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# Financial incentives and labour market duality☆

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## HIGHLIGHTS

- We use a matching model calibrated on France to simulate incentive policies aiming at reducing labour-market duality.
- Introducing taxes on short-term employment decreases their share in total employment but strengthens labour-market rigidities.
- Unemployment spells are longer and transformations of short-term contracts to permanent ones are lower.
- Targeting taxes and subsidies to encourage permanent hiring is more efficient to reduce duality.

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## ABSTRACT

The French labour market is divided between workers in permanent jobs and those who alternate fixed-term contracts with unemployment spells. Among other public policies aiming at reducing this duality, financial incentives could induce employers to lengthen contract duration or favour permanent contracts. This article develops a matching model fitted to the French labour market characteristics and calibrated on French data. A gradual decrease in unemployment contributions or a firing tax reduces the share of short-term contract in total employment but increases market rigidity and lowers labour productivity. However, decreasing unemployment contributions gradually is less favourable for new entrants than a firing tax and lengthens unemployment spells. An additional contribution levied on short-term contracts to finance a bonus for permanent-contract hirings also decreases labour market duality and increases activity by 0.13% but without negative impacts on labour market flexibility and productivity.



## 1. Introduction

The French labour market is divided between workers in stable jobs with high employment protection and those who accumulate unemployment spells and short-term contracts. These two categories are compartmentalised, inducing a bumpy occupational path for the most precarious workers. Since introducing a unique contract or a convergence of employment protection of both types of contract to reduce duality is socially difficult during crisis periods, this paper aims at comparing the efficacy of financial incentives proposed during public debates.

The coexistence of short-term and permanent contracts leads to an unequal distribution of risks induced by economic conditions. As shown by Saint-Paul (1996), risk exposure is highest for workers under short-term contracts and the most precarious population categories. In case of a shock, short-term contracts are not renewed to reduce the firms' wage–bill. Furthermore, the advantages of a permanent contract extend beyond the labour market, as a stable job facilitates access to housing and loans. Moreover, labour market duality could induce a disconnection between wages and unemployment (Bentolila and Dolado, 1994). Indeed, insiders, working under permanent contracts, are less threatened by unemployment. Consequently, unemployment weighs less on wages.

The empirical literature, in particular Bassanini and Garnero (2013), shows that the phenomenon could be related to labour market institutions and the gap between the employment protection of permanent and fixed-term contracts. To dismiss a worker in a permanent contract is often a long, risky, and costly process. This may explain why firms use short-term contracts to increase workforce flexibility in order to

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cope with economic risks. Indeed, employers seek this flexibility on the margins of the system. The growing use of short-term contracts and temporary work has made the labour market more fluid, increasing job creation and destruction. However, as shown by Picart (2014), this higher employment flexibility, focused solely on short-term contracts, does not seem to have significantly reduced unemployment. It has also helped to reinforce the employment protection of insiders at the expense of the integration of outsiders. Moreover, this duality reduces human capital, and then productivity, because of the reduction in training of workers under a short-term contract and in firm-specific human capital accumulation. A recent survey of adult skills conducted by the OECD points out that temporary contract status has a negative impact on the probability of receiving employer-sponsored training. In particular, this probability decreases by 25% in France. On the contrary, workers under permanent contract benefit from returns to experience and increase their human capital. Therefore, labour turnover relies mainly on workers under short-term contracts. According to the OECD, the three-year transition rate from temporary to permanent contracts in France is around 20%, against 50% in the Nordic countries.

Theoretical analysis confirms these arguments and shows that partial flexibility, focused exclusively on short-term contracts, reduces the share of permanent contracts or CDI (Contrat à Durée Indéterminée) and has an even stronger negative impact on flows into and out of permanent contracts. The imbalance due to a gap in hiring costs between permanent and short-term contracts could be more harmful than the gap in separation costs. Blanchard and Landier (2002) show the negative effect of fixed-term contracts on the functioning of the labour market. Staff turnover and the unemployment rate are higher. Cahuc and Postel-Vinay (2002) highlight the inefficiency of the combination of high employment protection and the introduction of short-term contracts. However, in their model, a majority of workers prefer this inefficient *laissez faire*, an attitude that explains the system's persistence. More recently, Cahuc et al. (forthcoming) point out that strong employment protection under permanent contracts increases short-term job flows. The impact on employment is small but this employment protection significantly reduces the labour productivity, substituting permanent jobs with short-term contracts. To reduce labour market duality, these authors suggest harmonising employment protection for fixed-term contracts with that of permanent contracts, or instituting a single labour contract.[1] However, this would generate legal difficulties and might not win economic and social acceptance. Implementation of such a policy could be problematic, with a difficult transition period.[2] An alternative could be to offer employers financial incentives in favour of stable jobs, either via employment duration or type of contract (CDI versus CDD or temporary work).

In this paper, we examine three proposals for reaching this goal. The first proposal comes from French labour unions. To encourage employers to offer stable jobs, unemployment insurance contributions should decrease gradually, based on the worker's tenure. The additional contribution in the first months or years is roughly equivalent to a hiring tax spread over several months. Second, as suggested by Blanchard and Tirole (2003), we introduce a termination tax to finance unemployment benefits, along the lines of the U.S. "experience rating" system. This tax aims at insourcing the social costs of unemployment into the employer's lay-off decision. Both proposals would increase labour market flow costs, which could induce employers to lengthen average employment duration. The third proposal is based on the Italian labour market reform of 2012. An additional contribution is levied on temporary contracts to discourage short-term hirings. When an employer turns a temporary contract into permanent one, the surtax is partly or fully refunded. Unlike the first two proposals, the penalty on short-term contracts is linked to support for permanent hirings. This approach would generate a milder increase in labour market rigidity than the first two proposals because of hiring incentives. Moreover, by directly targeting the issue, this policy better reduces duality by encouraging transition to permanent contracts.

To study these policies, we use a matching model based on Pissarides (2000), where permanent and short-term jobs are distinct and permanent jobs are endogenously destroyed. Due to the existence of a minimum wage in France, real wages cannot be viewed as perfectly flexible, in particular for temporary unskilled jobs. To allow for this, we split the labour market into skilled and unskilled workers. We calibrate the model on French data and simulate three public policies designed to reduce labour market duality: a hiring tax, a firing tax, and a surtax on fixed-term contracts to finance a bonus for permanent hirings.

The article is organised as follows. Section 2 briefly describes the matching model used and Section 3 details its calibration on French data. Section 4 shows the impact of the three stylised reforms. Finally, Section 5 draws conclusions.

## 2. Model

To study the impact of these financial incentives, we developed a matching model with endogenous job destruction as described by Pissarides (2000), where firms create only short-term contracts, which are converted to permanent ones or terminated. This approach takes into account the trade-off between the two types of contracts but needs simplification: all permanent hirings follow short-term contracts. Details of the model are in Appendix.

### 2.1. Assumptions and notations

Jobs are divided into those with a costly separation initiated by the employer (mostly permanent contracts) and those with a reduced termination cost (temporary work, short-term contracts, trial periods, and apprenticeship). For simplicity, we shall refer to the first situation as "CDI" or "permanent contract" and the second as "CDD" or "short-term contract."

Exit flows from permanent contracts are not exogenous. They are determined by productivity shocks, $\epsilon$, so as to capture the effect of a dismissal tax. We model productivity as the sum of a perennial component, which reflects the inherent quality of the job/worker match, and an economic component, which reflects hazards on demand for the firm's products.

Lastly, we need to take into account the effects of the minimum wage on the lowest wages. Cahuc and Zylberberg (1999) highlighted a strong interaction between employment protection and minimum wage: when wages are set by bargaining, dismissal costs have no impact on the unemployment rate because the decrease in hirings is offset by the decrease in breaches of terminations. In particular, employment protection induces lower wages at hiring and curbs the negative effects on hiring. When wages are not negotiated–and especially when they are constrained by the minimum wage–the hiring wage cannot be adjusted. As a result, the negative effect on hiring is not offset by the decrease in terminations. This mechanism concerns earnings at minimum-wage levels but also slightly higher earnings in order to maintain a wage hierarchy.[3]

In order to take it into account, the labour market is divided in two worker categories. In the first part, workers are skilled and wages are always negotiated. In the second part, workers are unskilled and are paid at the minimum wage in short-term contracts, whereas their wage is negotiated when they are in permanent ones. Skill level is subscripted by $k$, with $k = n$ for unskilled workers and $k = q$ for skilled workers.

[1] See, especially, the reports by Blanchard and Tirole (2003) and Cahuc and Kramarz (2004).

[2] See Lepage-Saucier et al. (2013).

[3] As demonstrated by the diffusion effects when the minimum wage increases—see Koubi and Lhommeau (2007) and, more recently, by Goarant and Muller (2011) and Aeberhardt et al. (2012).

The two categories are normalised to 1. A proportion $l_{0k}$ is hired under short-term contracts, $l_{1k}$ under permanent contracts, and $u_k$ is unemployed. Unemployment benefits are $b_k$ and the cost of a vacancy for a firm is $h_k$ (Fig. 1).

We model the matching process between vacancies and unemployed persons by a matching function. When $u$ unemployed are seeking work and firms open $v$ job vacancies, the number of hirings is $M_k(v, u)$, where $M_k(.,.)$ is an increasing function relative to both parameters, with constant scale returns such that $M_k(v, 0) = M_k(0, u) = 0$. Let $\theta_k = v_k/u_k$ the tightness of each labour market. The probability of filling the post is $m_k(\theta_k)$ with $m_k(\theta_k) = M_k(1,1/\theta_k)$. The probability for an unemployed person of finding a job is $\theta_k m_k(\theta_k)$.

