{0,t}(p) + \alpha\left[S_{j,t}(p') - S_{0,t}(p)\right], \text{for } j \in \{0,1\} \\
T_{2,t}(p',p) &= \frac{\alpha}{\alpha+\gamma}S_{2,t}(p) + \alpha\left[S_{2,t}(p') - S_{2,t}(p)\right]
\end{aligned}$$

3.5 Joint surpluses

We now define the joint surpluses.[12] The joint surplus depends not only on the external opportunities available to the worker (which may be influenced by their training status) but also on the possibility of transitioning to nonemployment. The valuation of these opportunities is closely tied to the sharing rules and the presence (or absence) of a transfer fee system. Let $\zeta \in [0,1]$ represent the discount factor. We introduce $\Psi \equiv \{1-\beta/(1-\alpha); 1-\beta\}$ for the cases with and without transfer fees, respectively.

Proposition 1 : Equilibrium joint surpluses satisfy, for $t = [1, T-1]$:

$$\begin{aligned}
S_{0,t}(p) &= p - b + \zeta S^+_{0,t+1}(p) \\
&+\zeta\Psi\lambda_e \int_{p'\in M^{E_0}_{t+1}(p)} \left(S^+_{0,t+1}(p') - S^+_{0,t+1}(p)\right) dG(p') \\
&+\zeta\Psi\lambda_e \int_{p'\in M^{E_1}_{t+1}(p)} \left(S^+_{1,t+1}(p') - S^+_{0,t+1}(p)\right) dG(p') \\
&-\frac{\gamma}{\alpha+\gamma}\zeta\lambda_u\left(\int_{p'\in M^{U_0}_{t+1}} S_{0,t+1}(p')\,dG(p') + \int_{p'\in M^{U_1}_{t+1}} S_{1,t+1}(p')\,dG(p')\right) \\
S_{1,t}(p) &= (1+\Delta)p - b - z + \zeta S^+_{2,t+1}(p) + \left(U_{2,t+1} - U_{0,t+1}\right) \\
&+\zeta\Psi\lambda_e \int_{p'\in M^{E_2}_{t+1}(p)} \left(S^+_{2,t+1}(p') - S^+_{2,t+1}(p)\right) dG(p') \\
&-\frac{\gamma}{\alpha+\gamma}\zeta\lambda_u\left(\int_{p'\in M^{U_0}_{t+1}} S_{0,t+1}(p')\,dG(p') + \int_{p'\in M^{U_1}_{t+1}} S_{1,t+1}(p')\,dG(p')\right) \\
S_{2,t}(p) &= (1+\Delta)p - b + \zeta S^+_{2,t+1}(p) \\
&+\zeta\Psi\lambda_e \int_p \left(S^+_{2,t+1}(p') - S^+_{2,t+1}(p)\right) dG(p') \\
&-\frac{\gamma}{\alpha+\gamma}\zeta\lambda_u\left(\int_{p'\in M^{U_2}_{t+1}} S_{2,t+1}(p')\,dG(p')\right)
\end{aligned}$$

$$\begin{aligned}
\text{with } U_{2,t} - U_{0,t} &= \left(U_{2,t+1} - U_{0,t+1}\right) + \frac{\gamma}{\alpha+\gamma}\zeta\lambda_u\Bigg[\int_{p'\in M^{U_2}_{t+1}} S_{2,t+1}(p',\underline{s})\,dG(p') \\
&- \int_{p'\in M^{U_0}_{t+1}} S_{0,t+1}(p')\,dG(p') - \int_{p'\in M^{U_1}_{t+1}} S_{1,t+1}(p')\,dG(p')\Bigg]
\end{aligned}$$

[12] See Appendix B for a detailed presentation, including exogenous specific human capital.

where sets M are defined as follows:

- $p' \in M_t^{E_0}(p)$: $p' \geq p$ and $p' < F_t$, with $S_{0,t}(F_t) = S_{1,t}(F_t)$
- $p' \in M_t^{E_1}(p)$: $p' \geq p$ and $p' \geq F_t$, with $S_{0,t}(F_t) = S_{1,t}(F_t)$
- $p' \in M_t^{U_0}$: $p' \geq R_{0,t}$ and $p' < F_t$, with $S_{0,t}(R_{0,t}) = 0$ and $S_{0,t}(F_t) = S_{1,t}(F_t)$
- $p' \in M_t^{U_1}$: $p' \geq R_{0,t}$ and $p' \geq F_t$, with $S_{0,t}(R_{0,t}) = 0$ and $S_{0,t}(F_t) = S_{1,t}(F_t)$
- $p' \in M_t^{U_2}$: $p' \geq R_{2,t}$, with $S_{2,t}(R_{2,t}) = 0$

Proof. See Appendix B for more details.

Note that $S_{2,t}(p) > S_{0,t}(p)\ \forall p$ and that F_t determines the productivity threshold at which the employer is indifferent between training the worker or not, i.e. $S_{1,t}(F_t) = S_{0,t}(F_t)$. Additionally, it is important to emphasize that transfer fees unambiguously increase the joint surplus, as $1 - \beta/(1-\alpha) < 1 - \beta$.

3.6 Age-dynamics of matching and training, and the role of transfer fees

Our objective now is to characterize some key properties of the model. We can derive the first set of properties by abstracting from training considerations and instead focusing on the age dynamics of $R_{0,t}$, which shapes the patterns of job creation and job destruction with age.

Corollary A :

Assuming no training, if $\frac{\alpha+\gamma}{\gamma}\Psi > \frac{\lambda_u}{\lambda_e}$, then $R_{0,t+1} > R_{0,t}\ \forall t$, meaning that job creation decreases and job destruction increases with age. Without transfer fees, $\Psi = \frac{\gamma}{\beta+\gamma}$, and the condition can be rewritten as $\frac{\alpha+\gamma}{\beta+\gamma} > \frac{\lambda_u}{\lambda_e}$.

Proof. For the sake of clarity, we assume here that $\zeta = 1$. Considering the equilibrium joint surplus without training (S_0) and without transfer fees ($\Psi = \frac{\gamma}{\beta+\gamma}$), we have:

$$\begin{aligned} S_{0,t}(p) &= p - b + S^+_{0,t+1}(p) + \Psi\lambda_e \int \left(S^+_{0,t+1}(p') - S^+_{0,t+1}(p)\right) dG(p') \\ &\quad - \frac{\gamma}{\alpha+\gamma}\lambda_u \int_{R_{0,t+1}} S_{0,t+1}(p')\, dG(p') \end{aligned}$$

As $S'_{0,t}(x) = 1 + [1 - \Psi\lambda_e(1-G(x))]S'_{0,t+1}(x)$, it follows that the equilibrium joint surplus takes the form $S_{0,t}(x) = \nu_{t,x}(x - R_{0,t})$, where $\nu_{t,x} \equiv \sum_{j=0}^{T-(t+1)}[1 - \Psi\lambda_e(1-G(x))]^j$.

The job creation and destruction decision rule depends on the productivity threshold $R_{0,t}$, which satisfies $S_{0,t}(R_{0,t}) = 0\ \forall t$. The age dynamics for $R_{0,t}$ can be solved recursively starting from

$t = T-1$. At the end of their working life, we have:

$$\begin{aligned} R_{0,T-1} &= b \\ R_{0,T-2} &= b - \tilde{v}_{T-1} \max\{[1-\Psi\lambda_e(1-G(R_{0,T-2}))][R_{0,T-2}-R_{0,T-1}], 0\} \\ &\quad + \tilde{v}_{T-1}\left\{\Psi\lambda_e \int_{\max(R_{0,T-2},R_{0,T-1})} (x-R_{0,T-1})dG(x) - \lambda_u \frac{\gamma}{\alpha+\gamma}\int_{R_{0,T-1}} (x-R_{0,T-1})dG(x)\right\} \end{aligned}$$

where $\tilde{v}_{T-1} = \tilde{v}_{T-1}$ if $R_{0,T-2} > R_{0,T-1}$, and $\tilde{v}_{T-1} = v_{T-1,R_{0,T-1}}$ if $R_{0,T-2} < R_{0,T-1}$.

From this, it is straightforward to see that $\frac{\lambda_e}{\beta+\gamma} > \frac{\lambda_u}{\alpha+\gamma}$ is a sufficient condition for $R_{0,T-1} - R_{0,T-2} > 0$. This implies, in particular, that $\max\{S_{0,T-1}(R_{0,T-2}), 0\} = 0$; therefore, in $T-2$, the productivity threshold can ultimately be written as:

$$R_{0,T-2} = b - \tilde{v}_{T-1}\left\{\Psi\lambda_e - \lambda_u\frac{\gamma}{\alpha+\gamma}\right\}\int_{R_{0,T-1}}(x-R_{0,T-1})dG(x)$$

By applying backward induction and using the properties $\max\{S_{0,t+1}(R_{0,t}), 0\} = 0$ and $\tilde{v}_{t+1} < \tilde{v}_t$, we can demonstrate that::

$$sign(R_{0,t+1} - R_{0,t}) = sign\left(\left\{\Psi\lambda_e - \lambda_u\frac{\gamma}{\alpha+\gamma}\right\}\left\{\int_{R_{0,t+1}}(x - R_{0,t+1} - \int_{R_{0,t+2}}(x-R_{0,t+2})\right\}\right).$$

Therefore, $\Psi\lambda_e > \lambda_u\frac{\gamma}{\alpha+\gamma}$ holds when $sign(R_{0,t+1} - R_{0,t}) > 0$. *QED.*

Corollary A highlights the key role of on-the-job search and the bargaining power of the poaching firm in the age dynamics of job creation and destruction. This can be seen first by considering the case where $\lambda_e \to 0$. At some point, if a worker is matched with a low-productivity firm, it may be beneficial for them to become nonemployed, and wait to draw a new job opportunity (from the entire set of possibilities) with probability λ_u. For instance, when $\lambda_e \to 0$, we observe $R_{0,T-2} > R_{0,T-1}$ (indicating decreasing job destruction with age), because at $T-1$, the value of an outside opportunity is null. However, when $\lambda_e > 0$, the shape of $R_{0,t}$ over time depends on bargaining powers. The match surplus now accounts for the possibility of job-to-job mobility and hinges on the ability of the firm-worker pair to capture a share of the surplus gap between the current firm and the poaching firm. The lower the poaching firm's bargaining power (β), the higher the current match surplus.

Consider, for instance, the case where $\lambda_u = \lambda_e$. If we are interested in the scenario where $R_{0,T-2} < R_{0,T-1}$ (and, more generally, $R_{0,t} < R_{0,t+1}$), then the current firm's bargaining power (α) must be greater than that of the poaching firm (β). If $\alpha = \beta$, the condition $\lambda_u < \lambda_e$ is sufficient.

Overall, this analysis highlights that the identification of the respective bargaining powers of current and poaching firms crucially depends on the job contact rates of nonemployed and employed workers. Clearly, studies that assume $\alpha = \beta$ are unable to address the key role played by the respective bargaining powers on the age dynamics of job creation and job destruction. Accordingly, our empirical investigation strategy focuses on job-to-job and nonemployment-to-employment transitions to identify the key parameters. Based on this set of identified parameters, we run counterfactual simulations to assess the potential impact of a transfer fee system.

Theoretically, the impact of the transfer fee system can already be analyzed by examining the impact of Ψ on the equilibrium, as Ψ is higher with transfer fees than without. However, we first focus on the impact of Ψ on job creation and destruction in the absence of training.

Corollary B :

Assuming no training and $\frac{\alpha+\gamma}{\gamma}\Psi > \frac{\lambda_u}{\lambda_e}$, then $\frac{dR_{0,t}}{d\Psi} \leq 0$, and the transfer fee system increases job creation and decreases job destruction.

Proof. Referring to the proof of Corollary A, we first observe that $\frac{dR_{0,T-1}}{d\Psi} = 0$ and $\frac{dR_{0,t}}{d\Psi} < 0$. Then, assuming $\frac{\alpha+\gamma}{\gamma}\Psi > \frac{\lambda_u}{\lambda_e}$, from Corollary A we also know that $R_{0,t+1} - R_{0,t} > 0$ and the productivity threshold characterizing job creation satisfies:

$$R_{0,t} = b - \tilde{v}_{t+1}\left\{\Psi\lambda_e - \lambda_u\frac{\gamma}{\alpha+\gamma}\right\}\int_{R_{0,t+1}}(x - R_{0,t+1})dG(x),$$

where $\tilde{v}_t \equiv \sum_{j=0}^{T-(t+1)}\{1 - \Psi\lambda_e[1 - G(R_{0,t+1})]\}^j$. From this, it is straightforward that $\frac{dR_{0,t}}{d\Psi} \leq 0$. *QED.*

This highlights the potential role of the transfer fee system in reducing nonemployment at every age. This effect is driven by the positive impact of the system on the match surplus, which is unambiguously increased by the transfer fees. As a result, transfer fees lead to a clear increase in job creation.

Next, we address training issues and the role of the transfer fee system. Interestingly, we find that the impact in this context is no longer clear-cut.

Corollary C :

The age-differentiated effect of the transfer fee system on access to training is ambiguous. While $\frac{dF_{T-1}}{d\Psi} = 0$ and $\frac{dF_{T-2}}{d\Psi} < 0$, it is possible for F_{T-i} to increase with Ψ for younger individuals.

Proof. See Appendix A.

Corollary C emphasizes that the impact of the transfer fee system on access to training is not straightforward; at certain ages, the payment of transfer fees can raise the training productivity threshold (thereby decreasing access to training). As shown in the Appendix, $\frac{\partial[U_{2,T-3}-U_{0,T-3}]}{\partial\Psi} < 0$ can indeed result in an increase in F_{T-4} when Ψ rises. In other words, transfer fees could lead to a higher selection threshold for entering the training process because the relative gain for nonemployed individuals from being trained is reduced, as all surpluses increase.

4 Quantitative analysis

In Sections 2 and 3, we highlighted the theoretical properties of transfer fees. Our objective now is to assess the quantitative impact of introducing a transfer system on the French labor market. We begin by presenting the data used, the calibration of certain model parameters, and the estimation of the remaining parameters. We then compare the moments generated by the model to those derived from the data. Next, we introduce the transfer system in Section 5.

4.1 Data

We use the French Labor Force Survey (FLFS) from 2017 to 2019 to measure labor market outcomes over the life cycle, including labor market flows, employment rates, and access to training. The observation period begins in 2017, as some variables, particularly those related to training, were introduced or added that year, and ends in 2019, prior to the COVID-19 pandemic. We focus on individuals aged 35 to 60 to abstract from labor market entry and exit decisions.[13]

Note that training can encompass a wide range of activities (on-the-job training, driving lessons, sports courses, cultural activities, language courses, etc.). Here, we focus exclusively on training actions that are likely to enhance a worker's productivity in their current or future job. We define trained workers as those who have received training for professional reasons within the past 12 months. Therefore, the training access rate will be expressed on an annual basis, unlike the transition rates, which will be expressed quarterly. Table 1 presents the transition rates, employment rate, and training access rate for individuals aged 35 to 60.