The cost for a firm of hiring a worker under a short-term contract is $d_{0k}$, comprising administrative costs and/or taxes. The hired worker's productivity is $z_{0k}$. The net and gross wages for the job is $w_{0k}$ and $\rho_{0k}w_{0k}$ respectively, where $\rho_{0k}$ is the tax wedge. The contract ends randomly, following a Poisson process of parameter $\lambda_{0k}$. At that point, the worker reveals her initial productivity $z_d$ in a permanent contract. Taking this productivity into account, the firm decides whether or not to hire the worker under a permanent contract. $z_d$ is a random variable, distributed according to the cumulative distribution function $F_{zk}$. Reservation productivity is noted $\tilde{z}_{dk}$. Below this threshold, the worker is not productive enough to be kept on a permanent basis under a permanent contract. The termination costs $c_{0k}$ to the firm and the conversion of the contract into a permanent contract costs $d_{1k}$ in taxes and expenses.

Once the worker is hired, some economic shocks occur following a Poisson process of parameter $\lambda_{1k}$. The shocks change the worker's productivity on the job, which becomes $z = z_d + \varepsilon$. After each shock, the job is maintained only if $z$ is high enough. $\underline{\varepsilon}_k(z_d)$ is also the threshold of $\varepsilon$ below which the job is destroyed. In case of termination, the firm pays $c_{1k}$ for the dismissal, a sum that includes taxes. In a permanent contract, the net wage is $w_{1k}(z_d, \varepsilon)$ for an initial productivity of $z_d$ and a possible productivity shock of $\varepsilon$. The tax wedge is $\rho_{1k}$.

### 2.2. Model equilibrium

#### 2.2.1. Reservation productivities

*2.2.1.1. Permanent contract maintained.* When a shock occurs, with a new productivity $z_d + \varepsilon$, the contract is maintained if the firm's surplus and the worker's surplus are positive—$S^f_{1k}(z_d, \varepsilon) \geq 0$ and $S^e_{1k}(z_d, \varepsilon) \geq 0$. The productivity shock threshold $\underline{\varepsilon}_k(z_d)$, above which the firm does not dismiss the worker, is also defined by:

$$\forall z_d,\ \ S^t_{1k}(z_d, \underline{\varepsilon}_k(z_d)) = 0 \tag{1}$$

Eq. (1) gives the job destruction, implicitly yielding the value of $\underline{\varepsilon}_k(z_d)$:

$$\forall z_d,\ \ 0 = \underline{\varepsilon}_k(z_d) + z_d - r(\rho_{1k}V_{uk} - c_{1k}) + \frac{\lambda_{1k}}{r+\lambda_{1k}} \int_{\underline{\varepsilon}_k(z_d)}^{\infty} (\varepsilon' - \underline{\varepsilon}_k(z_d)) dF_{\varepsilon k}(\varepsilon'). \tag{2}$$

$\underline{\varepsilon}_k(z_d)$ is a decreasing function of $z_d$. The higher the initial productivity, the fewer the shocks $\varepsilon$ leading to dismissal. For a given $z_d$, $\underline{\varepsilon}_k(z_d)$ reduces with $c_{1k}$ and increases with $V_{uk}$. In other words, a high dismissal cost decreases the probability of a contract termination. By contrast, a higher reservation wage increases this probability.

*2.2.1.2. Hiring under a permanent contract.* At the end of a short-term contract, the employer decides to turn the contract into a permanent one if and only if $z_d \geq \tilde{z}_{dk}$, i.e. if and only if the hiring flow value is sufficiently high compared with the dismissal flow value. The first value is $\Pi_{1k}(z_d, 0) - \Pi_{0k} - d_{1k}$ and the second $\Pi_{vk} - \Pi_{0k} - c_{0k}$. Accordingly, the hiring under permanent contract will occur if and only if $S^f_{1k}(z_d, 0) \geq d_{1k} + c_{1k} - c_{0k}$. In what follows, we write $S^t_{0k} = S^f_{0k} + \rho_{0k}S^e_{0k}$ and $S^t_{1k}(z_d, \varepsilon) = S^f_{1k}(z_d, \varepsilon) + \rho_{1k}S^e_{1k}(z_d, \varepsilon)$. The

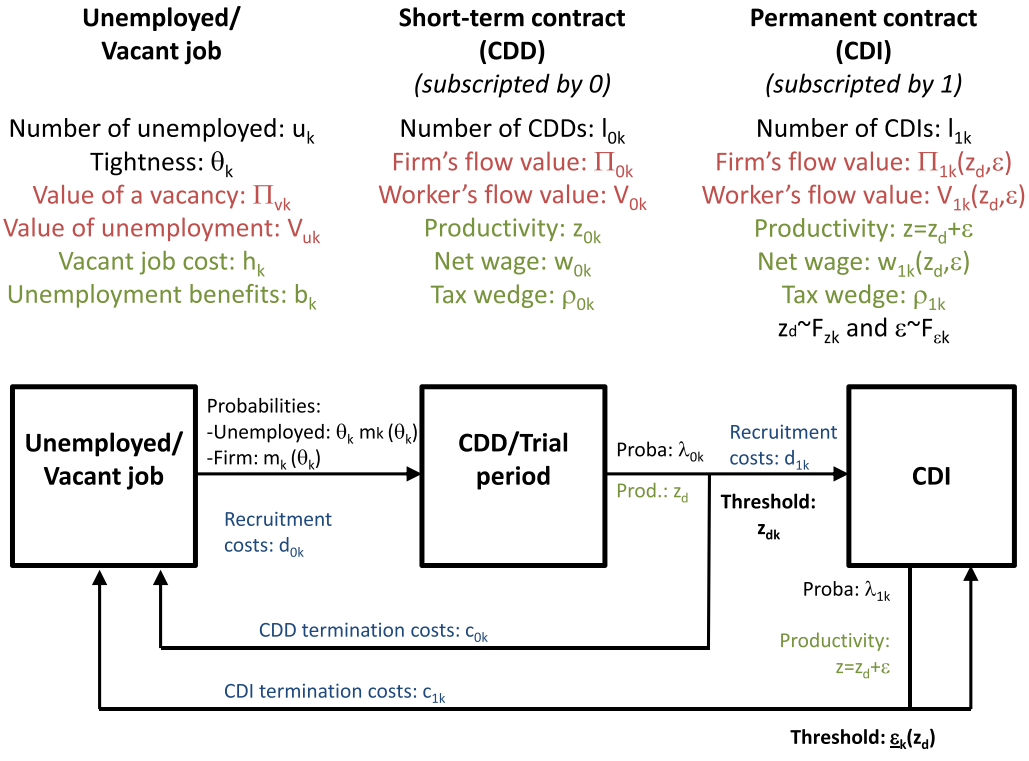


**Fig. 1.** Model block diagram.

productivity threshold $\tilde{z}_d$, above which the worker is hired permanently, is given by:

$$S^f_{1k}(\tilde{z}_{dk}, 0) = d_{1k} + c_{1k} - c_{0k}. \quad (3)$$

Using the results of wage bargaining Eq. (17) in Appendix, Eq. (3) is rewritten:

$$S^t_{1k}(\tilde{z}_{dk}, 0) = \frac{1}{1-\gamma_{1k}}[d_{1k} + c_{1k} - c_{0k}] \quad (4)$$

Supposing the dismissal costs of a permanent contract are high enough such that $d_{1k} + c_{1k} - c_{0k}$ is strictly positive. Then, $S^t_{1k}(\tilde{z}_{dk}, 0)$ is also strictly positive. For initial productivities $z_d$ lower than $\tilde{z}_{dk}$ but sufficiently high to obtain $S^t_{1k}(z_d, 0) > 0$, the worker and the firm can find a wage such that both lead to a permanent-contract hiring. However, when the contract is signed, the worker could upwardly renegotiate her wage, using the threat of dismissal costs. Anticipating this "holdup", the employer prefers to terminate the contract.

The permanent-contract hiring equation is given by the following Eq. (5), in which $\underline{\varepsilon}_k(\tilde{z}_{dk})$ is set by Eq. (6).

$$0 = \underline{\varepsilon}_k(\tilde{z}_{dk}) + \tilde{z}_{dk} - r(\rho_{1k}V_{uk} - c_{1k}) + \frac{\lambda_{1k}}{r+\lambda_{1k}} \int_{\underline{\varepsilon}_k(\tilde{z}_{dk})}^{\infty} (\varepsilon - \underline{\varepsilon}_k(\tilde{z}_{dk}))dF_{\varepsilon k}(\varepsilon). \quad (5)$$

$$\underline{\varepsilon}_k(\tilde{z}_{dk}) = -\frac{r+\lambda_{1k}}{1-\gamma_{1k}}[d_{1k} + c_{1k} - c_{0k}]. \quad (6)$$

Using the permanent-contract hiring equation, we obtain the reservation productivity $\tilde{z}_{dk}$ required for a permanent contract, depending on $V_{uk}$ and the exogenous parameters of the model. $\tilde{z}_{dk}$ is thus a growing and linear function of the unemployment flow value. If this value is high, the worker can negotiate a higher wage, so that the hiring under permanent contract will occur only for high initial productivities $z_d$.

For a given $V_{uk}$ the reservation productivity $\tilde{z}_{dk}$ increases with $d_{1k}$ and $c_{1k}$ and decreases with $c_{0k}$. Hiring and dismissal costs of permanent contracts discourage hirings. By contrast, dismissal costs of a short-term contract are an incentive to maintain the job by offering the worker a permanent contract. Moreover, the threshold $\tilde{z}_{dk}$ increases with $\rho_{1k}$, as a high tax wedge reduces the collective surplus to maintain the job. $\rho_{0k}$ and $d_{0k}$ does not impact the CDI hiring equation.

#### 2.2.2. The total economy

We examine the two labour markets in parallel in a broader framework aiming at reproducing the whole economy. We consider a closed economy with capital and labour as inputs. The different types of labour–short-term or permanent contracts, skilled or unskilled–are perfectly substitutable but differ by their productivity, $z$. In the long-term equilibrium, the value added ($VA$) is thus given, to within a constant factor, by

$$VA = \sum_{k\in\{q,n\}} N_k[l_{0k}z_{0k} + l_{1k}\bar{z}_{1k}] \quad (7)$$

where the $\bar{z}_{1k}$ values are the average productivity values of permanent contracts for each skills level.

## 3. Calibration on French data

We calibrate the model using French data between 2003–2011 using an annual time unit. Self-employed workers are not taken into account. Some parameters are directly estimated while others are calibrated to have the model reflect some labour market characteristics. The model parameters for both labour markets are summarised in Table 1. The corresponding equilibrium is described in Tables 2 and 3.

**Table 1**
Model parameters.

| | Variable | Unskilled workers | Skilled workers |
|---|---|---|---|
| CDD hiring costs | $d_{0k}$ | 0 | 0 |
| CDI hiring costs | $d_{1k}$ | 0.021 | 0.039 |
| CDD dismissal costs | $c_{0k}$ | 0 | 0 |
| CDI dismissal costs | $c_{1k}$ | 0.28 | 0.52 |
| CDD tax wedge | $\rho_{0k}$ | 1.74 | 2.06 |
| CDI tax wedge | $\rho_{1k}$ | 2.02 | 2.15 |
| CDD termination probability | $\lambda_{0k}$ | 1.64 | 1.52 |
| CDI productivity-shock probability | $\lambda_{1k}$ | 0.40 | 0.26 |
| Constant factor of matching function | $M_{0k}$ | 3.36 | 2.48 |
| Unemployment elasticity of matching function | $\eta_k$ | 0.3 | 0.3 |
| CDD productivity | $z_{0k}$ | 0.63 | 1.30 |
| Minimal productivity when CDI extended | $z^{min}_{dk}$ | 0.47 | 1.13 |
| Maximal productivity when CDI extended | $z^{max}_{dk}$ | 1 | 1.70 |
| Lower bound of productivity shocks | $\epsilon^{min}_k$ | −0.78 | −1.07 |
| Cost of a vacancy | $h_k$ | 1 | 1.70 |
| Unemployment benefits | $b_k$ | 0.20 | 0.32 |
| CDD bargaining power | $\gamma_{0k}$ | – | 0.19 |
| CDI bargaining power | $\gamma_{1k}$ | 0.4 | 0.4 |
| Wage under CDD | $w_{0k}$ | 0.24 | – |
| Interest rate | $r$ | 4% | |
| Constant factor of labour supply | $\Psi_{0k}$ | 0.29 | 0.34 |
| Labour-supply elasticity | $\mu_k$ | 0.2 | 0.2 |

CDI stands for permanent contract and CDD for short-term contract.

### 3.1. Labour market flows

We estimate labour market flows using the Labour Force Survey with a quarterly panel (Table 7 in Appendix B.1). We consider that an individual's state is defined by a Markov chain and estimate transition probabilities from one state to another. The measured transition probabilities indicate $\lambda_{0k}$ values of 1.52 for skilled workers and 1.64 for unskilled workers—for an average short-term contract duration of 8 and 7 months respectively. Probabilities that the productivity at the end of a short-term contract is sufficient to be hired under a permanent contract, $F_{zk}(\tilde{z}_{dk})$, are 40.8% for skilled workers and 57.1% for unskilled workers. It means that a skilled worker has 6 chances in 10 of staying

**Table 2**
Equilibrium of each labour market.

| | Variable | Unskilled workers | Skilled workers |
|---|---|---|---|
| Unemployment flow value | $V_{uk}$ | 7.3 | 13.2 |
| Reservation productivity for CDI hiring | $\tilde{z}_{dk}$ | 0.77 | 1.36 |
| Labour-market tightness | $\theta_k$ | 0.51 | 1.06 |
| Average unemployment duration (months) | $1/(\theta_k m_k(\theta_k))$ | 5.8 | 4.7 |
| Average CDI duration (years) | | 6.9 | 9.6 |
| Unemployment rate (% of working pop.) | $u_k$ | 11.9 | 5.8 |
| Employment rate (ditto) | $l_{0k} + l_{1k}$ | 88.1 | 94.2 |
| CDD employment rate (ditto) | $l_{0k}$ | 15.1 | 9.7 |
| CDI employment rate (ditto) | $l_{1k}$ | 73.0 | 84.5 |
| CDD average net wage* | $w_{0k}$ | 0.24 | 0.34 |
| CDD average productivity | $z_{0k}$ | 0.63 | 1.30 |
| CDI average net wage* | $\bar{w}_{1k}$ | 0.33 | 0.58 |
| CDI average productivity | $\bar{z}_{1k}$ | 0.75 | 1.37 |
| Average net wage* | | 0.31 | 0.55 |
| Average productivity | | 0.73 | 1.36 |
| Net unemployment benefits* (€/month) | | 824 | 1 343 |
| CDD average net wage* (ditto) | | 980 | 1 428 |
| CDI average net wage* (ditto) | | 1 350 | 2 388 |
| Average net wage* (ditto) | | 1 287 | 2 288 |
| CDI hiring cost (in euros) | | 1 065 | 1 947 |
| CDI dismissal cost (ditto) | | 13 772 | 25 753 |
| Number of unemployed (million) | | 1.9 | 0.6 |
| Number of CDD workers (ditto) | | 2.4 | 1.0 |
| Number of CDI workers (ditto) | | 11.8 | 9.1 |
| Working population (ditto) | $N_k$ | 16.2 | 10.7 |

CDI stands for permanent contract and CDD for short-term contract.
* Net wages and benefits are calculated after taxes, including VAT.

**Table 3**
Main macro-economic aggregates.

| | Value |
|---|---|
| GDP (€ bn/year) | 1937 |
| Workers compensation (ditto) | 1033 |
| Gross payroll* (ditto) | 760 |
| Net payroll* (ditto) | 498 |
| Working population, excluding self-employed workers (million) | 26.9 |
| Number of unemployed (ditto) | 2.5 |
| Number of CDD workers (ditto) | 3.5 |
| Number of CDI workers (ditto) | 20.9 |

CDI stands for permanent contract and CDD for short-term contract.
* Net wages are calculated after tax, including VTA. Gross wages exclude employer contributions but include employee contributions.

on under a permanent contract; an unskilled worker, 4 chances in 10. The average duration of a permanent contract is 10 years for skilled workers and 7 years for unskilled workers. Unemployment durations are 5 and 6 months respectively. These values, lower than those actually observed, reflect the model's choice of a systematic unemployment transition between jobs.

Using the LFS to compare termination rates of permanent contracts and their average tenure, we can assess the extent and regularity of productivity shocks on the labour market. If the shocks were large but infrequent, employers would dismiss their workers at almost every shock. As a result, mean tenure would be close to the average duration of permanent contracts. If, instead, the shocks were frequent but small, we would also observe substantial selection. Workers with high initial productivity $z_{dk}$ would remain employed for a long period. Consequently, the average tenure of the stock of workers, which comprises highly productive workers, would exceed the average duration of permanent contracts as the low-productive workers do not keep their jobs for long. In practice, the average tenure in permanent contracts for skilled and unskilled workers as measured in the LFS is 2.7 and 3.4 times longer respectively than the average duration of permanent contracts.

### 3.2. Wages

The LFS measures the ratio of average net wages between permanent and short-term contracts. The average net wage for permanent contracts is 1.67 times that of short-term ones for skilled workers, versus 1.28 for unskilled workers. On average, skilled workers earn 1.78 times more than unskilled workers.

### 3.3. Tax wedges

The tax wedge is the gap between the wage paid by the employer and the wage actually received by the worker. It captures the difference between purchasing power and labour costs, comprising social contributions, income tax, and VAT. For simplicity, we regard the tax wedges $\rho_{1k}$ and $\rho_{0k}$ as independent of the wage level, in spite of the progressiveness of taxes and social contributions on labour earnings and we do not take into account the labour costs that are not included in workers' compensation. We posit a homogeneous income tax rate of 10% (see, for instance, Laffargue (1996)). Supposing that 59% of the VAT is paid by households (Conseil des impôts, 2001), national accounting data for 2010 put the average VAT rate on household consumption at 7.9%. The average employer's social contribution rate is 35.8%, calculated as the ratio of net wages to gross wages. This average is differentiated by skill because of the contribution exemption for low wages. Taking the mean payrolls and relative wages in the LFS, and factoring in the contribution exemption, we get employer social contributions rates of 13.8% for unskilled workers under a short-term contract, 32.5% for unskilled workers under permanent contract, 35.2% for skilled workers under a short-term contract, and 41.0% for skilled workers under permanent contract. Private-sector employees contribute 21.5% of their gross wages. The total tax wedge is 43% and 51% of the labour cost for unskilled workers under short-term and permanent contracts respectively, and 52% and 54% of the labour cost for skilled workers under short-term and permanent contracts respectively. This is consistent with OECD estimates of the French tax wedge of 48% on this period for a single person at 100% of average earnings and no child. Note that OECD does not take into account VTA in its estimates.

Consequently, $\rho$ is worth 1.74 and 2.02 for unskilled workers under short-term and permanent contracts respectively and 2.06 and 2.15 for skilled workers under short-term and permanent contracts respectively.