Table 1: Labor market variables (Data)

Variable	Trained workers	Untrained workers	All workers
Transition rate from nonemployment to employment	19.03	6.28	7.76
Transition rate from employment to nonemployment	1.48	3.03	2.48
Job-to-job transition rate	1.60	1.48	1.52
Employment rate	92.25	72.39	77.94
Training access rate	-	-	27.97

Note: Raw data. Transition rates are expressed on a quarterly basis. Training access rate is expressed on a annual basis. Sample: Individuals aged 35 to 60.

[13] Education and retirement decisions are beyond the scope of this paper.

Table 1 warrants a few comments. First, trained workers exhibit a transition rate from nonemployment (N) to employment (E) that is three times higher than that of untrained workers, while their transition rate from employment to nonemployment is half as low. As a result, the employment rate for trained workers stands at 92.25%, compared to 72.39% for untrained workers, highlighting the substantial influence of training on labor market outcomes. Job-to-job transition rates are approximately equal for both trained and untrained workers. Finally, between one in four and one in three employees have received training over the past 12 months.

4.2 Calibrated parameters

For our simulations, we use the general version of the model presented in Appendix B, which incorporates an exogenous specific human capital accumulation process defining the s-dimension. Consequently, the match surplus depends on the firm's productivity, p, and the worker's three-dimensional status, defined by age t, general human capital j, and specific human capital s.

We now detail our calibration strategy. Our goal is not to analyze entry and exit decisions in the labor market, but rather to focus on training and mobility choices throughout the worker's life cycle. We abstract from education and retirement decisions by assuming that all workers enter the labor market as unemployed at the age $t_0 = 20$ and retire at $T = 60$. The model is simulated on a quarterly basis, with a discount factor set to $\zeta = 0.99$. Firms' productivity is assumed to be distributed across the range $[\underline{p} = 0.15, \overline{p} = 1.50]$. Importantly, $\overline{p} = 10\underline{p}$, meaning the most productive firm is ten times more efficient than the least productive one. The value of home production is set to $b = 0.40$. Note that $\underline{p} < b$ implies that firms at the lower end of the productivity distribution can only be viable if they employ workers with high human capital and long expected employment durations. Table 2 summarizes the calibrated parameter values.

Table 2: Calibrated parameters

Description	Parameter	Value
Age of entry into the labor market	t_0	20
Age of exit from the labor market	T	60
Discount factor	ζ	0.99
Lower bound of the Pareto distribution of productivities	$\underline{p}$	0.15
Upper bound of the Pareto distribution of productivities	$\overline{p}$	1.50
Home production	b	0.40

4.3 Estimated parameters

We estimate the remaining parameters using the method of simulated moments proposed by McFadden (1989). Let Θ denote the set of structural parameters:

$$\Theta = \{k, \lambda_u, \lambda_e, \alpha, \gamma, z, \Delta, \phi, \bar{s}, \rho\}$$

Our goal is to reproduce the following life cycle profiles: (i) the transition rate from nonemployment to employment (by training status), (ii) the job-to-job transition rate (by training status), and (iii) the training access rate. In the spirit of Albertini et al. (2020), we simulate the model from age 20 to age 60 and target series (i)-(iii) over the age range of 35 to 59. Thus, we have $5 \times 25 = 125$ moments for 10 parameters.[14] We note here that our model also allows for exogenous and endogenous separations. We derive exogenous separations directly from the data by fitting the observed employment-to-nonemployment transition rates by age and training status.[15]

Let $\hat{\mathbf{Y}}_n^D$ be a vector of moments from data with n observations. Let $\hat{\mathbf{Y}}_{s,n}^M$ be a vector of the corresponding moments from the s simulations of n observations. Let $\boldsymbol{W}_n$ be the weighting matrix. The estimation procedure consists of finding the vector of parameters that minimizes the distance between the model and data moments. Formally, the

[14] Note that β is not estimated but derived from the constraint $\beta = 1 - \alpha - \gamma$.

[15] We simulated alternative versions of the model (single δ based on the average separation rate; single δ based on the lowest separation rate observed during the life cycle; age-dependent δ_t based on the average separation rate by age; status-dependent δ_j based on the average separation rate by training status). We also followed the strategy proposed by Hairault et al. (2019) of imposing that the share of exogenous separations in total separations remains constant throughout the life cycle, based on the work of Fujita and Ramey (2012). In all cases, the estimated parameter values remain fairly close, and the model results are nearly the same.

SMM estimator $\hat{\Theta}_{s,n}$ solves:

$$\hat{\Theta}_{s,n} = \arg\min_{\Theta} \left[\hat{\mathbf{Y}}_n^D - \hat{\mathbf{Y}}_{s,n}^M(\Theta)\right]' \boldsymbol{W}_n \left[\hat{\mathbf{Y}}_n^D - \hat{\mathbf{Y}}_{s,n}^M(\Theta)\right]$$

Table 3 reports the estimated parameter values.

Table 3: Estimated parameters

Description	Parameter	Value
Parameter of the Pareto distribution of productivities	k	0.235
Job offer arrival rate during nonemployment	λ_u	0.175
Job offer arrival rate during employment	λ_e	0.232
Bargaining power of the current firm	α	0.211
Bargaining power of the worker	γ	0.298
Bargaining power of the poaching firm*	β	0.4913
Training cost	z	20.001
Productivity gain associated with general human capital (training)	Δ	0.184
Probability of general human capital depreciation during nonemployment	ϕ	0.441
Productivity gain associated with specific human capital (learning by doing)	$\bar{s}$	0.697
Probability of specific human capital appreciation during employment	ρ	0.139

Note: (*) β is not estimated but derived from the constraint $\beta = 1 - \alpha - \gamma$

It is worth emphasizing that we find $\lambda_u < \lambda_e$ and $\beta > \gamma > \alpha$. This echoes Corollary A which shows that such a parameter configuration can be consistent with age-decreasing (increasing) job creation (destruction) as despite $\beta > \alpha$. Then, this is crucial because, as Amand et al. (2023) point out, the bargaining power of the poaching firm influences the degree of potential underinvestment in training; it becomes significantly higher when β is elevated. Consequently, our identification strategy for the model parameters, which is based on the age dynamics of labor market transitions, suggests there is scope for public intervention.

4.4 Model vs. Data

To what extent is our model able to reproduce the main characteristics of the labor market? Before comparing the moments generated by the model to those from the data, few points are worth noting. First, we evaluate the model's performance across a wide range of moments, both targeted and non-targeted by the estimation procedure. Most life-cycle search and matching models aim to replicate labor market stocks over the life cycle, such as the employment rate by age (see, for example, Albertini et al. (2020)). Notable exceptions include Chéron et al. (2013), Albertini and Terriau (2019), and Créchet et al. (2024), who also consider the inflows and outflows of unemployment over the life cycle. Menzio et al. (2016) extends this analysis by incorporating job-to-job mobility over the life cycle. Labor market flows have greater explanatory power than stocks but also impose stricter constraints on the model's parameters. It is also important to note that none of the previously cited studies incorporate endogenous training. Shi (2023) develops a life-cycle model with endogenous training, but does not include age-related moments in the calibration strategy, instead focusing on other dimensions such as match quality. In our paper, we assess the model's performance in terms of both flows and stocks (by age and worker type), as well as the training access rate (by age), which is endogenous in our model.

Figure 2 displays the labor market flows (by age and training status) observed in the data alongside those generated by the model. As we can see, our model accurately reproduces the overall transition rates. In particular, it captures the decline in nonemployment-to-employment transitions at the end of the life cycle and the decreasing profile of job-to-job transitions throughout the life cycle.[16] The model also reflects the differences in transition rates based on training status. Specifically, it shows that the transition rate from nonemployment to employment is two to three times higher for trained workers than for untrained workers.

Another notable feature is the model's ability to replicate job-to-job transition rates, which is crucial for understanding training investments and the potential impact of introducing transfer fees. Regardless of worker type, the job-to-job transition rate is halved between the ages of 35 and 60. Given the extensive set of moments characterizing labor market flows, however, our model cannot perfectly fit all of these statistics. Specifically, it underestimates job-to-job transition rates at the beginning of the life cycle for trained workers, while overestimating them for untrained workers. Nevertheless, the overall representation of labor market flows produced by the model aligns well with the data.

[16] Since exogenous separation rates are estimated to fit employment-to-nonemployment transition rates, we do not discuss model performance regarding those transitions.

Figure 2: Model vs. the data (Labor market flows)

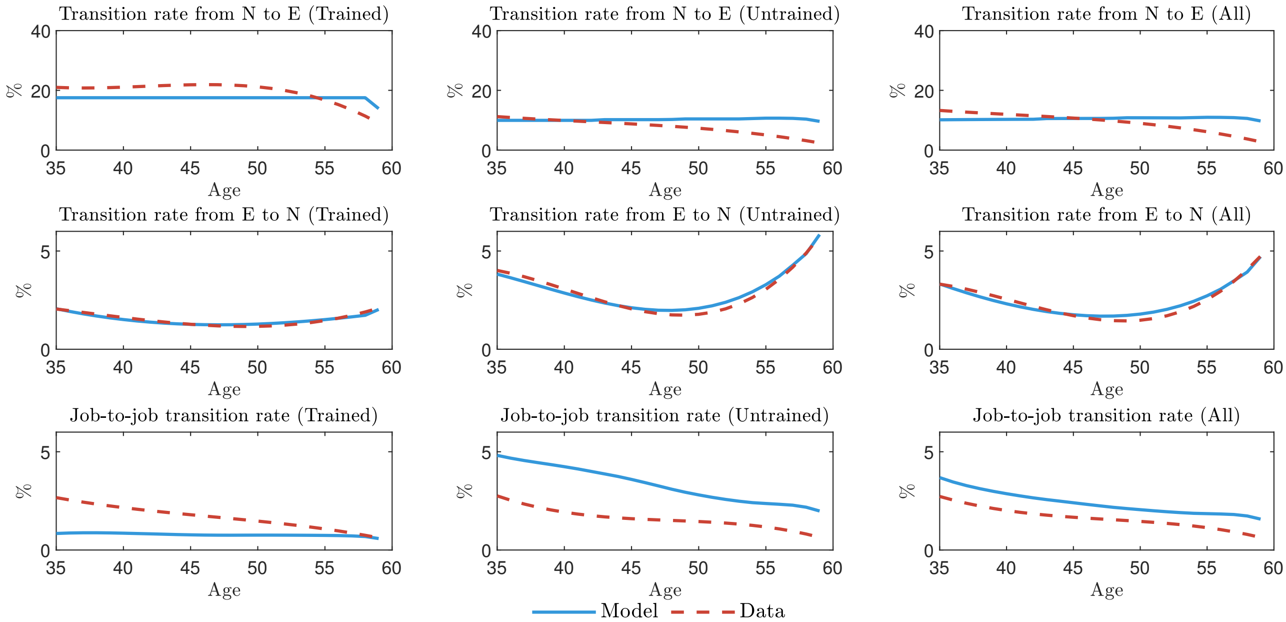
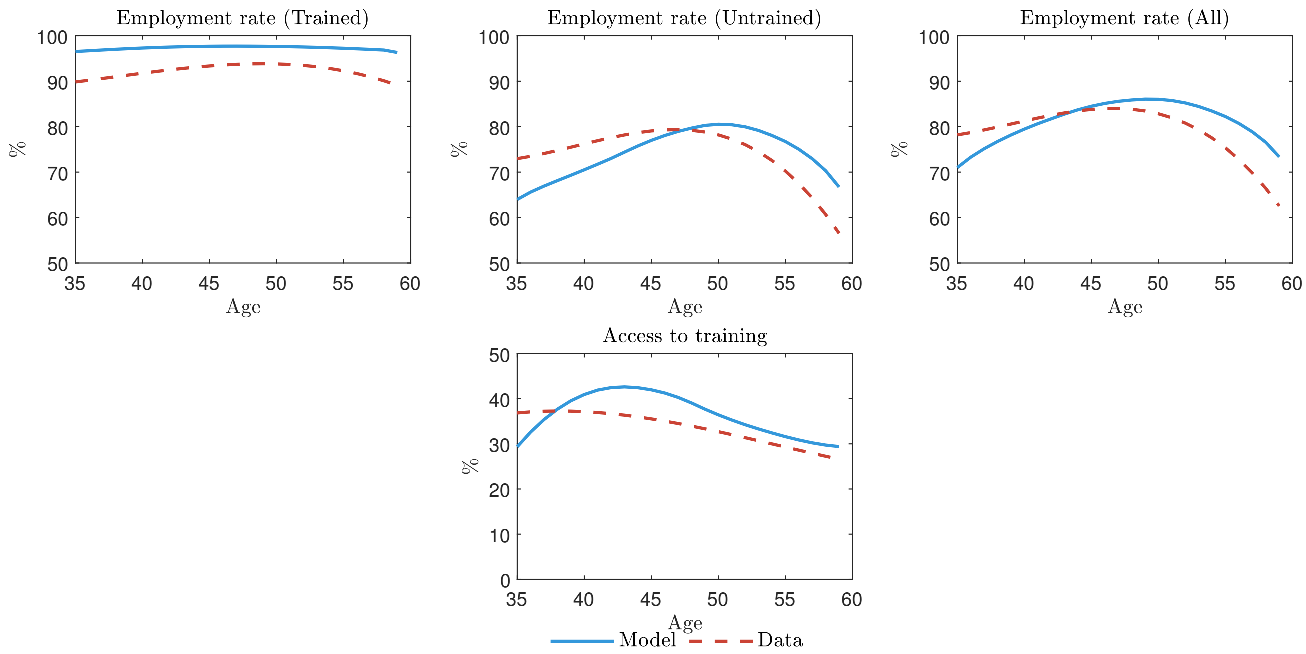


Figure 3 compares the employment rate and access to training over the life cycle, in both the data and the model. The model performs well in replicating the hump-shaped age dynamics of the employment rate at the aggregate level and by worker type (which were not directly targeted in the estimation). Our simulations align with the observation that, across all ages, the employment rate of trained workers is significantly higher than that of untrained workers, though our predictions of this positive impact are slightly overestimated. Specifically, the model captures the significant decline in the employment rate of untrained workers towards the end of their working lives, as well as the gradual decrease in access to training.

Figure 3: MODEL VS. THE DATA (EMPLOYMENT AND ACCESS TO TRAINING)



Finally, Table 4 shows that the model adequately replicates the key characteristics of the labor market at the aggregate level (flows, stocks, and access to training).