### 3.4. Unemployment benefits

On the basis of LFS wage levels for skilled and unskilled workers and average unemployment benefits distributed by public employment services, unemployment benefits represent 67.2% of the average of the most recent wages for skilled workers and 72% for unskilled workers because of the contribution exemption for the latter.

### 3.5. Hiring and termination costs

Kramarz and Michaud (2009) show that hiring costs of short-term contracts are not significant, so that $d_{0k} = 0$. Termination costs of short-term contracts $c_{0k}$ are zero because the short-term contract allowance can be regarded as deferred compensation. Kramarz and Michaud (2009) also conclude that hiring costs of permanent contracts are equal to 3% of annual compensation and are linear with respect to wages. Consequently, we set $d_{1k}$ at 3% of average wages at the start of a permanent contract, irrespective of the worker's skill level.

Dismissal costs are harder to calibrate. Abowd and Kramarz (2003) obtain high dismissal costs, with a large fixed cost. These results are confirmed by Kramarz and Michaud (2009). Fixed costs are particularly high for collective dismissals. On average, at the median wage level, dismissal costs are equivalent to 8 months' wages. However, the costs include severance pay, which should be treated as deferred wages in a wage-negotiation situation (Lazear, 1990). Subtracting severance pay, we assume that dismissal costs are equal to 5 months' mean wages at the end of a permanent contract (Cheron, 2009).

### 3.6. Bargaining power

Like Abowd and Allain (1996), we set bargaining power of workers under permanent contract at 0.4. We calibrate skilled CDD workers' bargaining power so that the ratio between their short-term and permanent contracts wages is consistent with observations. Note that the calibrated bargaining power of 0.19 is lower than for workers under a permanent contract and that such negotiation power would lead to a lower wage for unskilled workers under a short-term contract if their wages were negotiated.

### 3.7. Matching functions

The matching functions are Cobb–Douglas functions $M_k(v,u) = M_{0k} v^{1-\eta_k} u^{\eta_k}$ with $u$ and $v$ the number of unemployed and vacancies, respectively. The $m_k$ functions are written $m_k(\theta) = M_{0k}\theta^{-\eta_k}$. There is no consensus on the unemployment elasticity of the matching function. To our knowledge, the only estimate on French data is the one by Maillard (1997) over the period 1974–1992. However, the data are sensitive and the results of 0.6 or 0.7–depending on the specification–are higher than the figures for other countries and do not take into account endogeneity bias. Indeed, if firms know that they will have trouble hiring, they may not advertise vacancies and, consequently, labour market tightness is endogenous. This is why we use 0.3 for each labour market, consistent with the recent results by Borowczyk-Martins et al. (2012)

on U.S. data, accounting for endogeneity of labour market tightness and for the dynamics of efficiency shocks. We calibrate $M_{0k}$ coefficients.

### 3.8. Productivity

The stochastic processes $z_d$ and $\varepsilon$–defined by the cumulative distribution functions $F_{zk}$ and $F_{\varepsilon k}$–follow a uniform law between $z_{dk}^{min}$ and $z_{dk}^{max}$ for $z_d$ and between $\varepsilon_k^{min}$ and 0 for $\varepsilon$, with $\varepsilon_k^{min} < 0$. By setting 0 as the maximum for $\varepsilon$, we aim to simplify the model, as we assume that the most recently created jobs are those best suited to a changing economic environment.

For unskilled workers, we normalise maximal productivity $z_{dn}^{max}$ to 1. The other bounds–$z_{dq}^{max}$, $z_{dn}^{min}$, $z_{dq}^{min}$, $\varepsilon_q^{min}$ and $\varepsilon_n^{min}$–are calibrated. This calibration notably ensure that the average productivity ratio between unskilled and skilled workers is equal to the ratio of average labour compensation, i.e. that $\overline{(z_q)}/\overline{(z_n)}$ equal to $\overline{(\rho_q w_q)}/\overline{(\rho_n w_n)}$.

### 3.9. Labour supply

The labour market participation rate is given by $\Psi_k(V_{uk}) = \Psi_{0k} V_{uk}^{\mu_k}$.[4] Labour market elasticity $\mu_k$ is set at 0.2 for both skilled and unskilled workers (Cahuc and Carcillo, 2007; Chetty, 2012). The $\Psi_{0k}$ values are set to obtain the observed participation rate.

### 3.10. Interest rate

The interest rate $r$ is 4% (Petrongolo and Pissarides, 2001).

### 3.11. Calibrated parameters

For each labour market, two degrees of freedom remain. We arbitrarily choose to set $h_k$ at the level of $z_{dk}^{max}$ and $z_{0k}$ at 30% of the segment $[z_{dk}^{min}, z_{dk}^{max}]$.

Ultimately, a 1% increase in the tax wedge raises the unemployment rate by 0.34 percentage points. In the (WS–PS) model, where the curve (PS) is horizontal in the long term and the tax-wedge elasticity of real labour costs in the (WS) curve is assumed to equal unity, such a sensitivity of the unemployment rate to the tax wedge corresponds to a quasi-elasticity of 3 of the negotiated wage to the unemployment rate in the (WS) curve. Empirical estimates based on French data for this parameter show an impact between 2 (L'Horty and Sobczak, 1997) and 6 (Cotis et al., 1998; Bonnet and Mahfouz, 1996). Moreover, a 1% increase in the minimum wage destroys 0.21% of employment. Such a variation seems to be reasonable given the distribution of low wages, the estimates of the labour-cost elasticity of jobs used in the literature, and the available measures of the minimum-wage diffusion effect (Aeberhardt et al., 2012).

## 4. Three stylised public policies

We now provide the model's numerical simulation results. First, we describe the effects of an increase in each interest variable—hiring tax, termination tax and tax wedge. Then, we simulate three reforms aiming at reducing labour market duality using the model calibrated on French data. In order to compare results, the amount of policy funding is 0.1% of GDP. The simulation results are summarised in Table 4. Reforms are calibrated so as to be balanced ex ante because they are more robust than ex post neutral reforms. The last subsection shows that the results are similar in the two cases.

Duality could be measured by the share of short-term contracts in total employment. While this frequently used index tells us the magnitude of the phenomenon, it cannot show the sealing of both markets.

[4] Formally, this means that the law of $U^{-1}(U(\zeta/r) + \xi)$ follows the cumulative distribution function $\Psi_k(x) = \Psi_{0k} x^{\mu_k}$ on the support $[1, \Psi_{0k}^{-1/\mu_k}]$.

**Table 4**
Neutral ex ante impact of reforms.

| | | Decreasing contrib. | Termination tax | Italian style |
|---|---|---|---|---|
| Unskilled workers | Average unemployment duration (months) | +0.19 | +0.16 | +0.08 |
| | Average CDI duration (years) | +0.25 | +0.27 | −0.15 |
| | CDD employment rate (% of working pop.) | −0.53 | −0.51 | −0.07 |
| | CDD hirings (ditto) | −0.86 | −0.83 | −0.12 |
| | CDI hirings (ditto) | −0.29 | −0.32 | +0.23 |
| | Productivity (%) | −0.53 | −0.56 | +0.14 |
| Skilled workers | Average unemployment duration (months) | +0.00 | +0.00 | −0.07 |
| | Average CDI duration (years) | +0.12 | +0.17 | −0.16 |
| | CDD employment rate (% of working pop.) | −0.14 | −0.15 | −0.02 |
| | CDD hirings (ditto) | −0.21 | −0.23 | −0.03 |
| | CDI hirings (ditto) | −0.08 | −0.13 | +0.16 |
| | Productivity (%) | −0.20 | −0.24 | +0.07 |
| Economy | Average unemployment duration (months) | +0.13 | +0.11 | +0.04 |
| | Average CDI duration (years) | +0.21 | +0.25 | −0.15 |
| | CDD employment rate (% of working pop.) | −0.37 | −0.37 | −0.05 |
| | CDD hirings (ditto) | −0.61 | −0.59 | −0.08 |
| | CDI hirings (ditto) | −0.21 | −0.25 | +0.20 |
| | Average CDD net wage (%) | −0.15 | −0.16 | −0.33 |
| | Average CDI net wage (%) | −0.20 | −0.19 | +0.12 |
| | Employment (thousands) | +11 | +22 | −3 |
| | CDI productivity (%) | −0.51 | −0.55 | +0.14 |
| | Value added (%) | −0.28 | −0.29 | +0.13 |
| | Public administrations balance (% of GDP) | +0.02 | +0.04 | +0.03 |

CDI stands for permanent contract and CDD for short-term contract.

The share of short-term contracts converted into permanent contracts gives this information and highlights the lack of transition between both markets. In the following sections, the success of a policy is measured by both indexes, even if the second one is more relevant in the context of a reduction of labour market duality. Some results–particularly the ones for job and unemployment stocks–are sensitive to the calibration. The effects on unemployment should be interpreted with caution. However, all results concerning labour market flows are robust to the parameter choices.

### 4.1. Simulations of a receipts increase

Tables 8, 9 and 10 in the Appendix summarise the impact of a receipts increase of 0.1% of GDP on the economy using hiring tax, termination tax and an increase in the tax wedge. Unsurprisingly, a hiring tax induces higher average unemployment and permanent contracts durations, whatever the targeted type of contract. For employers, this tax is a disincentive to hiring a new worker, which in turn induce longer unemployment spells. The phenomenon is stronger concerning taxes on short-term contracts than permanent ones because of the model construction. As a worker under a permanent contract must first be hired under a short-term contract, a tax of 0.1% of GDP on hirings under short-term contracts is more damaging than the same amount on hirings under permanent contracts. This type of tax reduces workers' productivity and subsequently value added. As employers anticipate the hiring cost of a new worker before dismissing the previous one, they keep their worker longer on the job. Hirings under both types of contract are less frequent. Consequently, compared to the case before the hiring tax, the conversion of a fixed-term contract into a permanent one is also less frequent.

The introduction of a termination tax causes similar results. Nevertheless, contrary to a hiring tax, the reduction of hirings comes from employers' anticipation of firing costs and not from direct hiring costs. Consequently, the negative impact of the termination tax on hirings is

smaller than in the previous case. However, compared to the hiring tax, the impact on contract duration is direct and subsequently higher. Both tax types have a similar impact on the economy. Note that a tax on short-term contract terminations seems to be more positive on duality as the share of short-term contracts in the working population is lower and the number of hirings under a permanent contract is slightly positive. However, it dramatically increases the unemployment duration of unskilled workers and has a negative impact on productivity and value added.

Finally, an increase in the tax wedge has expected effects on the economy: a decrease in employment, particularly in permanent contract, and an increase in employment duration. Targeted on short-term contracts, the effects are similar to those of a hiring tax. It increases average unemployment and permanent contracts durations, decreases the share of short-term contracts in total employment but also hirings under a permanent contract too. When permanent contracts are targeted, average duration of permanent contracts slightly decreases because of the additional cost associated with this type of contract. As permanent contracts are negotiated, the increase in the tax wedge is partially offset by a decrease in wages. The impact on hirings is due to two different mechanisms. First, employers substitute short-term contracts for permanent ones because short-term contracts are relatively less expensive, hirings under a short-term contract increase and hirings under a permanent contract declines. Second, average permanent contracts wage is lower, which encourages hirings under a permanent contract. The simulation results show that the second mechanism is stronger and hirings under a permanent contract increase slightly. When the tax wedge of both types of contract rises, the share of permanent contracts in total employment decreases in favour of unemployment, due to higher unemployment duration. However, hirings are stable, the productivity slightly increases but value added decreases. In the following subsections, a decrease in the tax wedge helps to balance the State budget. Consequently, the expected impacts are the opposite.

### 4.2. "Gradually decreasing contributions" reform

The key proposal, which is mainly advocated by trade unions,[5] is that unemployment insurance contributions should decrease in proportion to workers' length of service. labour costs would thus be higher at hiring and then decrease with time. The aim would be to encourage employers to increase employment duration and, then, to decrease the number of transitions between employment and unemployment. An alternative reform consists in raising unemployment insurance contributions for short-term contracts in order to discourage hirings under this type of contract.

This tax directly discourages hirings. Consequently, the level of job creation decreases. Subsequently, in anticipating hiring costs for the next worker, employers are slower to dismiss a permanent worker. So job duration is higher, but there is less turnover in the labour market and the transition rate between short-term and permanent contracts should decrease. This measure is likely to reduce labour market flows and increase both average unemployment spells and job duration. In principle, its impact on the level of unemployment is ambiguous. Even if the number of short-term hirings decreases, the transition from a temporary job to a permanent one would not be easier and duality would be likely to persist.

We model the introduction of an additional contribution of 2 percentage points of gross wages during the first year of employment, representing ex ante 0.1% of GDP. The additional contribution is equivalent to a hiring tax such as $d_{0k}$ equal to 1.7% of annual gross wages.[6] This entails a cost for the employer of € 306 and € 447 for hiring unskilled and skilled workers respectively. The additional contribution is offset by a uniform decrease in labour contributions ($\rho_{0k}$ and $\rho_{1k}$), corresponding to 0.26 percentage point of gross wages. Thanks to this decrease, the reform is neutral ex ante on the public finances, i.e. before taking into account agents' behavioural changes due to the reform.

By imposing a financial penalty on hirings under short-term contract, the reform reduces labour market flexibility, lengthening average unemployment and permanent contracts durations by 0.13 months and 0.21 years respectively. As hirings are more expensive, employers have an incentive to decrease employee turnover and keep workers in their jobs. Consequently, permanent contract duration is longer and the share of permanent contracts in the working population is higher. Short-term contracts are less profitable and the employment rate falls for short-term contracts. This phenomenon is more pronounced for unskilled workers than for skilled workers. As the first are paid at the minimum wage, the entire tax is supported by the firm. For skilled workers, wages are negotiated, so that the tax burden is shared between the worker and the employer. However, even if the share of short-term contract decreases, it is not obvious that duality is reduced. Indeed, hirings under a permanent contract diminishes by 0.21%, showing that less workers are hired under a permanent contract and, consequently, the number of CDD-to-CDI transformations decreases. The separation between both labour markets is still present.

Moreover, as entry and exit flows are smaller, the matching is less efficient and labour productivity of permanent contracts decreases by 0.51%. The impact on total productivity is less negative owing to the increase in the share of permanent contracts. In all, value added decreases by 0.28%. This loss is essentially supported by low-skilled workers and short-term contracts. Low-skilled workers under short-term contracts are particularly affected. The higher share of low-skilled workers under a permanent contract in the working population does not offset the decrease in productivity of permanent contracts and in the working population. Moreover, wages fall because of lower labour productivity and in spite of the tax wedge reduction. Excluding the 0.86% decline in wages of skilled workers under a short-term contract–due to the fact that the hiring tax is factored into the wage negotiation–most of the wage decrease is concentrated among unskilled workers under a permanent contract. By contrast, the wages of skilled workers under a permanent contract do not change. The loss of productivity is sufficiently modest to be offset by the decrease in the tax and social-contribution parameters.

### 4.3. "Termination tax" reform

This proposal, put forward by economists in the wake of the Blanchard and Tirole (2003) report, is based on the experience rating of North American countries. In the United States and Canada, each firm's unemployment insurance contribution is determined by the benefits paid out to previously dismissed workers. This bonus–penalty system is designed to raise employers' awareness of their responsibilities concerning the impact of dismissals on the financial position of unemployment insurance funds and to make them factor this cost into their decisions. To the extent that system takes into account all breaches of contract entitling dismissed workers to benefits (including termination of temporary and short-term contracts, redundancies, and the mutually agreed terminations applied in France), it offers an incentive to firms to offer stable jobs under permanent contracts rather than short-term contracts. The system also encourages employers to increase their workers' non-specific human capital in anticipation of their possible dismissal. On the other hand, it could discourage firms from hiring less-employable workers because of the greater likelihood of long unemployment spells in case of contract termination. In addition, it could incite firms to hire under very-short-term contracts, which do not make workers eligible for unemployment benefits.

[5] See Coquet (2010) and Coquet & Sylvain, "L'indemnisation du chômage : éléments pour une réforme", http://www.actualite-de-la-formation.fr/IMG/pdf/DGEFP_note_indemnisation.pdf.

[6] The gap in relation to the additional-contribution rate reflects the fact that life expectancy in the job during the first year is necessarily lower than 1 year.

A measure similar to the previous one but simpler consists in taxing breaches and terminations of labour contracts that make workers eligible for unemployment benefits. Unlike in the experience rating system, firms pay the additional cost at the time of dismissal and not in subsequent years, and the cost does not depend on the length of dismissed workers' unemployment spells. It therefore does not encourage firms to increase their workers' employability, but it does not offer an incentive to hire only the more employable workers. The two solutions may also respond differently to economic shocks. Experience rating is less pro-cyclical (see L'Haridon and Malherbet, 2010). As payment arises after dismissal, it worsens a less firm situation than a tax due at contract termination. Nevertheless, both measures seem to be equivalent as regards the link between employment protection and labour market duality.

There is much literature detailing the advantages and disadvantages of such measures. For instance, Cahuc and Zylberberg (2008) show that without a dismissal tax, the volume of lay-offs is too high because firms do not factor in the social cost of unemployment. However, we must take French labour market characteristics into account, as high employment protection reduces the expected benefits of the measure. Wage rigidity accentuates this effect (see Cahuc and Malherbet, 2001, 2004). Charlot and Malherbet (2010) argue that experience rating must substitute for standard employment protection in order to limit the average unemployment spell. In the same vein, Blanchard and Tirole (2003) argue that a reduction in the non-monetary cost of dismissal offsets the introduction of a dismissal tax.

Given higher termination costs, this measure should increase permanent contract duration. As employers take contract termination into account, termination tax should discourage hirings also. Permanent contracts become more stable and are less frequently broken. Consequently, while the short-term contracts share of total employment is expected lower than before the termination tax, the transition rate between short-term and permanent contracts should decrease. By discouraging job destruction rather than hiring, a dismissal tax is probably more favourable for employment than a declining-contributions system.

We model the introduction of a tax on labour-contract terminations, set at 16% of the worker's last gross monthly wage. We summarise the reform by an increase in the separation cost for all types of contract except short-term contracts converted to permanent ones. In the model, therefore, we apply comparable increases to $c_{0k}$ and $c_{1k}$, equivalent to 0.1% of GDP. For the employer, the tax represents € 245 at the end of a short-term contract not converted to a permanent one and € 340 at the end of a permanent contract for an unskilled worker (for a skilled worker, the tax comes to € 356 and € 597 respectively). As previously, the introduction of a termination cost is offset by a decrease in the tax wedge equal to 0.26% of the gross wage, in order to preserve fiscal neutrality.