Table 4: Model vs. Data: Aggregate outcomes

Variable	Data	Model
Transition rate from N to E	9.35	10.5
Transition rate from E to N	2.42	2.46
Job-to-job transition rate	1.62	2.39
Employment rate	79.08	81.05
Training access rate	33.51	36.35

Note: Smoothed Data. The values correspond to averages over the life cycle, assuming that all cohorts are of the same size. Transition rates are expressed on a quarterly basis. Training access rate is expressed on a annual basis. Sample: Individuals aged 35 to 60.

5 The impact of transfer fees on labor market equilibrium

We now assess the quantitative impact of implementing a transfer system. Before presenting the results, we explain some key mechanisms of the model, which are essential for understanding the outcomes.

What is the effect of introducing a transfer system in a frictional labor market? First, the transfer system has a direct positive effect on the value of match surplus, regardless of the training status of the worker. This policy also increases the return on training investments: if the worker is poached, the current firm receives compensation from the poaching firm. The value of the joint surplus increases at the lower and middle levels of the firm distribution, so that some firms with intermediate productivity, which previously did not invest in training in the absence of a transfer system, now agree to train workers. However, it should be noted that the direct positive effect of transfer fees on the joint surplus diminishes as the firm's productivity increases. Ultimately, an individual hired by the most productive firm has no risk of being poached, meaning that the introduction of a transfer system has no direct impact on firms that are at the top of the distribution.

Secondly, the introduction of a transfer system has an indirect negative effect on the joint surplus through its impact on the value of nonemployment. By increasing the surplus value for firms in the lower and middle parts of the productivity distribution, nonemployed individuals benefit from more job opportunities. This raises the value of nonemployment, which in turn reduces the joint surplus. Since nonemployment is independent of p, this negative effect impacts all firms, regardless of their productivity level.

Consequently, the introduction of a transfer system induces two effects: a positive effect that primarily impacts firms in the lower and middle parts of the distribution, and a negative effect that affects all firms, regardless of their productivity. In the lower part of the distribution, the positive effect outweighs the negative one, increasing the value of the joint surplus. This leads to more job creation, fewer job destructions, and thus higher employment (Corollary B). In the upper part of the distribution, the negative effect dominates the positive one, reducing the value of the joint surplus. The effect on training is ambiguous, depending on whether the required productivity threshold for receiving training (F_t) was initially in the lower, middle, or upper part of the distribution (Corollary C). Only a quantitative assessment can reveal the impact of a transfer system on access to training.

A final point to discuss before presenting the results is the duration of the entitlement to compensation. In the soccer labor market, players are tied to their clubs (which can receive a transfer fee in the event of poaching) for a maximum period of 5 years (FIFA, 2021). To assess the relevance of limiting this entitlement over time, we conduct two counterfactual experiments: i) a time-limited entitlement to compensation; ii) an unlimited entitlement to compensation.

A simple way to introduce a time-limited entitlement to compensation in the model is to refer to the worker's specific human capital, which reflects the time elapsed since training. Recall that specific human capital can be either low or high, that all workers begin a job with the lowest level of specific human capital, and that this capital can increase with a probability of ρ. In the model, we assume that the firm is entitled to transfer compensation as long as the worker's specific human capital is low. According to our estimation, $\rho = 0.139$, which means that firms are entitled to compensation in the event of poaching for an average period of 2 years.

5.1 Time-Limited entitlement to compensation

We begin by analyzing the impact of implementing a time-limited entitlement to compensation in the event of poaching, similar to the system used in soccer. Compared to the laissez-faire economy, the economy with a time-limited entitlement to compensation is characterized by a higher job-finding rate (see Figure 4). This policy increases the value of the surplus, especially at the lower end of the distribution, thereby providing more job opportunities for the nonemployed. Some matches that would have been unprofitable without a transfer system become profitable with its introduction. Even if a firm is not productive enough to train a worker, the joint surplus increases because workers now represent assets that can be transferred to another firm (in exchange for compensation), which can train them. Let us also recall that the transfer system does not hinder reallocations to more productive firms. In fact, Figure 4 shows that job-to-job mobility is higher with transfer fees than without. Time-limited entitlement to compensation also boosts access to training (see Figure 5). The employment rate increases not only due to the rise in the job-finding rate across worker types but also because the proportion of trained workers, who benefit from a higher job-finding rate and a lower job-separation rate, increases.

Under this transfer system, only firm-worker pairs with low specific human capital (those with expected tenure of less than two years) are entitled to compensation, resulting in a moderate impact on employment opportunities and, consequently, the value of nonemployment. In this setting, the direct effect on net surplus quantitatively outweighs the indirect effect for job matches with moderate productivity. As a result, job-finding rates for untrained workers in lower-productivity jobs increase significantly. Additionally, the minimum productivity threshold required for training decreases, leading to a 2.5 percentage points (pp) rise in the proportion of trained workers. This further amplifies the initial positive impact of the policy on employment, as trained workers benefit from both a higher job-finding rate and a lower job-separation rate.

Therefore, this policy is well-suited to boosting both employment and access to training. Table 5 shows that a time-limited (TL) transfer system generates significant employment gains: +3.5pp. This corresponds to an approximate 25% rise in the transition rate from nonemployment to employment. Welfare increases by 3%, which is substantial. To put this into perspective, this is equivalent, in terms of welfare, to a 15% increase in the job contact rate.

5.2 Unlimited entitlement to compensation

Alternatively, we now assume that the transfer compensation is no longer time-limited. This means that the employer can receive the transfer compensation in the event of poaching, whether the worker leaves after a period of 1 year or 10 years of employment.

Figures 4 and 5 show that such a policy leads to more mixed effects. The key point is that removing the time limit on transfer compensation significantly increases the value of a nonemployed worker, which reduces the joint surplus for firms at the middle and top of the productivity distribution. Consequently, intermediate-productivity firms become more selective, leading to a decrease in access to training. Since untrained workers have a lower job-finding rate and a higher job-separation rate, this greatly diminishes the positive impact of transfer compensation on employment. The employment rate increases by 2.5pp, and welfare by 1.5pp, which is significantly less than in the case of a time-limited entitlement (see Table 5).

These two counterfactual experiments reveal several important findings: i) Regardless of the duration of the entitlement to compensation, the introduction of a transfer system improves welfare; ii) a highest level of welfare is achieved when the compensation entitlement is time-limited. These results suggest that the introduction of a transfer system, similar to that in soccer, could substantially increase employment and welfare.

Figure 4: Counterfactual experiments (Labor market flows)

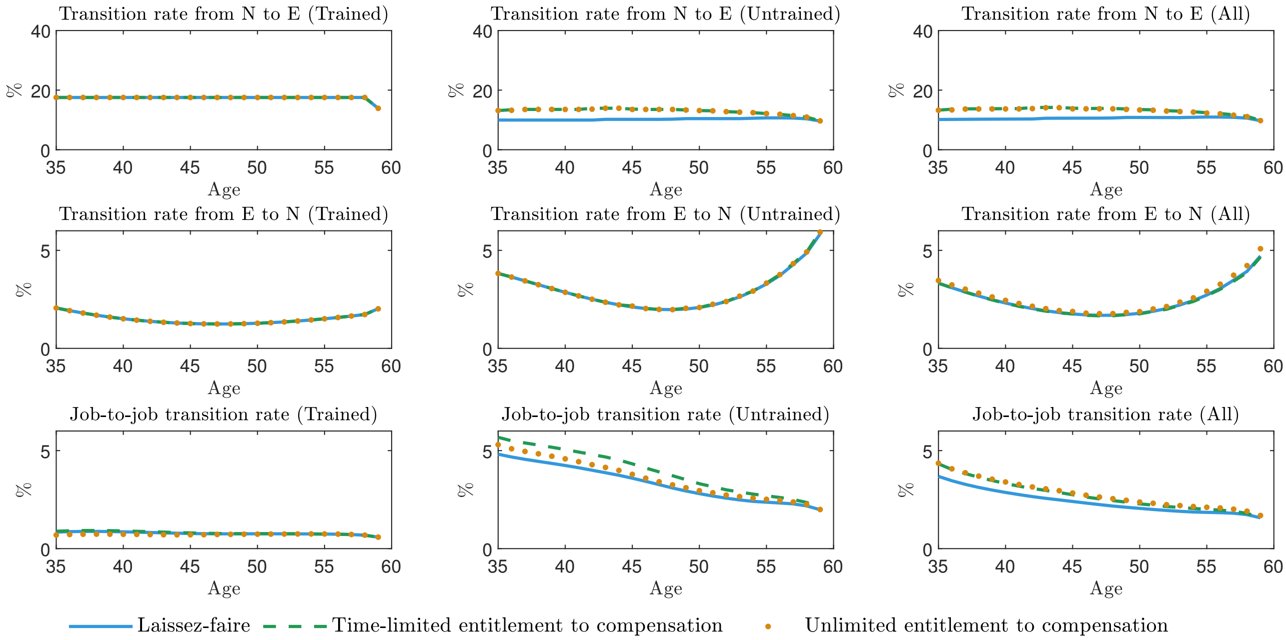


Figure 5: Counterfactual experiments (Employment and access to training)

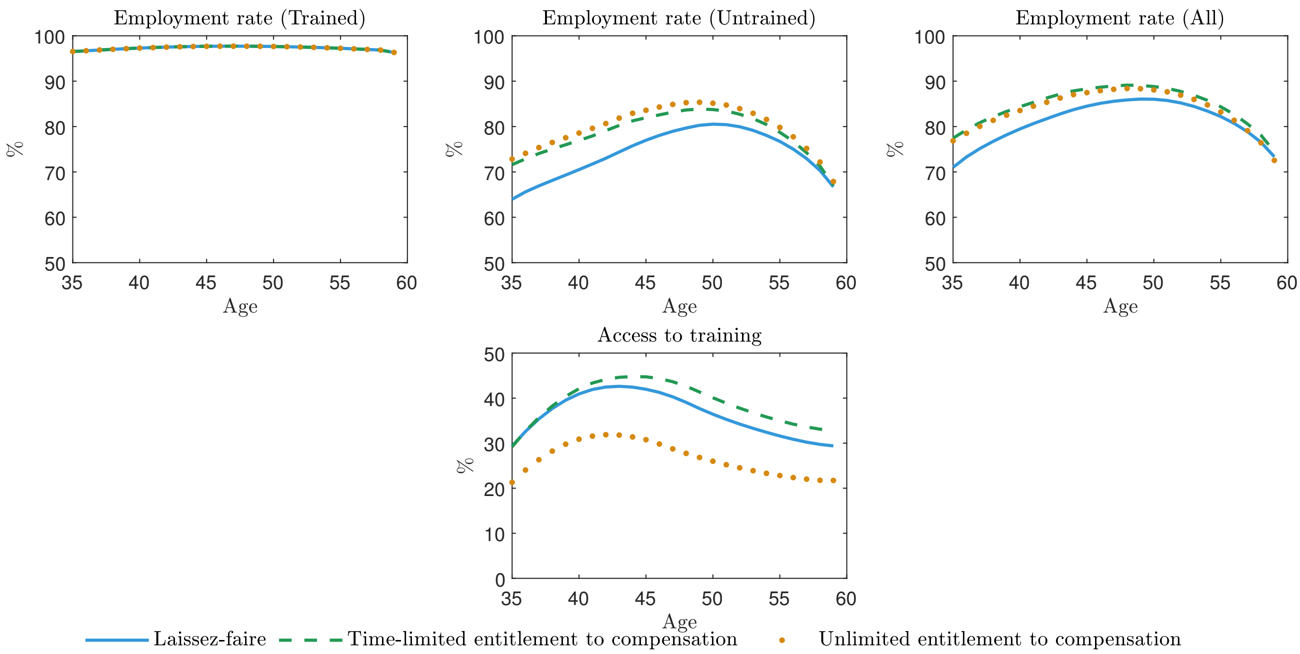


Table 5: Counterfactual experiments: Aggregate outcomes

Variable \ Scenario	Data	LF	TL	UL
Transition rate from N to E	0.0935	0.1054	0.1321	0.1309
Transition rate from E to N	0.0241	0.0246	0.0244	0.0261
Job-to-job transition rate	0.0162	0.0239	0.0270	0.0278
Employment rate	0.7908	0.8105	0.8464	0.8369
Training access rate	0.3351	0.3635	0.3880	0.2659
Welfare		100	102.77	101.51

Note: **LF:** Laissez-faire; **TL:** Time-limited entitlement to compensation; **UL:** Unlimited entitlement to compensation

6 Discussion and conclusion

Human capital is an important driver of economic growth. It is therefore crucial to understand the conditions that foster its accumulation and the policies that can best address social externalities. Training subsidies can help align firms' private training decisions with those of a social planner. However, this requires accurately measuring the size of social externalities associated with human capital investments to properly calibrate the subsidies, which is difficult in practice. Another tool used in the labor market is the non-compete clause. However, as shown by Shi (2023) and highlighted in our toy model, non-compete clauses create a trade-off between training and mobility: they encourage training investments but hinder reallocations to more efficient firms.

In this paper, we explore an innovative policy: a transfer system similar to that used in the labor market for soccer players. We first show theoretically that such a policy can increase training investments without hindering mobility to more productive firms. We then conduct a quantitative analysis to assess the potential effects of introducing a transfer system into the standard French labor market. Our results show that the implementation of a transfer system can lead to substantial welfare gains. Specifically, introducing a time-limited compensation entitlement could result in a 3.5pp increase in the employment rate and nearly a 3% rise in welfare.

From a practical standpoint, the transfer system could extend the principle of the mutual termination agreement (or "rupture conventionnelle" in French) introduced in France in 2008. The mutual termination agreement is a mechanism in France that allows an employer and an employee to mutually agree to end a permanent employment contract without resorting to dismissal or resignation. The employer and the worker must sign a simple document specifying the amount of compensation. This mechanism could be extended in the case of job-to-job mobility. In this scenario, the current employer, the worker, and the poaching firm would negotiate a new salary for the worker and a compensation for the former employer, similar to the system used in the soccer market.

It is worth noting that while some soccer players have agents or lawyers, many professional players negotiate and sign their contracts themselves. As highlighted by Amand et al. (2023), the equilibrium in the soccer labor market is very close to the social optimum, suggesting that transaction/negotiation costs induced by a transfer system are very low. All of these elements support the implementation of a transfer system in the standard labor market.

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Appendix

A Proof of Corollary C

To prove Corollary C, we determine explicit solutions for equilibrium surplus, hence training thresholds, starting from $T-1$. As we shall demonstrate, the overall effect of the transfer fee system can be captured only in $T-4$ (and before). The transfer fee system notably impacts the expected nonemployment value of training, which is indeed zero on $T-1$, and still does not depend on the transfer fee system on $T-2$.