The effects of this reform are relatively similar to those of the previous one, since employers anticipate termination tax during hiring negotiation. Thus, by encouraging employers to maintain the jobs, the reform increases the average permanent contract duration. Here, the incentive is direct—in contrast to the hiring tax, for which the incentive was the expectation of a higher replacement cost. Consistent with intuition, the impact on average duration of permanent contracts is stronger than with the previous reform. We estimate it at 0.25 additional years versus 0.21. As employers anticipate termination costs during the hiring process, the reform also discourages hiring because of the expectation of a higher termination cost. Unemployment duration increases less than under the previous reform, by 0.11 month versus 0.13. This finding is also consistent with intuition, since the disincentive to hire due to the tax is less direct than the previous one. The employment rate rises 0.45 points for permanent contracts and falls 0.37 points for short-term ones. However, hirings are smaller whatever the contract. This is due to lower job turnover. Consequently, the permanent contract share in total employment increases, but change of employment occurs less frequently. Hirings under a permanent contract fall by 0.25% of the working population. As with the previous reform, even if the share of short-term contract decreases, the number of CDD-to-CDI conversions does not significantly increase.

For skilled and unskilled workers alike, a termination tax is more favourable than gradually decreasing contributions in terms of unemployment flow values, which we can regard as equivalent to the well-being of new entrants. We find comparable results for average unemployment duration. However, gradually decreasing contributions have a more positive effect on the CDD-to-CDI conversion rate. The unemployment rate is relatively similar.

As duration of permanent contracts increases more than with the previous reform, the probability of a negative shock on productivity is higher and the mean matching quality is lower. Consequently, the impact on productivity is more negative at −0.37% against −0.33%. The impact on value added is close to that of the previous reform, at −0.29% versus −0.28%. As in the previous case, the decrease is due to low-skilled workers and fixed-term contracts.

### 4.4. "Italian-style" reform

The third proposal consists in raising unemployment insurance contributions on short-term contracts to finance a bonus for turning short-term contracts into permanent ones. The Fornero reform in Italy, enacted in July 2012, introduces a tax on short-term contracts (1.4% of gross wages), which is transferred to the unemployment insurance fund. If the short-term contract is turned into a permanent one, the tax is refunded after the trial period. The amount is limited to the last six monthly payments. Firms are no longer required to justify their use of short-term contracts and controls and rules to limit substitutes for short-term contracts have been strengthened. Ciani and de Blasio (2015) show that the bonus increased conversions of short-term contracts to permanent ones by 83% on average, with no substitution effects over time or across groups of workers.

To obtain a reform that has no impact on public finances, the "Italian-style" reform in our simulation uses all revenues from the tax on short-term contracts to finance the bonus for turning short-term contracts into permanent ones. The Italian reform has a positive impact on public finances as not all short-term contracts are transformed into permanent ones and refunds are capped at six monthly payments.

This reform seems to cause a smaller increase in labour market rigidities and bring about an increase in labour market turnover due to the lower cost of permanent-contract hirings. Indeed, tax on short-term contracts diminishes hirings under this type of contract. However, the tax is refunded if the contract is converted into an open-ended contract. This incentive to hiring of permanent workers should increases the transition rate between short-term and permanent contracts, even if the share of short-term contracts could be relatively stable. As Brown et al. (2011) show in the case of hiring vouchers, targeted subsidies are particularly efficient compared to other types of incentives, especially low wage subsidies.

This reform introduces an additional contribution on short-term contracts of 2.7% of the gross wage, equivalent to 0.1% of GDP. To offset the tax and ensure the reform's ex ante fiscal neutrality, hirings under a permanent contract at the end of a short-term one are subsidised at the rate of 26% of the gross monthly wage on hiring. The subsidy amounts to € 581 for unskilled workers and € 997 for skilled workers.

Contrary to the first two reforms, employers are incited to hire under permanent contract which induces a less rigid labour market. Entries into permanent contracts rise by 0.2% of the working population per year, compared with a 0.2-point decline with gradually decreasing contributions. This means there are more CDD-to-CDI conversions due to the decrease in the productivity threshold required to obtain a permanent contract. Entries into a short-term contract are slightly fewer, down 0.08 point. This reflects the ambiguous effect of higher entry and exit rates under a permanent contract and a larger tax

wedge for short-term contracts. However, the decline in CDD entries is clearly smaller than with the other reforms, which fall by around 0.6 of a point. A reduction in labour market duality is revealed in the higher number of CDD-to-CDI conversions.

However, this greater flexibility reflects the average unemployment and permanent contracts durations. Average unemployment duration increases by 0.04 month due to tax on short-term contracts, less than for the first two reforms (the increase with gradually decreasing contributions is 0.13). Duration of permanent contracts decreases by 0.15 per year, whereas it increases with the first two reforms. This is due to a decrease in the productivity level required to be hired under a permanent contract, which induces that productivity shocks quickly lead to a dismissal. Indeed, the worker's productivity level has to compensate the wage and the potential termination costs. If those latter decrease, the required productivity decreases also.

The share of short-term contracts in total employment decreases by a modest 0.05 points, compared with a more significant decline of 0.4 points under the other two reforms. The higher contributions on short-term contracts increase the share of permanent contracts in total employment. However, this effect is offset by the decrease in entry costs in a permanent contract $d_{1k}$, which raises the share of short-term contracts in total employment.[7] This result, paradoxical at first sight, is due to the fact that the reduction in $d_{1k}$ costs raises the unemployment flow value and hence CDI exits. This effect is clearly stronger than the first one. By contrast, a uniform decrease in wage contributions under the previous reforms has only a slight impact on the share of short-term contracts in total employment.

Due to a higher labour market flexibility, the reform raises productivity by 0.14%, unlike the first two reforms (for example, gradually decreasing contributions lowers it by 0.33%). As a result, wages in a permanent contract rise 0.12% while the CDD wages of skilled workers shed 0.93% because of the wider tax wedge and despite the expectation of a hiring subsidy in the wage negotiation. Moreover, contrary to the other reforms, the Italian one induces an increase in value added of 0.13%. The only negative factor is the share of short-term contracts in the working population. However, it is largely offset by other factors.

### 4.5. Ex post fiscal neutrality of the reforms

The reforms described above are calibrated so as to be fiscally neutral ex ante. Theoretically, it is preferable to ensure ex post neutrality, after agents change their behaviour in response to the reform. This alternative approach yields results more sensitive to calibration, with a multiplier effect that is channelled through the (fragile) estimate of the impact on the fiscal balance. Moreover, it does not reflect actual political practices, as reforms are calibrated on an ex ante basis because of the uncertainty of agents' responses to the reform.

The three reforms we have modelled generate a fiscal surplus. In ex post neutral reforms, the tax wedge is uniformly reduced to offset the surplus. The wedge is set at 0.27 points of the gross wage for the gradually decreasing contributions (putting the total decrease at 0.53 points), at 0.53 points for the termination tax (putting the total decrease at 0.79 points), and 0.45 points for the Italian reform (curtailing the rise in contributions on short-term contracts to 2.3 points). Taking into account the ex post constraint on the fiscal balance does not significantly modify the results (see Table 5) but leads to more favourable results in terms of employment and value added.

**Table 5**
Neutral ex post impact of reforms.

| | | Decreasing contrib. | Termination tax | Italian style |
|---|---|---|---|---|
| Unskilled workers | Average unemployment duration (months) | +0.15 | +0.07 | +0.01 |
| | Average CDI duration (years) | +0.27 | +0.32 | −0.12 |
| | CDD employment rate (% of working pop.) | −0.55 | −0.56 | −0.10 |
| | CDD hirings (ditto) | −0.91 | −0.92 | −0.17 |
| | CDI hirings (ditto) | −0.31 | −0.35 | +0.21 |
| | Productivity (%) | −0.58 | −0.65 | +0.08 |
| Skilled workers | Average unemployment duration (months) | −0.00 | −0.01 | −0.09 |
| | Average CDI duration (years) | +0.12 | +0.19 | −0.14 |
| | CDD employment rate (% of working pop.) | −0.15 | −0.17 | −0.03 |
| | CDD hirings (ditto) | −0.23 | −0.26 | −0.05 |
| | CDI hirings (ditto) | −0.09 | −0.14 | +0.15 |
| | Productivity (%) | −0.21 | −0.27 | +0.05 |
| Economy | Average unemployment duration (months) | +0.10 | +0.04 | −0.02 |
| | Average CDI duration (years) | +0.23 | +0.28 | −0.13 |
| | CDD employment rate (% of working pop.) | −0.39 | −0.40 | −0.07 |
| | CDD hirings (ditto) | −0.63 | −0.64 | −0.11 |
| | CDI hirings (ditto) | −0.22 | −0.26 | +0.20 |
| | Average CDD net wage (%) | −0.09 | −0.03 | −0.24 |
| | Average CDI net wage (%) | −0.04 | +0.10 | +0.38 |
| | Employment (thousands) | +39 | +77 | +41 |
| | CDI productivity (%) | −0.57 | −0.67 | +0.05 |
| | Value added (%) | −0.21 | −0.15 | +0.24 |
| | Fiscal balance (% of GDP) | 0.00 | 0.00 | 0.00 |

CDI stands for permanent contract and CDD for short-term contract.

## 5. Conclusions

This article develops a matching model whose originality lies in its use of two different approaches. First, the model distinguishes between short-term and permanent jobs. Hiring under permanent contracts is endogenous and determined, in particular, by a stable productivity level for the job-worker match. This level is observed during an initial job under a short-term contract. Second, permanent job destruction is endogenous and takes into account the long-term productivity component and productivity shocks. The shocks notably reflect the uncertainties concerning demand for the firm's products. We perform quantitative simulations based on the model's calibration on French labour market characteristics.