In $T-1$, it is straightforward that $R_{0,T-1} = b, F_{T-1} = z/\Delta$ and $R_{2,T-1} = b/(1+\Delta)$. Then, in $T-2$, we can explicit surplus values, which satisfy for $p \geq b$:

$$\begin{aligned}
S_{0,T-2}(p) &= p - b + S_{0,T-1}(p) \\
&\quad + \Psi\lambda_e \int_p^{\frac{z}{\Delta}} \Big(S_{0,T-1}(p') - S_{0,T-1}(p)\Big) dG(p') \\
&\quad + \Psi\lambda_e \int_{\frac{z}{\Delta}} \Big(S_{1,T-1}(p') - S_{0,T-1}(p)\Big) dG(p') \\
&\quad - \frac{\gamma}{\alpha+\gamma}\lambda_u \bigg(\int_b^{\frac{z}{\Delta}} S_{0,T-1}(p') dG(p') + \int_{\frac{z}{\Delta}} S_{1,T-1}(p') dG(p') \bigg) \\
&= 2(p-b) + \Psi\lambda_e \bigg[\int_p (p'-p) dG(p') + \Delta \int_{\frac{z}{\Delta}} \Big(p' - \frac{z}{\Delta}\Big) dG(p') \bigg] \\
&\quad - \frac{\gamma}{\alpha+\gamma}\lambda_u \bigg[\int_b (p'-b) dG(p') + \Delta \int_{\frac{z}{\Delta}} \Big(p' - \frac{z}{\Delta})\Big) dG(p') \bigg]
\end{aligned}$$

$$\begin{aligned}
S_{1,T-2}(p) &= (1+\Delta)p - b - z + S_{2,T-1}(p) \\
&\quad + \Psi\lambda_e \int_p \Big(S_{2,T-1}(p') - S_{2,T-1}(p)\Big) dG(p') \\
&\quad - \frac{\gamma}{\alpha+\gamma}\lambda_u \bigg(\int_b^{\frac{z}{\Delta}} S_{0,T-1}(p') dG(p') + \int_{\frac{z}{\Delta}} S_{1,T-1}(p') dG(p') \bigg) \\
&= 2[(1+\Delta)p - b] - z + \Psi\lambda_e(1+\Delta) \int_p (p'-p) dG(p') \\
&\quad - \frac{\gamma}{\alpha+\gamma}\lambda_u \bigg[\int_b (p'-b) dG(p') + \Delta \int_{\frac{z}{\Delta}} \Big(p' - \frac{z}{\Delta}\Big) dG(p') \bigg]
\end{aligned}$$

$$
\begin{aligned}
S_{2,T-2}(p) &= (1+\Delta)p - b + S_{2,T-1}(p) \\
&\quad +\Psi\lambda_e \int_p \Big(S_{2,T-1}(p') - S_{2,T-1}(p)\Big) dG(p') \\
&\quad -\frac{\gamma}{\alpha+\gamma}\lambda_u \int_{\frac{b}{1+\Delta}} S_{2,T-1}(p') dG(p') \\
&= 2[(1+\Delta)p - b] + (1+\Delta)\Psi\lambda_e \int_p (p'-p) dG(p') \\
&\quad -(1+\Delta)\frac{\gamma}{\alpha+\gamma}\lambda_u \int_{\frac{b}{1+\Delta}} \left(p' - \frac{b}{1+\Delta}\right) dG(p')
\end{aligned}
$$

Accordingly, we get:

$$
\begin{aligned}
S_{1,T-2}(p) - S_{0,T-2}(p) &= 2\Delta p - z + \Psi\lambda_e\Delta\left[\int_p (p'-p)dG(p') - \int_{\frac{z}{\Delta}} \left(p' - \frac{z}{\Delta}\right) dG(p')\right] \\
S_{2,T-2}(p) - S_{0,T-2}(p) &= 2\Delta p + \Psi\lambda_e\Delta\left[\int_p (p'-p)dG(p') - \int_{\frac{z}{\Delta}} \left(p' - \frac{z}{\Delta}\right) dG(p')\right] \\
&\quad -\frac{\gamma}{\alpha+\gamma}\lambda_u\left[(1+\Delta)\int_{\frac{b}{1+\Delta}} \left(p' - \frac{b}{1+\Delta}\right) dG(p') - \int_b (p'-b) dG(p') \right. \\
&\quad \left. -\Delta \int_{\frac{z}{\Delta}} \left(p' - \frac{z}{\Delta}\right) dG(p')\right]
\end{aligned}
$$

This implies notably:

$$
\begin{aligned}
\frac{\partial[S_{1,T-2}(p) - S_{0,T-2}(p)]}{\partial p} &> 0 \\
\frac{\partial[S_{2,T-2}(p) - S_{0,T-2}(p)]}{\partial p} &> 0
\end{aligned}
$$

At this stage, it is worth emphasizing that the impact of the transfer fee system on surplus gaps with respect to the untrained situation is actually productivity dependent. We indeed have:

$$
\text{if} p > \frac{z}{\Delta}, \frac{\partial[S_{1,T-2}(p) - S_{0,T-2}(p)]}{\partial \Psi} < 0 \text{and} \frac{\partial[S_{2,T-2}(p) - S_{0,T-2}(p)]}{\partial p} < 0 \tag{17}
$$

$$
\text{if} p < \frac{z}{\Delta}, \frac{\partial[S_{1,T-2}(p) - S_{0,T-2}(p)]}{\partial \Psi} > 0 \text{and} \frac{\partial[S_{2,T-2}(p) - S_{0,T-2}(p)]}{\partial p} > 0 \tag{18}
$$

Then, from $S_{0,T-2}(F_{T-2}) = S_{1,T-2}(F_{T-2})$, it comes that

$$2F_{T-2} = \frac{z}{\Delta} - \Psi\lambda_e \Big[\int_{F_{T-2}} (p' - F_{T-2}) dG(p') - \int_{\frac{z}{\Delta}} \Big(p' - \frac{z}{\Delta} \Big) dG(p') \Big]$$

which impliques $\frac{dF_{T-2}}{d\Psi} < 0$. In words, the transfer fee system does increase access to training at $T-2$. But then, the point is that it is not necessarily the case for younger ages.

First, consider $T-3$ and notice in particular that the gap between the value of nonemployment for trained workers and untrained workers now enters surplus for type-1:

$$\begin{aligned} S_{1,T-3}(p) &= (1+\Delta)p - b - z + S_{2,T-2}(p) \\ &\quad + \Psi\lambda_e \int_p \Big(S_{2,T-2}(p') - S_{2,T-2}(p) \Big) dG(p') \\ &\quad - \frac{\gamma}{\alpha+\gamma}\lambda_u \Big(\int_b^{F_{T-2}} S_{0,T-2}(p') dG(p') + \int_{F_{T-2}} S_{1,T-2}(p') dG(p') \Big) \\ &\quad + \Big(U_{2,T-2} - U_{0,T-2} \Big) \end{aligned}$$

with

$$\begin{aligned} U_{2,T-2} - U_{0,T-2} &= \Big(U_{2,T-1} - U_{0,T-1} \Big) + \frac{\gamma}{\alpha+\gamma}\lambda_u \Big(\int_b^{F_{T-1}} (S_{2,T-1}(p') - S_{0,T-1}(p')) dG(p') \\ &\quad + \int_{F_{T-1}} (S_{2,T-1}(p') - S_{1,T-1}(p')) dG(p') \Big) \\ &= \frac{\gamma}{\alpha+\gamma}\lambda_u \Big(\Delta \int_b p' dG(p') - z \int_{F_{T-1}} dG(p') \Big) \end{aligned}$$

But yet, this gap between nonemployment values does not depend on Ψ, that is the existence (or not) of a transfer fee system. This is no longer the case in $T-4$ since the surplus for type-1 workers is given by:

$$
\begin{aligned}
S_{1,T-4}(p) &= (1+\Delta)p - b - z + S_{2,T-3}(p) \\
&+\Psi\lambda_e \int_p \Big(S_{2,T-3}(p') - S_{2,T-3}(p)\Big) dG(p') \\
&-\frac{\gamma}{\alpha+\gamma}\lambda_u \Big(\int_b^{F_{T-3}} S_{0,T-3}(p')dG(p') + \int_{F_{T-3}} S_{1,T-3}(p')dG(p') \Big) \\
&+\Big(U_{2,T-3} - U_{0,T-3}\Big)
\end{aligned}
$$

with

$$
\begin{aligned}
U_{2,T-3} - U_{0,T-3} &= \Big(U_{2,T-2} - U_{0,T-2}\Big) + \frac{\gamma}{\alpha+\gamma}\lambda_u \Big(\int_b^{F_{T-2}} (S_{2,T-2}(p') - S_{0,T-2}(p'))dG(p') \\
&+ \int_{F_{T-2}} (S_{2,T-2}(p') - S_{1,T-2}(p'))dG(p') \Big)
\end{aligned}
$$

The key point is that $\frac{\partial[U_{2,T-2}-U_{0,T-2}]}{\partial\Psi} = 0$ and from equation (17) we do know that for some $p > \frac{z}{\Delta}$ we have $\frac{\partial[S_{2,T-2}(p')-S_{0,T-2}(p')]}{\partial\Psi} < 0$, $\frac{\partial[S_{1,T-2}(p4)-S_{0,T-2}(p')]}{\partial\Psi} < 0$.
Therefore, depending notably on the cdf G, ie. $G(\frac{z}{\Delta})$ low enough, it can be the case:

$$
\frac{\partial[U_{2,T-3} - U_{0,T-3}]}{\partial\Psi} < 0
$$

Accordingly, since the training threshold at $T-4$ is given by:

$$
\begin{aligned}
\Delta F_{T-4} &= z - [S_{2,T-3}(F_{T-4}) - S_{0,T-3}(F_{T-4})][1 - \Psi\lambda_e(1 - G(F_{T-4}))] \\
&-\Psi\lambda_e \int_{F_{T-4}} \Big(S_{2,T-3}(p') - S_{0,T-3}(p')\Big) dG(p') \\
&-\Psi\lambda_e \int_{F_{T-4}} \Big(S_{1,T-3}(p') - S_{0,T-3}(p')\Big) dG(p') \\
&-(U_{2,T-3} - U_{0,T-3})
\end{aligned}
$$

The impact of Ψ on F_{T-4} is no longer clear cut, and in particular whether the transfer fee system leads to a large decrease of $U_{2,T-3} - U_{0,T-3}$, then it would lead to an increase of F_{T-4}, hence a lower share of workers accessing training. *QED*.

B Value fonctions and joint surpluses

Firms are characterized by their technology $p \in [\underline{p}, \overline{p}]$, distributed according to a distribution function $G(p)$.

Workers are characterized by their type $j \in \{0, 1, 2\}$ and their age $t \in [1, T]$. They are also characterized by their level of specific human capital, denoted by s, with $\underline{s}$ and $\overline{s}$ the lowest and highest level of specific human capital, respectively. At the end of the period, the specific human capital of an employed worker may increase with probability ρ, provided that it has not already reached the highest level. Specific human capital is thus governed by the following Markov process:

$$\mu(s, s') = \begin{cases} 1-\rho & \text{if } s < \overline{s} \text{ and } s' = s \\ \rho & \text{if } s < \overline{s} \text{ and } s' = s+1 \\ 1 & \text{if } s = \overline{s} \end{cases}$$

Note that, in our simulations, we only consider two levels of specific human capital, which can be low ($\underline{s}$) or high ($\overline{s}$).

We consider that the wage is fixed and can only be renegotiated if either party has a credible threat. The wage thus depends on the worker's negotiation benchmark, noted NB, which corresponds to the maximum between the value of nonemployment and the value of the highest outside offer received while employed. We denote by $w_{j,t}(p, s, NB)$ the wage of a worker of type j and age t, with specific human capital s and negotiation benchmark NB, matched with a p-firm.

Let's define the following value functions:

- $E_{j,t}(p, s, NB)$ is the value of employment for a worker of type j and age t, matched with a p-firm, with specific human capital s and negotiation benchmark NB
- $U_{j,t}$ is the value of nonemployment for a worker of type j and age t
- $J_{j,t}(p, s, NB)$ is the value of a filled job for a p-firm, matched with a worker of type j and age t, with specific human capital s and negotiation benchmark NB

Let $S_{j,t}(p, s) = E_{j,t}(p, s, NB) - U_{j,t} + J_{j,t}(p, s, NB)$ be the joint surplus of a match between a p-firm and a worker of type j and age t. Note that $S_{j,t}(p, s)$ depends on p and s, which determines the productivity of the worker and therefore the value of the joint surplus, but not on NB, which has no impact on the value of the joint surplus but only on the way in which the worker and firm share it. Note also that an initial match is formed only if the surplus is non-negative and that an existing match is endogenously destroyed if the value becomes negative.

In the rest of the paper, we will use the following notation:

$$S^{+}_{j,t}(p, s) = \max\{S_{j,t}(p, s), 0\}$$

Workers search on and off the job. Employed workers receive an outside offer from a p'-firm (which can lead to job-to-job mobility or wage renegotiation) with an arrival rate λ_e, while nonemployed workers receive a job offer from a p'-firm with an arrival rate λ_u. Existing matches can be exogenously destroyed with probability $\delta_{j,t}$, which depends on the worker's type and age. The discount factor is denoted by $\zeta \in (0, 1)$. Finally, for the equilibrium with transfer fees, we let $T_{j,t}(p', s, p)$ be the transfer fees paid by the poaching firm to the current firm.