Consistent with intuition, introducing a termination tax or gradually decreasing contributions reduces labour market duality, which we can define as the share of short-term contracts (such as CDDs, temporary work, and trial periods) in total employment. However, it is not obvious that this kind of policy reduces the number of short-term contracts converted to permanent ones. Consequently, workers in short-term contracts remain in a trap, without the possibility of obtaining a permanent contract in the near future. Moreover, the reduction in duality is obtained at the price of lower labour market flexibility and its consequences, i.e. lower labour productivity, wages, and growth. In both cases, total value added decreases.

In keeping with the first intuition, a termination tax has a more positive effect than gradually decreasing contributions on the well-being of labour market new entrants and average unemployment duration. These results are independent of the calibration. Our numerical simulations show that a termination tax provides a greater stimulus to employment but weighs on labour productivity.

The third reform we examined, inspired by a recent Italian policy abolished in 2015, consists in an additional contribution on short-term contracts that finances a bonus for employers who hire a worker under a permanent contract after the short-term contract expires. This policy is clearly targeted on duality as it encourages employers to transform short-term contracts into permanent ones. Unlike the first two reforms, the third preserves labour market flexibility and has a positive impact on growth and labour productivity. The value added significantly increases. This reform diminishes labour market duality by reducing

[7] See Table 8 in Appendix C. This table summarises the opposite effect of an increase in the entry costs in a permanent contract.

the share of short-term contracts leading to unemployment. However, it generates only a modest decline in the share of short-term contracts in total employment.

Finally, it may be a good idea to accompany incentives to reduce labour market duality by activation policies. In particular in the Italian style reform, the larger turnover of workers implies an efficient training policy to compensate a potential decrease in human capital during the more frequent unemployment spells.

## Appendix A. Calculations and expressions of variables necessary for results analysis

The working populations $N_k$ are determined by the individual trade-off between labour and leisure (Cahuc and Carcillo, 2007). Inactivity income and leisure preferences are random variables. As the utility of entering the market rises with the unemployment flow value, the probability of labour-market participation $\Psi_k$ grows with $V_{uk}$.

### A.1. Bellman equations

Decisions to create jobs, hire under permanent contracts or terminate permanent or short-term contracts are based on the flow values of the various options. To the firm, the flow value of a vacant job is noted $\Pi_{vk}$, $\Pi_{0k}$ for a short-term job and $\Pi_{1k}(z_d, \varepsilon)$ for a permanent one. Symmetrically, the worker's flow values are noted $V_{uk}$ if she is unemployed, $V_{0k}$ under a CDD and $V_{1k}(z_d, \varepsilon)$ under a CDI.

The firm's flow values correspond to Bellman Eqs. (8) to (10), where $r$ is the interest rate.

$$r\Pi_{vk} = -h_k + m_k(\theta_k)[\Pi_{0k} - \Pi_{vk} - d_{0k}]. \tag{8}$$

$$r\Pi_{0k} = z_{0k} - \rho_{0k} w_{0k} + \lambda_{0k} F_{zk}(\tilde{z}_{dk})[\Pi_{vk} - \Pi_{0k} - c_{0k}] + \lambda_{0k} \int_{\tilde{z}_{dk}}^{\infty} [\Pi_{1k}(z_d, 0) - \Pi_{0k} - d_{1k}] dF_{zk}(z_d). \tag{9}$$

$$r\Pi_{1k}(z_d, \varepsilon) = z_d + \varepsilon - \rho_{1k} w_{1k}(z_d, \varepsilon) + \lambda_{1k} F_{\varepsilon k}(\underline{\varepsilon}_k(z_d))[\Pi_{vk} - \Pi_{1k}(z_d, \varepsilon) - c_{1k}] + \lambda_{1k} \int_{\underline{\varepsilon}_k(z_d)}^{\infty} [\Pi_{1k}(z_d, \varepsilon') - \Pi_{1k}(z_d, \varepsilon)] dF_{\varepsilon k}(\varepsilon'), \quad \forall (z_d, \varepsilon). \tag{10}$$

The flow values for an unemployed person or a CDD or CDI worker are determined in the same way and are given by Bellman Eqs. (11) to (13).

$$rV_{uk} = b_k + \theta_k m_k(\theta_k)[V_{0k} - V_{uk}]. \tag{11}$$

$$rV_{0k} = w_{0k} + \lambda_{0k} F_{zk}(\tilde{z}_{dk})[V_{uk} - V_{0k}] + \lambda_{0k} \int_{\tilde{z}_{dk}}^{\infty} [V_{1k}(z_d, 0) - V_{0k}] dF_{zk}(z_d). \tag{12}$$

$$rV_{1k}(z_d, \varepsilon) = w_{1k}(z_d, \varepsilon) + \lambda_{1k} F_{\varepsilon k}(\underline{\varepsilon}_k(z_d))[V_{uk} - V_{1k}(z_d, \varepsilon)] + \lambda_{1k} \int_{\underline{\varepsilon}_k(z_d)}^{\infty} [V_{1k}(z_d, \varepsilon') - V_{1k}(z_d, \varepsilon)] dF_{\varepsilon k}(\varepsilon'), \quad \forall (z_d, \varepsilon). \tag{13}$$

In what follows, we consider that firms can freely enter or exit the market, verifying the free-entry condition $\Pi_{vk} = 0$.

### A.2. Wages

As noted earlier, unskilled workers' wages are exogenous and set by the minimum wage. By contrast, wages for permanent jobs and skilled CDD workers are negotiated using a generalised Nash criterion.

Wages of negotiated short-term jobs are set at hiring and cannot be renegotiated before the end of the contract. For skilled workers, the firm's surplus during the negotiation is $S^f_{0q} = (\Pi_{0q} - d_{0q}) - \Pi_{vq}$ and the worker's surplus is $S^e_{0q} = V_{0q} - V_{uq}$. With $\gamma_{0q}$ the skilled CDD worker's negotiation power, the negotiation programme is the following:

$$\max_{w_{0q}} \left[S^e_{0q}\right]^{\gamma_{0q}} \left[S^f_{0q}\right]^{1-\gamma_{0q}}. \tag{14}$$

Regarding Eqs. (9) and (12) $S^f_{0q}$ and $S^e_{0q}$ are linear functions of $w_{0q}$ with the slopes $-\rho_{0q}/(r + \lambda_{0q})$ and $1/(r + \lambda_{0q})$, respectively. The solution of the maximisation programme is the following:

$$\gamma_{0q} S^f_{0q} = \left(1 - \gamma_{0q}\right) \rho_{0q} S^e_{0q} \tag{15}$$

In contrast, the CDI wage–whatever the skill level–can be renegotiated at any time after hiring, including at contract signature. This is therefore anticipated during the hiring process, and the hiring wage is negotiated as the contract was already in force. Accordingly, regardless of when the negotiation takes place, the firm negotiates depending on its surplus $S^f_{1k}(z_d, \varepsilon) = \Pi_{1k}(z_d, \varepsilon) - (\Pi_{vk} - c_{1k})$.

The worker's surplus is given by $S^e_{1k}(z_d, \varepsilon) = V_{1k}(z_d, \varepsilon) - V_{uk}$. The CDI worker's negotiation power is noted $\gamma_{1k}$. The negotiated wage is also determined by the following maximisation programme:

$$\forall (z_d, \varepsilon), \quad \max_{w_{1k}(z_d, \varepsilon)} \left[S^e_{1k}(z_d, \varepsilon)\right]^{\gamma_{1k}} \left[S^f_{1k}(z_d, \varepsilon)\right]^{1-\gamma_{1k}} \tag{16}$$

According to Bellman Eqs. (10) and (13), $S^f_{1k}(z_d, \varepsilon)$ and $S^e_{1k}(z_d, \varepsilon)$ are linear functions of $w_{1k}$. Their slope ratio is $\rho_{1k}$. The solution of the programme is thus:

$$\forall (z_d, \varepsilon), \quad \gamma_{1k} S^f_{1k}(z_d, \varepsilon) = (1 - \gamma_{1k}) \rho_{1k} S^e_{1k}(z_d, \varepsilon) \tag{17}$$

Using Bellman equations, we show that the wage is determined by $w_{1k}(z_d, \varepsilon) = (1 - \gamma_{1k}) r V_{uk} + \frac{\gamma_{1k}}{\rho_{1k}} (z_d + \varepsilon + r c_{1k})$. The CDI wage increases with the productivity current value $z_d + \epsilon$, the termination costs, and the flow value of unemployment, which is the worker's downturn point in the wage negotiation. In what follows, we write $S^t_{0k} = S^f_{0k} + \rho_{0k} S^e_{0k}$ and $S^t_{1k}(z_d, \varepsilon) = S^f_{1k}(z_d, \varepsilon) + \rho_{1k} S^e_{1k}(z_d, \varepsilon)$.[8]

From the results of wage negotiations of Eqs. (15) and (17), we can deduce Eqs. (18)–(21).

$$S^e_{0k} = \frac{\gamma_{0q}}{\rho_{0q}} S^t_{0k}. \tag{18}$$

$$S^f_{0k} = \left(1 - \gamma_{0q}\right) S^t_{0k}. \tag{19}$$

$$S^e_{1k}(z_d, \varepsilon) = \frac{\gamma_{1q}}{\rho_{1q}} S^t_{1k}(z_d, \varepsilon), \quad \forall z_d, \varepsilon. \tag{20}$$

$$S^f_{1k}(z_d, \varepsilon) = \left(1 - \gamma_{1q}\right) S^t_{1k}(z_d, \varepsilon), \quad \forall z_d, \varepsilon \tag{21}$$

Using Eq. (18), we obtain:

$$(r + \lambda_{1k}) S^t_{1k}(z_d, \varepsilon) = \frac{\rho_{1k}}{\gamma_{1k}} (w_{1k}(z_d, \varepsilon) - r V_{uk}) + \lambda_{1k} \int_{\underline{\varepsilon}_k(z_d)}^{\infty} S^t_k(z_d, \varepsilon') dF_{\varepsilon k}(\varepsilon'). \tag{23}$$

[8] Strictly speaking, these do not represent the collective surpluses, which are slightly more complex: $S^c_{0k} = S^e_{0k} + S^f_{0k}$ and $S^c_{1k}(z_d, \varepsilon) = S^f_{1k}(z_d, \varepsilon) + S^e_{1k}(z_d, \varepsilon)$. The wage-negotiation results of Eqs. (15) and (17) show that, when wages are negotiated, both expressions are proportional and have the same sign. More precisely, $S^c_{0q} = (1 - \gamma_{0q} + \gamma_{0q}/\rho_{0q}) S^t_{0q}$ et $S^c_{1k}(z_d, \varepsilon) = (1 - \gamma_{1k} + \gamma_{1k}/\rho_{1k}) S^t_{1k}(z_d, \varepsilon)$.