B.1 Joint surplus - Type 0 - Equilibrium without transfer fees

$$E_{0,t}(p,s,NB) = w_{0,t}(p,s,NB) + \zeta\Bigg[(1-\delta_{0,t})\Bigg[\lambda_e\Bigg(\int_{p'\in M^{R_0}_{t+1}(p,s,NB)}\sum_{s'}\mu(s,s')E_{0,t+1}(p,s',p')\,dG(p')$$
$$+\int_{p'\in M^{E_0}_{t+1}(p,s,NB)} E_{0,t+1}(p',\underline{s},p)\,dG(p') + \int_{p'\in M^{E_1}_{t+1}(p,s,NB)} E_{1,t+1}(p',\underline{s},p)\,dG(p')\Bigg)$$
$$+\Bigg(1-\lambda_e\int_{p'\in M^{R_0}_{t+1}(p,s,NB)\cup M^{E_0}_{t+1}(p,s,NB)\cup M^{E_1}_{t+1}(p,s,NB)} dG(p')\Bigg)\sum_{s'}\mu(s,s')E_{0,t+1}(p,s',NB)\Bigg] + \delta_{0,t}U_{0,t+1}\Bigg]$$

$$U_{0,t} = b + \zeta\Bigg[\lambda_u\Bigg(\int_{p'\in M^{U_0}_{t+1}} E_{0,t+1}(p',\underline{s},u)\,dG(p') + \int_{p'\in M^{U_1}_{t+1}} E_{1,t+1}(p',\underline{s},u)\,dG(p')\Bigg)$$
$$+\Bigg(1-\lambda_u\int_{p'\in M^{U_0}_{t+1}\cup M^{U_1}_{t+1}} dG(p')\Bigg)U_{0,t+1}\Bigg]$$

$$J_{0,t}(p,s,NB) = (1+s)p - w_{0,t}(p,s,NB) + \zeta(1-\delta_{0,t})\Bigg[\lambda_e\int_{p'\in M^{R_0}_{t+1}(p,s,NB)}\sum_{s'}\mu(s,s')J_{0,t+1}(p,s',p')\,dG(p')$$
$$+\Bigg(1-\lambda_e\int_{p'\in M^{R_0}_{t+1}(p,s,NB)\cup M^{E_0}_{t+1}(p,s,NB)\cup M^{E_1}_{t+1}(p,s,NB)} dG(p')\Bigg)\sum_{s'}\mu(s,s')J_{0,t+1}(p,s',NB)\Bigg]$$

$$S_{0,t}(p,s) \quad = \quad E_{0,t}(p,s,NB) - U_{0,t} + J_{0,t}(p,s,NB)$$

where:

- $p' \in M^{R_0}_{t+1}(p,s,NB)$ if $\sum_{s'}\mu(s,s')S_{0,t+1}(p,s') > S_{j,t+1}(p',\underline{s}) > S_{j,t+1}(NB,\underline{s})\ \forall\, j \in \{0,1\}$
- $p' \in M^{E_0}_{t+1}(p,s,NB)$ if $S_{0,t+1}(p',\underline{s}) > \sum_{s'}\mu(s,s')S_{0,t+1}(p,s')$ and $S_{0,t+1}(p',\underline{s}) > S_{1,t+1}(p',\underline{s})$
- $p' \in M^{E_1}_{t+1}(p,s,NB)$ if $S_{1,t+1}(p',\underline{s}) > \sum_{s'}\mu(s,s')S_{0,t+1}(p,s')$ and $S_{1,t+1}(p',\underline{s}) \geq S_{0,t+1}(p',\underline{s})$
- $p' \in M^{U_0}_{t+1}$ if $S_{0,t+1}(p',\underline{s}) > 0$ and $S_{0,t+1}(p',\underline{s}) > S_{1,t+1}(p',\underline{s})$
- $p' \in M^{U_1}_{t+1}$ if $S_{1,t+1}(p',\underline{s}) > 0$ and $S_{1,t+1}(p',\underline{s}) \geq S_{0,t+1}(p',\underline{s})$

The surplus can therefore be rewritten as follows:

$$
\begin{aligned}
&S_{0,t}(p,s) = (1+s)p - b \\
&+\zeta\Bigg[(1-\delta_{0,t})\Big[\sum_{s'}\mu(s,s')E_{0,t+1}(p,s',NB) - U_{0,t+1} + \sum_{s'}\mu(s,s')J_{0,t+1}(p,s',NB)\Big) \\
&+\lambda_e\Bigg(\int_{p'\in M^{R_0}_{t+1}(p,s,NB)}\Big(\sum_{s'}\mu(s,s')E_{0,t+1}(p,s',p') + \sum_{s'}\mu(s,s')J_{0,t+1}(p,s',p')\Big)\,dG(p') \\
&-\int_{p'\in M^{R_0}_{t+1}(p,s,NB)} dG(p')\Big(\sum_{s'}\mu(s,s')E_{0,t+1}(p,s',NB) + \sum_{s'}\mu(s,s')J_{0,t+1}(p,s',NB)\Big) \\
&+\int_{p'\in M^{E_0}_{t+1}(p,s,NB)} E_{0,t+1}(p',\underline{s},p)\,dG(p') \\
&-\int_{p'\in M^{E_0}_{t+1}(p,s,NB)} dG(p')\Big(\sum_{s'}\mu(s,s')E_{0,t+1}(p,s',NB) + \sum_{s'}\mu(s,s')J_{0,t+1}(p,s',NB)\Big) \\
&+\int_{p'\in M^{E_1}_{t+1}(p,s,NB)} E_{1,t+1}(p',\underline{s},p)\,dG(p') \\
&-\int_{p'\in M^{E_1}_{t+1}(p,s,NB)} dG(p')\Big(\sum_{s'}\mu(s,s')E_{0,t+1}(p,s',NB) + \sum_{s'}\mu(s,s')J_{0,t+1}(p,s',NB)\Big)\Bigg)\Big] \\
&-\lambda_u\Bigg(\int_{p'\in M^{U_0}_{t+1}}\Big(E_{0,t+1}(p',\underline{s},u) - U_{0,t+1}\Big)\,dG(p') + \int_{p'\in M^{U_1}_{t+1}}\Big(E_{1,t+1}(p',\underline{s},u) - U_{0,t+1}\Big)\,dG(p')\Bigg)\Bigg]
\end{aligned}
$$

with:

$$\sum_{s'}\mu(s,s')E_{0,t+1}(p,s',NB) - U_{0,t+1} + \sum_{s'}\mu(s,s')J_{0,t+1}(p,s',NB) = \sum_{s'}\mu(s,s')S_{0,t+1}(p,s')$$

$$\sum_{s'}\mu(s,s')E_{0,t+1}(p,s',p') - U_{0,t+1} + \sum_{s'}\mu(s,s')J_{0,t+1}(p,s',p') = \sum_{s'}\mu(s,s')S_{0,t+1}(p,s')$$

$$E_{0,t+1}(p',\underline{s},p) - U_{0,t+1} = \sum_{s'}\mu(s,s')S_{0,t+1}(p,s') + \frac{\gamma}{\beta+\gamma}\big(S_{0,t+1}(p',\underline{s}) - \sum_{s'}\mu(s,s')S_{0,t+1}(p,s')\big) \text{ if } p' \in M^{E_0}_{t+1}(p,s,NB)$$

$$E_{1,t+1}(p',\underline{s},p) - U_{0,t+1} = \sum_{s'}\mu(s,s')S_{0,t+1}(p,s') + \frac{\gamma}{\beta+\gamma}\big(S_{1,t+1}(p',\underline{s}) - \sum_{s'}\mu(s,s')S_{0,t+1}(p,s')\big) \text{ if } p' \in M^{E_1}_{t+1}(p,s,NB)$$

$$E_{0,t+1}(p',\underline{s},u) - U_{0,t+1} = \frac{\gamma}{\alpha+\gamma}S_{0,t+1}(p',\underline{s})$$

$$E_{1,t+1}(p',\underline{s},u) - U_{0,t+1} = \frac{\gamma}{\alpha+\gamma}S_{1,t+1}(p',\underline{s})$$

With a little calculation, we get the following expression:

$$
\begin{aligned}
S_{0,t}(p,s) \;=\; & (1+s)p - b \\
& + \zeta\Bigg[(1-\delta_{0,t})\Bigg[\sum_{s'} \mu(s,s') S^{+}_{0,t+1}(p,s') \\
& + \frac{\gamma}{\beta+\gamma}\lambda_e\Bigg(\int_{p' \in M^{E_0}_{t+1}(p,s,NB)} \Big(S^{+}_{0,t+1}(p',\underline{s}) - \sum_{s'} \mu(s,s') S^{+}_{0,t+1}(p,s')\Big)\, dG(p') \\
& + \int_{p' \in M^{E_1}_{t+1}(p,s,NB)} \Big(S^{+}_{1,t+1}(p',\underline{s}) - \sum_{s'} \mu(s,s') S^{+}_{0,t+1}(p,s')\Big)\, dG(p')\Bigg)\Bigg] \\
& - \frac{\gamma}{\alpha+\gamma}\lambda_u\Bigg(\int_{p' \in M^{U_0}_{t+1}} S_{0,t+1}(p',\underline{s})\, dG(p') + \int_{p' \in M^{U_1}_{t+1}} S_{1,t+1}(p',\underline{s})\, dG(p')\Bigg)\Bigg]
\end{aligned}
$$

where:

- $p' \in M^{E_0}_{t+1}(p,s,NB)$ if $S_{0,t+1}(p',\underline{s}) > \sum_{s'} \mu(s,s') S_{0,t+1}(p,s')$ and $S_{0,t+1}(p',\underline{s}) > S_{1,t+1}(p',\underline{s})$
- $p' \in M^{E_1}_{t+1}(p,s,NB)$ if $S_{1,t+1}(p',\underline{s}) > \sum_{s'} \mu(s,s') S_{0,t+1}(p,s')$ and $S_{1,t+1}(p',\underline{s}) \geq S_{0,t+1}(p',\underline{s})$
- $p' \in M^{U_0}_{t+1}$ if $S_{0,t+1}(p',\underline{s}) > 0$ and $S_{0,t+1}(p',\underline{s}) > S_{1,t+1}(p',\underline{s})$
- $p' \in M^{U_1}_{t+1}$ if $S_{1,t+1}(p',\underline{s}) > 0$ and $S_{1,t+1}(p',\underline{s}) \geq S_{0,t+1}(p',\underline{s})$

B.2 Joint surplus - Type 0 - Equilibrium with transfer fees

$$E_{0,t}(p,s,u) = w_{0,t}(p,s,u) + \zeta\Bigg[(1-\delta_{0,t})\Bigg[\lambda_e\Bigg($$
$$+\int_{p'\in M^{E_0}_{t+1}(p,s,NB)} E_{0,t+1}(p',\underline{s},p)\,dG(p') + \int_{p'\in M^{E_1}_{t+1}(p,s,NB)} E_{1,t+1}(p',\underline{s},p)\,dG(p')\Bigg)$$
$$+\Bigg(1-\lambda_e\int_{p'\in M^{E_0}_{t+1}(p,s,NB)\cup M^{E_1}_{t+1}(p,s,NB)} dG(p')\Bigg)\sum_{s'}\mu(s,s')E_{0,t+1}(p,s',u)\Bigg] + \delta_{0,t}U_{0,t+1}\Bigg]$$

$$U_{0,t} = b + \zeta\Bigg[\lambda_u\Bigg(\int_{p'\in M^{U_0}_{t+1}} E_{0,t+1}(p',\underline{s},u)\,dG(p') + \int_{p'\in M^{U_1}_{t+1}} E_{1,t+1}(p',\underline{s},u)\,dG(p')\Bigg)$$
$$+\Bigg(1-\lambda_u\int_{p'\in M^{U_0}_{t+1}\cup M^{U_1}_{t+1}} dG(p')\Bigg)U_{0,t+1}\Bigg]$$

$$J_{0,t}(p,s,u) = (1+s)p - w_{0,t}(p,s,u) + \zeta(1-\delta_{0,t})\Bigg[\lambda_e\Bigg($$
$$\int_{p'\in M^{E_0}_{t+1}(p,s,NB)} T_{0,t+1}(p',s,p)\,dG(p') + \int_{p'\in M^{E_1}_{t+1}(p,s,NB)} T_{1,t+1}(p',s,p)\,dG(p')\Bigg)$$
$$+\Bigg(1-\lambda_e\int_{p'\in M^{E_0}_{t+1}(p,s,NB)\cup M^{E_1}_{t+1}(p,s,NB)} dG(p')\Bigg)\sum_{s'}\mu(s,s')J_{0,t+1}(p,s',u)\Bigg]$$

$$S_{0,t}(p,s) \quad = \quad E_{0,t}(p,s,u) - U_{0,t} + J_{0,t}(p,s,u)$$

where:

- $p' \in M^{E_0}_{t+1}(p,s,NB)$ if $S_{0,t+1}(p',\underline{s}) > \sum_{s'}\mu(s,s')S_{0,t+1}(p,s')$ and $S_{0,t+1}(p',\underline{s}) > S_{1,t+1}(p',\underline{s})$
- $p' \in M^{E_1}_{t+1}(p,s,NB)$ if $S_{1,t+1}(p',\underline{s}) > \sum_{s'}\mu(s,s')S_{0,t+1}(p,s')$ and $S_{1,t+1}(p',\underline{s}) \geq S_{0,t+1}(p',\underline{s})$
- $p' \in M^{U_0}_{t+1}$ if $S_{0,t+1}(p',\underline{s}) > 0$ and $S_{0,t+1}(p',\underline{s}) > S_{1,t+1}(p',\underline{s})$
- $p' \in M^{U_1}_{t+1}$ if $S_{1,t+1}(p',\underline{s}) > 0$ and $S_{1,t+1}(p',\underline{s}) \geq S_{0,t+1}(p',\underline{s})$

The surplus can therefore be rewritten as follows:

$$
\begin{aligned}
&S_{0,t}(p,s) = (1+s)p - b \\
&+\zeta\Bigg[(1-\delta_{0,t})\Bigg[\sum_{s'}\mu(s,s')E_{0,t+1}(p,s',u) - U_{0,t+1} + \sum_{s'}\mu(s,s')J_{0,t+1}(p,s',u) \\
&+\lambda_e\Bigg(\int_{p'\in M^{E_0}_{t+1}(p,s,NB)} E_{0,t+1}(p',\underline{s},p)\,dG(p') \\
&-\int_{p'\in M^{E_0}_{t+1}(p,s,NB)} dG(p')\Big(\sum_{s'}\mu(s,s')E_{0,t+1}(p,s',u) + \sum_{s'}\mu(s,s')J_{0,t+1}(p,s',u)\Big) \\
&+\int_{p'\in M^{E_1}_{t+1}(p,s,NB)} E_{1,t+1}(p',\underline{s},p)\,dG(p') \\
&-\int_{p'\in M^{E_1}_{t+1}(p,s,NB)} dG(p')\Big(\sum_{s'}\mu(s,s')E_{0,t+1}(p,s',u) + \sum_{s'}\mu(s,s')J_{0,t+1}(p,s',u)\Big) \\
&+\int_{p'\in M^{E_0}_{t+1}(p,s,NB)} T_{0,t+1}(p',s,p)\,dG(p') + \int_{p'\in M^{E_1}_{t+1}(p,s,NB)} T_{1,t+1}(p',s,p)\,dG(p')\Bigg)\Bigg] \\
&-\lambda_u\Bigg(\int_{p'\in M^{U_0}_{t+1}}\Big(E_{0,t+1}(p',\underline{s},u) - U_{0,t+1}\Big)\,dG(p') + \int_{p'\in M^{U_1}_{t+1}}\Big(E_{1,t+1}(p',\underline{s},u) - U_{0,t+1}\Big)\,dG(p')\Bigg)\Bigg]
\end{aligned}
$$

with:

$$\sum_{s'}\mu(s,s')E_{0,t+1}(p,s',u) - U_{0,t+1} + \sum_{s'}\mu(s,s')J_{0,t+1}(p,s',u) = \sum_{s'}\mu(s,s')S_{0,t+1}(p,s')$$

$$E_{0,t+1}(p',\underline{s},p) - U_{0,t+1} = \frac{\gamma}{\alpha+\gamma}\sum_{s'}\mu(s,s')S_{0,t+1}(p,s') + \frac{\gamma}{\alpha+\beta+\gamma}\big(S_{0,t+1}(p',\underline{s}) - \sum_{s'}\mu(s,s')S_{0,t+1}(p,s')\big) \text{ if } p' \in M^{E_0}_{t+1}(p,s,NB)$$

$$E_{1,t+1}(p',\underline{s},p) - U_{0,t+1} = \frac{\gamma}{\alpha+\gamma}\sum_{s'}\mu(s,s')S_{0,t+1}(p,s') + \frac{\gamma}{\alpha+\beta+\gamma}\big(S_{1,t+1}(p',\underline{s}) - \sum_{s'}\mu(s,s')S_{0,t+1}(p,s')\big) \text{ if } p' \in M^{E_1}_{t+1}(p,s,NB)$$

$$E_{0,t+1}(p',\underline{s},u) - U_{0,t+1} = \frac{\gamma}{\alpha+\gamma}S_{0,t+1}(p',\underline{s})$$

$$E_{1,t+1}(p',\underline{s},u) - U_{0,t+1} = \frac{\gamma}{\alpha+\gamma}S_{1,t+1}(p',\underline{s})$$

$$T_{0,t+1}(p',s,p) = \frac{\alpha}{\alpha+\gamma}\sum_{s'}\mu(s,s')S_{0,t+1}(p,s') + \frac{\alpha}{\alpha+\beta+\gamma}\Big[S_{0,t+1}(p',\underline{s}) - \sum_{s'}\mu(s,s')S_{0,t+1}(p,s')\Big]$$

$$T_{1,t+1}(p',s,p) = \frac{\alpha}{\alpha+\gamma}\sum_{s'}\mu(s,s')S_{0,t+1}(p,s') + \frac{\alpha}{\alpha+\beta+\gamma}\Big[S_{1,t+1}(p',\underline{s}) - \sum_{s'}\mu(s,s')S_{0,t+1}(p,s')\Big]$$

With a little calculation, we get the following expression:

$$
\begin{aligned}
S_{0,t}(p,s) \quad = \quad & (1+s)p - b \\
& +\zeta\Bigg[(1-\delta_{0,t})\Bigg[\sum_{s'}\mu(s,s')S^{+}_{0,t+1}(p,s') \\
& +(\alpha+\gamma)\lambda_e\Bigg(\int_{p'\in M^{E_0}_{t+1}(p,s,NB)}\Big(S^{+}_{0,t+1}(p',\underline{s}) - \sum_{s'}\mu(s,s')S^{+}_{0,t+1}(p,s')\Big)\,dG(p') \\
& +\int_{p'\in M^{E_1}_{t+1}(p,s,NB)}\Big(S^{+}_{1,t+1}(p',\underline{s}) - \sum_{s'}\mu(s,s')S^{+}_{0,t+1}(p,s')\Big)\,dG(p')\Bigg)\Bigg] \\
& -\frac{\gamma}{\alpha+\gamma}\lambda_u\Bigg(\int_{p'\in M^{U_0}_{t+1}} S_{0,t+1}(p',\underline{s})\,dG(p') + \int_{p'\in M^{U_1}_{t+1}} S_{1,t+1}(p',\underline{s})\,dG(p')\Bigg)\Bigg]
\end{aligned}
$$

where:

- $p' \in M^{E_0}_{t+1}(p,s,NB)$ if $S_{0,t+1}(p',\underline{s}) > \sum_{s'}\mu(s,s')S_{0,t+1}(p,s')$ and $S_{0,t+1}(p',\underline{s}) > S_{1,t+1}(p',\underline{s})$
- $p' \in M^{E_1}_{t+1}(p,s,NB)$ if $S_{1,t+1}(p',\underline{s}) > \sum_{s'}\mu(s,s')S_{0,t+1}(p,s')$ and $S_{1,t+1}(p',\underline{s}) \geq S_{0,t+1}(p',\underline{s})$
- $p' \in M^{U_0}_{t+1}$ if $S_{0,t+1}(p',\underline{s}) > 0$ and $S_{0,t+1}(p',\underline{s}) > S_{1,t+1}(p',\underline{s})$
- $p' \in M^{U_1}_{t+1}$ if $S_{1,t+1}(p',\underline{s}) > 0$ and $S_{1,t+1}(p',\underline{s}) \geq S_{0,t+1}(p',\underline{s})$

B.3 Joint surplus - Type 1 - Equilibrium without transfer fees

$$E_{1,t}(p,s,NB) = w_{1,t}(p,s,NB) + \zeta\Bigg[(1-\delta_{2,t})\Bigg[\lambda_e\Bigg(\int_{p'\in M^{R_2}_{t+1}(p,s,NB)}\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',p')\,dG(p')$$
$$+\int_{p'\in M^{E_2}_{t+1}(p,s,NB)} E_{2,t+1}(p',\underline{s},p)\,dG(p')\Bigg)$$
$$+\Bigg(1-\lambda_e\int_{p'\in M^{R_2}_{t+1}(p,s,NB)\cup M^{E_2}_{t+1}(p,s,NB)} dG(p')\Bigg)\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',NB)\Bigg]+\delta_{2,t}U_{2,t+1}\Bigg]$$

$$U_{0,t} = b + \zeta\Bigg[\lambda_u\Bigg(\int_{p'\in M^{U_0}_{t+1}} E_{0,t+1}(p',\underline{s},u)\,dG(p') + \int_{p'\in M^{U_1}_{t+1}} E_{1,t+1}(p',\underline{s},u)\,dG(p')\Bigg)$$
$$+\Bigg(1-\lambda_u\int_{p'\in M^{U_0}_{t+1}\cup M^{U_1}_{t+1}} dG(p')\Bigg)U_{0,t+1}\Bigg]$$

$$J_{1,t}(p,s,NB) = (1+\Delta)(1+s)p - w_{1,t}(p,s,NB) - z + \zeta(1-\delta_{2,t})\Bigg[\lambda_e\int_{p'\in M^{R_2}_{t+1}(p,s,NB)}\sum_{s'}\mu(s,s')J_{2,t+1}(p,s',p')$$
$$+\Bigg(1-\lambda_e\int_{p'\in M^{R_2}_{t+1}(p,s,NB)\cup M^{E_2}_{t+1}(p,s,NB)} dG(p')\Bigg)\sum_{s'}\mu(s,s')J_{2,t+1}(p,s',NB)\Bigg]$$

$$S_{1,t}(p,s) \quad = \quad E_{1,t}(p,s,NB) - U_{0,t} + J_{1,t}(p,s,NB)$$

where:

- $p' \in M^{R_2}_{t+1}(p,s,NB)$ if $\sum_{s'}\mu(s,s')S_{2,t+1}(p,s') > S_{2,t+1}(p',\underline{s}) > S_{2,t+1}(NB)$
- $p' \in M^{E_2}_{t+1}(p,s,NB)$ if $S_{2,t+1}(p',\underline{s}) > \sum_{s'}\mu(s,s')S_{2,t+1}(p,s')$
- $p' \in M^{U_0}_{t+1}$ if $S_{0,t+1}(p',\underline{s}) > 0$ and $S_{0,t+1}(p',\underline{s}) > S_{1,t+1}(p',\underline{s})$
- $p' \in M^{U_1}_{t+1}$ if $S_{1,t+1}(p',\underline{s}) > 0$ and $S_{1,t+1}(p',\underline{s}) \geq S_{0,t+1}(p',\underline{s})$

The surplus can therefore be rewritten as follows:

$$
\begin{aligned}
&S_{1,t}(p,s) = (1+\Delta)(1+s)p - b - z \\
&+\zeta\Bigg[(1-\delta_{2,t})\Bigg[\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',NB) - U_{2,t+1} + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',NB) \\
&+\lambda_e\Bigg(\int_{p'\in M^{R_2}_{t+1}(p,s,NB)}\Big(\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',p') + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',p')\Big)\,dG(p') \\
&-\int_{p'\in M^{R_2}_{t+1}(p,s,NB)} dG(p')\Big(\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',NB) + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',NB)\Big) \\
&+\int_{p'\in M^{E_2}_{t+1}(p,s,NB)} E_{2,t+1}(p',\underline{s},p)\,dG(p') \\
&-\int_{p'\in M^{E_2}_{t+1}(p,s,NB)} dG(p')\Big(\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',NB) + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',NB)\Big)\Bigg)\Bigg] \\
&-\lambda_u\Bigg(\int_{p'\in M^{U_0}_{t+1}}\Big(E_{0,t+1}(p',\underline{s},u) - U_{0,t+1}\Big)\,dG(p') + \int_{p'\in M^{U_1}_{t+1}}\Big(E_{1,t+1}(p',\underline{s},u) - U_{0,t+1}\Big)\,dG(p')\Bigg) \\
&+\Big(U_{2,t+1} - U_{0,t+1}\Big)\Bigg]
\end{aligned}
$$

with:

$$\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',NB) - U_{2,t+1} + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',NB) = \sum_{s'}\mu(s,s')S_{2,t+1}(p,s')$$

$$\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',p') - U_{2,t+1} + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',p') = \sum_{s'}\mu(s,s')S_{2,t+1}(p,s')$$

$$E_{2,t+1}(p',\underline{s},p) - U_{2,t+1} = \sum_{s'}\mu(s,s')S_{2,t+1}(p,s') + \frac{\gamma}{\beta+\gamma}\left(S_{2,t+1}(p',\underline{s}) - \sum_{s'}\mu(s,s')S_{2,t+1}(p,s')\right)$$

$$E_{0,t+1}(p',\underline{s},u) - U_{0,t+1} = \frac{\gamma}{\alpha+\gamma}S_{0,t+1}(p',\underline{s})$$

$$E_{1,t+1}(p',\underline{s},u) - U_{0,t+1} = \frac{\gamma}{\alpha+\gamma}S_{1,t+1}(p',\underline{s})$$

With a little calculation, we get the following expression:

$$
\begin{aligned}
S_{1,t}(p,s) &= (1+\Delta)(1+s)p - b - z \\
&+\zeta\Bigg[(1-\delta_{2,t})\Bigg[\sum_{s'}\mu(s,s')S^{+}_{2,t+1}(p,s') \\
&+\frac{\gamma}{\beta+\gamma}\lambda_e\Bigg(\int_{p'\in M^{E_2}_{t+1}(p,s,NB)}\Big(S^{+}_{2,t+1}(p',\underline{s}) - \sum_{s'}\mu(s,s')S^{+}_{2,t+1}(p,s')\Big)\,dG(p')\Bigg)\Bigg] \\
&-\frac{\gamma}{\alpha+\gamma}\lambda_u\Bigg(\int_{p'\in M^{U_0}_{t+1}} S_{0,t+1}(p',\underline{s})\,dG(p') + \int_{p'\in M^{U_1}_{t+1}} S_{1,t+1}(p',\underline{s})\,dG(p')\Bigg) \\
&+\Big(U_{2,t+1} - U_{0,t+1}\Big)\Bigg]
\end{aligned}
$$

with:

$$
\begin{aligned}
U_{2,t} - U_{0,t} &= \zeta\Bigg[\frac{\gamma}{\alpha+\gamma}\Bigg[\lambda_u\int_{p'\in M^{U_2}_{t+1}} S_{2,t+1}(p',\underline{s})\,dG(p') \\
&-\int_{p'\in M^{U_0}_{t+1}} S_{0,t+1}(p',\underline{s})\,dG(p') - \int_{p'\in M^{U_1}_{t+1}} S_{1,t+1}(p',\underline{s})\,dG(p')\Bigg] \\
&+\Bigg[1-\phi\Bigg(1-\lambda_u\int_{p'\in M^{U_2}_{t+1}} dG(p')\Bigg)\Bigg]\Bigg[U_{2,t+1} - U_{0,t+1}\Bigg]\Bigg]
\end{aligned}
$$

where:

- $U_{2,T-1} - U_{0,T-1} = 0$

and where:

- $p' \in M^{E_2}_{t+1}(p,s,NB)$ if $S_{2,t+1}(p',\underline{s}) > \sum_{s'}\mu(s,s')S_{2,t+1}(p,s')$
- $p' \in M^{U_0}_{t+1}$ if $S_{0,t+1}(p',\underline{s}) > 0$ and $S_{0,t+1}(p',\underline{s}) > S_{1,t+1}(p',\underline{s})$
- $p' \in M^{U_1}_{t+1}$ if $S_{1,t+1}(p',\underline{s}) > 0$ and $S_{1,t+1}(p',\underline{s}) \geq S_{0,t+1}(p',\underline{s})$
- $p' \in M^{U_2}_{t+1}$ if $S_{2,t+1}(p',\underline{s}) > 0$

B.4 Joint surplus - Type 1 - Equilibrium with transfer fees

$$E_{1,t}(p,s,u) = w_{1,t}(p,s,u) + \zeta \Bigg[(1-\delta_{2,t}) \Bigg[\lambda_e \Bigg($$
$$+ \int_{p' \in M^{E_2}_{t+1}(p,s,NB)} E_{2,t+1}(p', \underline{s}, p)\, dG(p') \Bigg)$$
$$+ \Bigg(1 - \lambda_e \int_{p' \in M^{E_2}_{t+1}(p,s,NB)} dG(p') \Bigg) \sum_{s'} \mu(s,s') E_{2,t+1}(p,s',u) \Bigg] + \delta_{2,t} U_{2,t+1} \Bigg]$$

$$U_{0,t} = b + \zeta \Bigg[\lambda_u \Bigg(\int_{p' \in M^{U_0}_{t+1}} E_{0,t+1}(p', \underline{s}, u)\, dG(p') + \int_{p' \in M^{U_1}_{t+1}} E_{1,t+1}(p', \underline{s}, u)\, dG(p') \Bigg)$$
$$+ \Bigg(1 - \lambda_u \int_{p' \in M^{U_0}_{t+1} \cup M^{U_1}_{t+1}} dG(p') \Bigg) U_{0,t+1} \Bigg]$$

$$J_{1,t}(p,s,u) = (1+\Delta)(1+s)p - w_{1,t}(p,s,u) - z + \zeta(1-\delta_{2,t}) \Bigg[\lambda_e \Bigg($$
$$+ \int_{p' \in M^{E_2}_{t+1}(p,s,NB)} T_{2,t+1}(p', s, p)\, dG(p') \Bigg)$$
$$+ \Bigg(1 - \lambda_e \int_{p' \in M^{E_2}_{t+1}(p,s,NB)} dG(p') \Bigg) \sum_{s'} \mu(s,s') J_{2,t+1}(p,s',u) \Bigg]$$

$$S_{1,t}(p,s) \quad = \quad E_{1,t}(p,s,u) - U_{0,t} + J_{1,t}(p,s,u)$$

where:

- $p' \in M^{E_2}_{t+1}(p,s,NB)$ if $S_{2,t+1}(p', \underline{s}) > \sum_{s'} \mu(s,s') S_{2,t+1}(p,s')$
- $p' \in M^{U_0}_{t+1}$ if $S_{0,t+1}(p', \underline{s}) > 0$ and $S_{0,t+1}(p', \underline{s}) > S_{1,t+1}(p', \underline{s})$
- $p' \in M^{U_1}_{t+1}$ if $S_{1,t+1}(p', \underline{s}) > 0$ and $S_{1,t+1}(p', \underline{s}) \geq S_{0,t+1}(p', \underline{s})$

The surplus can therefore be rewritten as follows:

$$
\begin{aligned}
&S_{1,t}(p,s) = (1+\Delta)(1+s)p - b - z \\
&+\zeta\Bigg[(1-\delta_{2,t})\Bigg[\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',u) - U_{2,t+1} + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',u) \\
&+\lambda_e\Bigg(\int_{p'\in M^{E_2}_{t+1}(p,s,NB)} E_{2,t+1}(p',\underline{s},p)\,dG(p') \\
&-\int_{p'\in M^{E_2}_{t+1}(p,s,NB)} dG(p')\Big(\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',u) + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',u)\Big) \\
&+\int_{p'\in M^{E_2}_{t+1}(p,s,NB)} T_{2,t+1}(p',s,p)\,dG(p')\Bigg)\Bigg] \\
&-\lambda_u\Bigg(\int_{p'\in M^{U_0}_{t+1}}\Big(E_{0,t+1}(p',\underline{s},u) - U_{0,t+1}\Big)\,dG(p') + \int_{p'\in M^{U_1}_{t+1}}\Big(E_{1,t+1}(p',\underline{s},u) - U_{0,t+1}\Big)\,dG(p')\Bigg) \\
&+\Big(U_{2,t+1} - U_{0,t+1}\Big)\Bigg]
\end{aligned}
$$

with:

$$\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',u) - U_{2,t+1} + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',u) = \sum_{s'}\mu(s,s')S_{2,t+1}(p,s')$$

$$E_{2,t+1}(p',\underline{s},p) - U_{2,t+1} = \frac{\gamma}{\alpha+\gamma}\sum_{s'}\mu(s,s')S_{2,t+1}(p,s') + \frac{\gamma}{\alpha+\beta+\gamma}(S_{2,t+1}(p',\underline{s}) - \sum_{s'}\mu(s,s')S_{2,t+1}(p,s'))$$

$$E_{0,t+1}(p',\underline{s},u) - U_{0,t+1} = \frac{\gamma}{\alpha+\gamma}S_{0,t+1}(p',\underline{s})$$

$$E_{1,t+1}(p',\underline{s},u) - U_{0,t+1} = \frac{\gamma}{\alpha+\gamma}S_{1,t+1}(p',\underline{s})$$

$$T_{2,t+1}(p',s,p) = \frac{\alpha}{\alpha+\gamma}\sum_{s'}\mu(s,s')S_{2,t+1}(p,s') + \frac{\alpha}{\alpha+\beta+\gamma}\left[S_{2,t+1}(p',\underline{s}) - \sum_{s'}\mu(s,s')S_{2,t+1}(p,s')\right]$$

With a little calculation, we get the following expression:

$$
\begin{aligned}
S_{1,t}(p,s) \quad = \quad & (1+\Delta)(1+s)p - b - z \\
& + \zeta \Bigg[(1-\delta_{2,t}) \Big[\sum_{s'} \mu(s,s') S^{+}_{2,t+1}(p,s') \\
& + (\alpha+\gamma)\lambda_e \Big(\int_{p' \in M^{E_2}_{t+1}(p,s,NB)} \Big(S^{+}_{2,t+1}(p',\underline{s}) - \sum_{s'} \mu(s,s') S^{+}_{2,t+1}(p,s') \Big)\, dG(p') \Big) \Big] \\
& - \frac{\gamma}{\alpha+\gamma} \lambda_u \Big(\int_{p' \in M^{U_0}_{t+1}} S_{0,t+1}(p',\underline{s})\, dG(p') + \int_{p' \in M^{U_1}_{t+1}} S_{1,t+1}(p',\underline{s})\, dG(p') \Big) \\
& + \Big(U_{2,t+1} - U_{0,t+1} \Big) \Bigg]
\end{aligned}
$$

with:

$$
\begin{aligned}
U_{2,t} - U_{0,t} \quad = \quad & \zeta \Bigg[\frac{\gamma}{\alpha+\gamma} \Big[\lambda_u \int_{p' \in M^{U_2}_{t+1}} S_{2,t+1}(p',\underline{s})\, dG(p') \\
& - \int_{p' \in M^{U_0}_{t+1}} S_{0,t+1}(p',\underline{s})\, dG(p') - \int_{p' \in M^{U_1}_{t+1}} S_{1,t+1}(p',\underline{s})\, dG(p') \Big] \\
& + \Big[1 - \phi \Big(1 - \lambda_u \int_{p' \in M^{U_2}_{t+1}} dG(p') \Big) \Big] \Big[U_{2,t+1} - U_{0,t+1} \Big] \Bigg]
\end{aligned}
$$

where:

- $U_{2,T-1} - U_{0,T-1} = 0$

and where:

- $p' \in M^{E_2}_{t+1}(p,s,NB)$ if $S_{2,t+1}(p',\underline{s}) > \sum_{s'} \mu(s,s') S_{2,t+1}(p,s')$
- $p' \in M^{U_0}_{t+1}$ if $S_{0,t+1}(p',\underline{s}) > 0$ and $S_{0,t+1}(p',\underline{s}) > S_{1,t+1}(p',\underline{s})$
- $p' \in M^{U_1}_{t+1}$ if $S_{1,t+1}(p',\underline{s}) > 0$ and $S_{1,t+1}(p',\underline{s}) \geq S_{0,t+1}(p',\underline{s})$
- $p' \in M^{U_2}_{t+1}$ if $S_{2,t+1}(p',\underline{s}) > 0$

B.5 Joint surplus - Type 2 - Equilibrium without transfer fees

$$
\begin{aligned}
&E_{2,t}(p,s,NB) = w_{2,t}(p,s,NB) + \zeta\Bigg[(1-\delta_{2,t})\Bigg[\lambda_e\bigg(\int_{p'\in M^{R_2}_{t+1}(p,s,NB)}\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',p')\,dG(p') \\
&+\int_{p'\in M^{E_2}_{t+1}(p,s,NB)} E_{2,t+1}(p',\underline{s},p)\,dG(p')\bigg) \\
&+\bigg(1-\lambda_e\int_{p'\in M^{R_2}_{t+1}(p,s,NB)\cup M^{E_2}_{t+1}(p,s,NB)} dG(p')\bigg)\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',NB)\Bigg] + \delta_{2,t}U_{2,t+1}\Bigg]
\end{aligned}
$$

$$
\begin{aligned}
&U_{2,t} = b + \zeta\Bigg[\lambda_u\bigg(\int_{p'\in M^{U_2}_{t+1}} E_{2,t+1}(p',\underline{s},u)\,dG(p')\bigg) \\
&+\bigg(1-\lambda_u\int_{p'\in M^{U_2}_{t+1}} dG(p')\bigg)\bigg((1-\phi)U_{2,t+1}+\phi U_{0,t+1}\bigg)\Bigg]
\end{aligned}
$$

$$
\begin{aligned}
&J_{2,t}(p,s,NB) = (1+\Delta)(1+s)p - w_{2,t}(p,s,NB) + \zeta(1-\delta_{2,t})\Bigg[\lambda_e\int_{p'\in M^{R_2}_{t+1}(p,s,NB)}\sum_{s'}\mu(s,s')J_{2,t+1}(p,s',p')\,dG(\\
&+\bigg(1-\lambda_e\int_{p'\in M^{R_2}_{t+1}(p,s,NB)\cup M^{E_2}_{t+1}(p,s,NB)} dG(p')\bigg)\sum_{s'}\mu(s,s')J_{2,t+1}(p,s',NB)\Bigg]
\end{aligned}
$$

$$
S_{2,t}(p,s) \quad = \quad E_{2,t}(p,s,NB) - U_{2,t} + J_{2,t}(p,s,NB)
$$

where:

- $p' \in M^{R_2}_{t+1}(p,s,NB)$ if $\sum_{s'}\mu(s,s')S_{2,t+1}(p,s') > S_{2,t+1}(p',\underline{s}) > S_{2,t+1}(NB,\underline{s})$
- $p' \in M^{E_2}_{t+1}(p,s,NB)$ if $S_{2,t+1}(p',\underline{s}) > \sum_{s'}\mu(s,s')S_{2,t+1}(p,s')$
- $p' \in M^{U_2}_{t+1}$ if $S_{2,t+1}(p',\underline{s}) > 0$

The surplus can therefore be rewritten as follows:

$$
\begin{aligned}
& S_{2,t}(p,s) = (1+\Delta)(1+s)p - b \\
& +\zeta\Bigg[(1-\delta_{2,t})\Bigg[\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',NB) - U_{2,t+1} + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',NB) \\
& +\lambda_e\bigg(\int_{p'\in M^{R_2}_{t+1}(p,s,NB)}\Big(\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',p') + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',p')\Big)\,dG(p') \\
& -\int_{p'\in M^{R_2}_{t+1}(p,s,NB)} dG(p')\Big(\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',NB) + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',NB)\Big) \\
& +\int_{p'\in M^{E_2}_{t+1}(p,s,NB)} E_{2,t+1}(p',\underline{s},p)\,dG(p') \\
& -\int_{p'\in M^{E_2}_{t+1}(p,s,NB)} dG(p')\Big(\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',NB) + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',NB)\Big)\bigg)\Bigg] \\
& -\lambda_u\bigg(\int_{p'\in M^{U_2}_{t+1}}\Big(E_{2,t+1}(p',\underline{s},u) - U_{2,t+1}\Big)\,dG(p')\bigg) \\
& +\phi\bigg(1-\lambda_u\int_{p'\in M^{U_2}_{t+1}} dG(p')\bigg)\bigg(U_{2,t+1}-U_{0,t+1}\bigg)\Bigg]
\end{aligned}
$$

with:

$$\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',NB) - U_{2,t+1} + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',NB) = \sum_{s'}\mu(s,s')S_{2,t+1}(p,s')$$

$$\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',p') - U_{2,t+1} + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',p') = \sum_{s'}\mu(s,s')S_{2,t+1}(p,s')$$

$$E_{2,t+1}(p',\underline{s},p) - U_{2,t+1} = \sum_{s'}\mu(s,s')S_{2,t+1}(p,s') + \frac{\gamma}{\beta+\gamma}\big(S_{2,t+1}(p',\underline{s}) - \sum_{s'}\mu(s,s')S_{2,t+1}(p,s')\big)$$

$$E_{2,t+1}(p',\underline{s},u) - U_{2,t+1} = \frac{\gamma}{\alpha+\gamma}S_{2,t+1}(p',\underline{s})$$

With a little calculation, we get the following expression:

$$\begin{aligned}
S_{2,t}(p,s) &= (1+\Delta)(1+s)p - b \\
&+\zeta\Bigg[(1-\delta_{2,t})\Big[\sum_{s'}\mu(s,s')S^{+}_{2,t+1}(p,s') \\
&+\frac{\gamma}{\beta+\gamma}\lambda_e\Big(\int_{p'\in M^{E_2}_{t+1}(p,s,NB)}\Big(S^{+}_{2,t+1}(p',\underline{s})-\sum_{s'}\mu(s,s')S^{+}_{2,t+1}(p,s')\Big)\,dG(p')\Big)\Big] \\
&-\frac{\gamma}{\alpha+\gamma}\lambda_u\Big(\int_{p'\in M^{U_2}_{t+1}} S_{2,t+1}(p',\underline{s})\,dG(p')\Big) \\
&+\phi\Big(1-\lambda_u\int_{p'\in M^{U_2}_{t+1}} dG(p')\Big)\Big(U_{2,t+1}-U_{0,t+1}\Big)\Bigg]
\end{aligned}$$

with:

$$\begin{aligned}
U_{2,t}-U_{0,t} &= \zeta\Bigg[\frac{\gamma}{\alpha+\gamma}\Big[\lambda_u\int_{p'\in M^{U_2}_{t+1}} S_{2,t+1}(p',\underline{s})\,dG(p') \\
&-\int_{p'\in M^{U_0}_{t+1}} S_{0,t+1}(p',\underline{s})\,dG(p') - \int_{p'\in M^{U_1}_{t+1}} S_{1,t+1}(p',\underline{s})\,dG(p')\Big] \\
&+\Big[1-\phi\Big(1-\lambda_u\int_{p'\in M^{U_2}_{t+1}} dG(p')\Big)\Big]\Big[U_{2,t+1}-U_{0,t+1}\Big]\Bigg]
\end{aligned}$$

where:

- $U_{2,T-1} - U_{0,T-1} = 0$

and where:

- $p' \in M^{E_2}_{t+1}(p,s,NB)$ if $S_{2,t+1}(p',\underline{s}) > \sum_{s'}\mu(s,s')S_{2,t+1}(p,s')$
- $p' \in M^{U_2}_{t+1}$ if $S_{2,t+1}(p',\underline{s}) > 0$

B.6 Joint surplus - Type 2 - Equilibrium with transfer fees

$$E_{2,t}(p,s,u) = w_{2,t}(p,s,u) + \zeta\Bigg[(1-\delta_{2,t})\Bigg[\lambda_e\Bigg($$
$$+\int_{p'\in M^{E_2}_{t+1}(p,s,NB)} E_{2,t+1}(p',\underline{s},p)\,dG(p')\Bigg)$$
$$+\Bigg(1-\lambda_e\int_{p'\in M^{E_2}_{t+1}(p,s,NB)} dG(p')\Bigg)\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',u)\Bigg]+\delta_{2,t}U_{2,t+1}\Bigg]$$

$$U_{2,t} = b + \zeta\Bigg[\lambda_u\Bigg(\int_{p'\in M^{U_2}_{t+1}} E_{2,t+1}(p',\underline{s},u)\,dG(p')\Bigg)$$
$$+\Bigg(1-\lambda_u\int_{p'\in M^{U_2}_{t+1}} dG(p')\Bigg)\Bigg((1-\phi)U_{2,t+1}+\phi U_{0,t+1}\Bigg)\Bigg]$$

$$J_{2,t}(p,s,u) = (1+\Delta)(1+s)p - w_{2,t}(p,s,u) + \zeta(1-\delta_{2,t})\Bigg[\lambda_e\Bigg($$
$$+\int_{p'\in M^{E_2}_{t+1}(p,s,NB)} T_{2,t+1}(p',s,p)\,dG(p')\Bigg)$$
$$+\Bigg(1-\lambda_e\int_{p'\in M^{E_2}_{t+1}(p,s,NB)} dG(p')\Bigg)\sum_{s'}\mu(s,s')J_{2,t+1}(p,s',u)\Bigg]$$

$$S_{2,t}(p,s) \quad = \quad E_{2,t}(p,s,u) - U_{2,t} + J_{2,t}(p,s,u)$$

where:

- $p' \in M^{E_2}_{t+1}(p,s,NB)$ if $S_{2,t+1}(p',\underline{s}) > \sum_{s'}\mu(s,s')S_{2,t+1}(p,s')$
- $p' \in M^{U_2}_{t+1}$ if $S_{2,t+1}(p',\underline{s}) > 0$

The surplus can therefore be rewritten as follows:

$$
\begin{aligned}
&S_{2,t}(p,s) = (1+\Delta)(1+s)p - b \\
&+\zeta\Bigg[(1-\delta_{2,t})\Big[\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',u) - U_{2,t+1} + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',u) \\
&+\lambda_e\Big(\int_{p'\in M^{E_2}_{t+1}(p,s,NB)} E_{2,t+1}(p',\underline{s},p)\,dG(p') \\
&-\int_{p'\in M^{E_2}_{t+1}(p,s,NB)} dG(p')\Big(\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',u) + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',u)\Big) \\
&+\int_{p'\in M^{E_2}_{t+1}(p,s,NB)} T_{2,t+1}(p',s,p)\,dG(p')\Big)\Big] \\
&-\lambda_u\Big(\int_{p'\in M^{U_2}_{t+1}}\Big(E_{2,t+1}(p',\underline{s},u) - U_{2,t+1}\Big)\,dG(p')\Big) \\
&+\phi\Big(1-\lambda_u\int_{p'\in M^{U_2}_{t+1}} dG(p')\Big)\Big(U_{2,t+1} - U_{0,t+1}\Big)\Bigg]
\end{aligned}
$$

with:

$$\sum_{s'}\mu(s,s')E_{2,t+1}(p,s',u) - U_{2,t+1} + \sum_{s'}\mu(s,s')J_{2,t+1}(p,s',u) = \sum_{s'}\mu(s,s')S_{2,t+1}(p,s')$$

$$E_{2,t+1}(p',\underline{s},p) - U_{2,t+1} = \frac{\gamma}{\alpha+\gamma}\sum_{s'}\mu(s,s')S_{2,t+1}(p,s') + \frac{\gamma}{\alpha+\beta+\gamma}(S_{2,t+1}(p',\underline{s}) - \sum_{s'}\mu(s,s')S_{2,t+1}(p,s'))$$

$$E_{2,t+1}(p',\underline{s},u) - U_{2,t+1} = \frac{\gamma}{\alpha+\gamma}S_{2,t+1}(p',\underline{s})$$

$$T_{2,t+1}(p',s,p) = \frac{\alpha}{\alpha+\gamma}\sum_{s'}\mu(s,s')S_{2,t+1}(p,s') + \frac{\alpha}{\alpha+\beta+\gamma}\left[S_{2,t+1}(p',\underline{s}) - \sum_{s'}\mu(s,s')S_{2,t+1}(p,s')\right]$$

With a little calculation, we get the following expression:

$$\begin{aligned}
S_{2,t}(p,s) \quad = \quad & (1+\Delta)(1+s)p - b \\
& +\zeta\Bigg[(1-\delta_{2,t})\Bigg[\sum_{s'}\mu(s,s')S^{+}_{2,t+1}(p,s') \\
& +(\alpha+\gamma)\lambda_e\Bigg(\int_{p'\in M^{E_2}_{t+1}(p,s,NB)}\Big(S^{+}_{2,t+1}(p',\underline{s}) - \sum_{s'}\mu(s,s')S^{+}_{2,t+1}(p,s')\Big)\,dG(p')\Bigg)\Bigg] \\
& -\frac{\gamma}{\alpha+\gamma}\lambda_u\Bigg(\int_{p'\in M^{U_2}_{t+1}} S_{2,t+1}(p',\underline{s})\,dG(p')\Bigg) \\
& +\phi\Bigg(1-\lambda_u\int_{p'\in M^{U_2}_{t+1}} dG(p')\Bigg)\Bigg(U_{2,t+1}-U_{0,t+1}\Bigg)\Bigg]
\end{aligned}$$

with:

$$\begin{aligned}
U_{2,t} - U_{0,t} \quad = \quad & \zeta\Bigg[\frac{\gamma}{\alpha+\gamma}\Bigg[\lambda_u\int_{p'\in M^{U_2}_{t+1}} S_{2,t+1}(p',\underline{s})\,dG(p') \\
& -\int_{p'\in M^{U_0}_{t+1}} S_{0,t+1}(p',\underline{s})\,dG(p') - \int_{p'\in M^{U_1}_{t+1}} S_{1,t+1}(p',\underline{s})\,dG(p')\Bigg] \\
& +\Bigg[1-\phi\Bigg(1-\lambda_u\int_{p'\in M^{U_2}_{t+1}} dG(p')\Bigg)\Bigg]\Bigg[U_{2,t+1}-U_{0,t+1}\Bigg]\Bigg]
\end{aligned}$$

where:

- $U_{2,T-1} - U_{0,T-1} = 0$

and where:

- $p' \in M^{E_2}_{t+1}(p,s,NB)$ if $S_{2,t+1}(p',\underline{s}) > \sum_{s'}\mu(s,s')S_{2,t+1}(p,s')$
- $p' \in M^{U_2}_{t+1}$ if $S_{2,t+1}(p',\underline{s}) > 0$

C Labor market flows

Specific human capital has an impact on workers' mobility and firms' training decisions. To determine labour market flows, we thus need to define the following thresholds:

- $\ddot{p}_j(t,s)$, which solves $S_{j,t}(\ddot{p}_j(t,s),s) = 0 \; \forall t,s$ and $j \in \{0,1,2\}$.
  This is the productivity threshold above which the match is viable. If a worker of type j, age t, and specific human capital s is employed in a firm of type $p < \ddot{p}_j(t,s)$, the job is destroyed endogenously and the worker enters the pool of nonemployed.

- $\hat{p}_j(t,p,s)$, which solves $S_{j,t}(\hat{p}_j(t,p,s),\underline{s}) = S_{j,t}(p,s) \; \forall t,p,s$ and $j \in \{0,1,2\}$. This is the productivity threshold above which it is in the worker's interest to move from job to job. If a worker of type j, age t, and specific human capital s is employed in a firm of type p and receives an external offer from a firm of type $p' > \hat{p}_j(t,p,s)$, the worker accepts the offer and moves from job to job. Note that $\hat{p}_j(t,p,\underline{s}) = p$.

- $\check{p}_j(t,p,s)$, which solves $S_{j,t}(p,\underline{s}) = S_{j,t}(\check{p}_j(t,p,s),s) \; \forall t,p,s$ and $j \in \{0,1,2\}$. This is the symmetrical threshold to the previous one. If a worker of type j, age t, and specific human capital s is employed in a firm of type $p < \hat{p}_j(t,p,s)$ and receives an external offer from a firm of type p, the worker accepts the offer and moves from job to job.

- $\tilde{p}(t)$, which solves $S_{1,t}(\tilde{p}(t),\underline{s}) = S_{0,t}(\tilde{p}(t),\underline{s}) \; \forall t$. This is the productivity threshold above which it is profitable to train the worker. If an untrained worker of age t is hired by a firm of type $p \geq \tilde{p}(t)$, the worker is trained.

Let's define the following stocks:

- $u_{j,t}$ is the stock of nonemployed workers of type j and age t

- $e_{j,t}(p,s)$ is the stock of employed workers of type j, age t, and specific human capital s, matched with p-firms

The stocks of nonemployed workers are defined by the following laws of motion, $\forall t \in [2, T-1]$:

$$
\begin{aligned}
u_{0,t} =& u_{0,t-1}\Big(1-\lambda_u[1-G(\ddot{p}_0(t,\underline{s}))]\Big) + u_{2,t-1}\Big(1-\lambda_u[1-G(\ddot{p}_2(t,\underline{s}))]\Big)\phi + \delta_{0,t-1}\Big(\sum_s \int e_{0,t-1}(p,s)dp\Big) \\
&+ \Big(1-\delta_{0,t-1}\Big)\Big(\sum_s \sum_{s'} \mu(s,s') \int^{\ddot{p}_0(t,s')} \Big(1-\lambda_e[1-G(\hat{p}_0(t,p,\underline{s}))]\Big) e_{0,t-1}(p,s')dp\Big)
\end{aligned}
$$

$$
\begin{aligned}
u_{2,t} =& u_{2,t-1}\Big(1-\lambda_u[1-G(\ddot{p}_2(t,\underline{s}))]\Big)\Big(1-\phi\Big) + \delta_{2,t-1}\Big(\sum_s \int [e_{1,t-1}(p,s)+e_{2,t-1}(p,s)]dp\Big) \\
&+ \Big(1-\delta_{2,t-1}\Big)\Big(\sum_s \sum_{s'} \mu(s,s') \int^{\ddot{p}_2(t,s')} \Big(1-\lambda_e[1-G(\hat{p}_0(t,p,\underline{s}))]\Big) [e_{1,t-1}(p,s')+e_{2,t-1}(p,s')]dp\Big)
\end{aligned}
$$

The stocks of employed workers are defined by the following laws of motion, $\forall t \in [2, T-1]$:

$$e_{0,t}(p,\underline{s}) = \mathbb{1}\{\tilde{p}(t) > p \geq \ddot{p}_0(t,\underline{s})\} \times \Big\{ e_{0,t-1}(p,\underline{s})\Big(1-\delta_{0,t-1}\Big)\Big(1-\lambda_e[1-G(\hat{p}_0(t,p,\underline{s}))]\Big)\Big(1-\rho\Big) + u_{0,t-1}\lambda_u g(p) + \Big(1-\delta_{0,t-1}\Big)\lambda_e g(p)\Big(\sum_s \int^{\check{p}_0(t,p,s)} e_{0,t-1}(p,s)dp\Big)\Big\}$$

$$e_{0,t}(p,s) = \mathbb{1}\{\tilde{p}(t) > p \geq \ddot{p}_0(t,s)\} \times \Big\{ e_{0,t-1}(p,s)\Big(1-\delta_{0,t-1}\Big)\Big(1-\lambda_e[1-G(\hat{p}_0(t,p,s))]\Big)\Big(1-\rho\Big) + e_{0,t-1}(p,s-1)\Big(1-\delta_{0,t-1}\Big)\Big(1-\lambda_e[1-G(\hat{p}_0(t,p,s-1))]\Big)\rho\Big\}$$

$$e_{0,t}(p,\bar{s}) = \mathbb{1}\{\tilde{p}(t) > p \geq \ddot{p}_0(t,\bar{s})\} \times \Big\{ e_{0,t-1}(p,\bar{s})\Big(1-\delta_{0,t-1}\Big)\Big(1-\lambda_e[1-G(\hat{p}_0(t,p,\bar{s}))]\Big) + e_{0,t-1}(p,\bar{s}-1)\Big(1-\delta_{0,t-1}\Big)\Big(1-\lambda_e[1-G(\hat{p}_0(t,p,\bar{s}-1))]\Big)\rho\Big\}$$

$$e_{1,t}(p,\underline{s}) = \mathbb{1}\{p \geq \tilde{p}(t) \geq \ddot{p}_0(t,\underline{s})\} \times \Big\{ u_{0,t-1}\lambda_u g(p) + \Big(1-\delta_{0,t-1}\Big)\lambda_e g(p)\Big(\sum_s \int^{\check{p}_0(t,p,s)} e_{0,t-1}(p,s)dp\Big)\Big\}$$

$$e_{2,t}(p,\underline{s}) = \mathbb{1}\{p \geq \ddot{p}_2(t,\underline{s})\} \times \Big\{ \Big(e_{1,t-1}(p,\underline{s}) + e_{2,t-1}(p,\underline{s})\Big)\Big(1-\delta_{2,t-1}\Big)\Big(1-\lambda_e[1-G(\hat{p}_2(t,p,\underline{s}))]\Big)\Big(1-\rho\Big) + u_{2,t-1}\lambda_u g(p) + \Big(1-\delta_{2,t-1}\Big)\lambda_e g(p)\Big(\sum_s \int^{\check{p}_2(t,p,s)} [e_{1,t-1}(p,s) + e_{2,t-1}(p,s)]dp\Big)\Big\}$$

$$e_{2,t}(p,s) = \mathbb{1}\{p \geq \ddot{p}_2(t,s)\} \times \Big\{ \Big(e_{1,t-1}(p,s) + e_{2,t-1}(p,s)\Big)\Big(1-\delta_{2,t-1}\Big)\Big(1-\lambda_e[1-G(\hat{p}_2(t,p,s))]\Big)\Big(1-\rho\Big) + \Big(e_{1,t-1}(p,s-1) + e_{2,t-1}(p,s-1)\Big)\Big(1-\delta_{2,t-1}\Big)\Big(1-\lambda_e[1-G(\hat{p}_2(t,p,s-1))]\Big)\rho\Big\}$$

$$e_{2,t}(p,\bar{s}) = \mathbb{1}\{p \geq \ddot{p}_2(t,\bar{s})\} \times \Big\{ \Big(e_{1,t-1}(p,\bar{s}) + e_{2,t-1}(p,\bar{s})\Big)\Big(1-\delta_{2,t-1}\Big)\Big(1-\lambda_e[1-G(\hat{p}_2(t,p,s))]\Big) + \Big(e_{1,t-1}(p,s-1) + e_{2,t-1}(p,s-1)\Big)\Big(1-\delta_{2,t-1}\Big)\Big(1-\lambda_e[1-G(\hat{p}_2(t,p,s-1))]\Big)\rho\Big\}$$

with the following initial conditions:

$$u_{0,1} = 1$$
$$u_{2,1} = 0$$
$$e_{0,1}(p,s) = e_{1,1}(p,s) = e_{2,1}(p,s) = 0 \;\forall p, s$$

and the condition:

$$e_{1,t}(p,s) = 0 \;\forall p, \forall s > \underline{s}$$

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