Then, we obtain $w_{1k}(z_d,\varepsilon)=(1-\gamma_{1k})rV_{uk}+\frac{\gamma_{1k}}{\rho_{1k}}(z_d+\varepsilon+rc_{1k})$ for all $(z_d, \varepsilon)$. We use the same method to calculate the wage under a short-term contract for skilled workers:

$$\begin{aligned}w_{0q}=&\left(1-\gamma_{0q}\right)rV_{uq}\\&+\frac{\gamma_{0q}}{\rho_{0q}}\left\{z_{0q}-\lambda_{0q}\left[F_{zq}(\tilde{z}_{dq})c_{0q}+(1-F_{zq}(\tilde{z}_{dq}))(d_{1q}+c_{1q})\right]-(r+\lambda_{0q})d_{0q}\right\}\\&+\lambda_{0q}\left[\frac{\gamma_{0q}\left(1-\gamma_{1q}\right)}{\rho_{0q}}-\frac{\gamma_{1q}\left(1-\gamma_{0q}\right)}{\rho_{1q}}\right]\int_{\tilde{z}_{dk}}^{\infty}S_{1k}^{t}(z_d,0)dF_{zk}(z_d).\end{aligned}\tag{24}$$

### A.3. Reservation productivities for permanent hirings (CDIs) and continuation of permanent employment

#### A.3.1. Skilled-workers equilibrium

*A.3.1.1. Labour demand.* The labour–demand equation is given by Eq. (25), where $\Lambda_q$ is set by Eq. (26), $\underline{\varepsilon}_q(z_d)$ by Eq. (2) and $\tilde{z}_{dq}$ by the CDI hiring Eqs. (5)–(6).

$$m_q(\theta_q)=\frac{h_q(r+\lambda_{0q})}{\left(1-\gamma_{0q}\right)\Lambda_q}\tag{25}$$

with:

$$\begin{aligned}\Lambda_q=&z_{0q}-\lambda_{0q}\left[F_{zq}(\tilde{z}_{dq})c_{0q}+(1-F_{zq}(\tilde{z}_{dq}))(d_{1q}+c_{1q})\right]-(r+\lambda_{0q})d_{0q}-r\rho_{0q}V_{uq}\\&-\frac{\lambda_{0q}}{r+\lambda_{1q}}\left[1-\gamma_{1q}+\gamma_{1q}\frac{\rho_{0q}}{\rho_{1q}}\right]\int_{\tilde{z}_{dq}}^{\infty}\underline{\varepsilon}_q(z_d)dF_{zq}(z_d).\end{aligned}\tag{26}$$

The unemployment flow value $V_{uq}$ of skilled workers decreases demand for this type of workers. The tightness of this labour market $\theta_q$ is a decreasing function of $V_{uq}$. Tightness also decreases with the cost of a vacant job $h_q$ and the workers' bargaining power under a CDD and CDI,[9] $\gamma_{0q}$ and $\gamma_{1q}$ respectively. It increases with CDD productivity $z_{0q}$.

Concerning the tax and social-contribution parameters, levies $d_{0q}$, $d_{1q}$, $c_{1q}$ and $\rho_{1q}$ increase labour costs and so reduce labour demand. For a given $V_{uq}$, they decrease labour-market tightness $\theta_q$. The impact of CDD termination costs $c_{0q}$ is ambiguous, as it partially reduces the "holdup" phenomenon, which, in turn, increases tightness of the labour market. The tax wedge effect $\rho_{0d}$ also has an indeterminate impact on $\theta_q$ as it reduces the collective surplus but increases the share of the firm's surplus in the wage negotiation.

*A.3.1.2. Labour supply.* The labour supply equation is given by Eq. (27). The unemployment flow value $V_{uq}$ is an increasing function depending on the tightness $\theta_q$, as the unemployed expect to find work more easily if tightness is greater.

$$\theta_q m_q(\theta_q)=\frac{(rV_{uq}-b_q)(r+\lambda_{0q})\rho_{0q}}{\gamma_{0q}\Lambda_q}.\tag{27}$$

Moreover, the unemployment flow value increases with unemployment benefits $b_q$ and the CDD worker's negotiation power, $\gamma_{0q}$. By contrast, it decreases with the CDI worker's negotiation power $\gamma_{1q}$.[10]

[9] This last point needs the hypothesis, which is verified in practice, $\rho_{0q}<\rho_{1q}$.
[10] Under the hypothesis, verified in practice $\rho_{0q}<\rho_{1q}$.

Because of the CDD wage negotiation, the impact of the tax and social-contribution parameters is symmetrical to those of the labour–demand equation. For a given labour-market tightness $\theta_q$, $d_{0q}$, $d_{1q}$, $c_{1q}$ and $\rho_{1q}$ reduce the value of unemployment, $V_{uq}$. $\rho_{0q}$ also reduces $V_{uq}$ as the tax wedge diminishes the collective surplus of a CDD matching and decreases the worker's share of this surplus. $c_{0q}$ has also an ambiguous effect by reducing the "holdup" phenomenon.

*A.3.1.3. Equilibrium.* Equilibrium is deduced from labour demand and supply curves. The cost of a vacancy $h_q$ reduces labour-market tightness and the unemployment flow value. Unemployment benefits, $b_q$, and the CDD worker's negotiation power in CDD, $\gamma_{0q}$, also decrease the tightness. However, $b_q$ positively impacts the unemployment flow value, whereas $\gamma_{0q}$ has an ambiguous effect—positive on wages, negative on job access.

The impact of $d_{0q}$, $d_{1q}$, $c_{1q}$ and $\rho_{1q}$ on $V_{uq}$ is directly deduced from the shifts in labour supply and demand curves. All four parameters reduce the unemployment flow value. They decrease the tightness of the labour market from the perspective of labour demand but increase it concerning the labour supply. However, the calculation shows that the first mechanism is stronger and, consequently, the four parameters decrease *in fine* the labour market tightness. The impact of $c_{0q}$ and $\rho_{0q}$ on $V_{uq}$ and $\theta_q$ are ambiguous for the same reasons as before. But we can show that $\rho_{0q}$ reduces $V_{uq}$.

$\tilde{z}_{dk}$ variations are also valuable, notably for assessing the impact of duality, because they show how tax and social-contribution parameters modify the probability of being hired under a permanent contract after a CDD. Accordingly, an increase in $d_{0q}$, $c_{0q}$ and $\rho_{0q}$ decreases $\tilde{z}_{dq}$ and so increases the likelihood of being hired under a CDI. Our intuitions are the following: $d_{0q}$ increases the initial hiring cost, which encourages employers to extend short-term contracts by CDI. $c_{0q}$ directly encourages CDI hiring rather than CDD termination; $\rho_{0q}$ reduces the CDI cost relative to the CDD cost. $d_{1q}$, $c_{1q}$ and $\rho_{1q}$ have an ambiguous impact on these hiring probabilities, as they directly reduce the benefits of CDI but also reduce the unemployment flow value $V_{uq}$. This tempers wage claims in CDI, increasing CDI hiring probability.

#### A.3.2. Unskilled-workers equilibrium

*A.3.2.1. Labour demand.* As CDD wages are not negotiated, labour supply and demand differ from those of skilled workers (Eq. (28)).

$$m_n(\theta_n)=\frac{h_n(r+\lambda_{0n})}{\Lambda_n^{(d)}}\tag{28}$$

with:

$$\begin{aligned}\Lambda_n^{(d)}=&z_{0n}-\rho_{0n}w_{0n}-\lambda_{0n}\left[F_{zn}(\tilde{z}_{dn})c_{0n}+(1-F_{zn}(\tilde{z}_{dn}))(d_{1n}+c_{1n})\right]-(r+\lambda_{0n})d_{0n}\\&-\frac{\lambda_{0n}(1-\gamma_{1n})}{r+\lambda_{1n}}\int_{\tilde{z}_{dn}}^{\infty}\underline{\varepsilon}_n(z_d)dF_{zn}(z_d).\end{aligned}\tag{29}$$

Labour demand is still a decreasing function of the unemployment flow value. It falls with the cost of a vacancy $w_{0n}$ and the CDI worker's bargaining power $\gamma_{1n}$. By contrast, it rises with CDD productivity $z_{0n}$.

As they increase the labour cost, $d_{0n}$, $d_{1n}$, $c_{1n}$, $\rho_{0n}$ and $\rho_{1n}$ reduce labour demand. However, the impact of the termination cost $c_{0n}$ is ambiguous. As with skilled workers, the termination cost raises the hiring cost but also moderates the "holdup" phenomenon.

*A.3.2.2. Labour supply.* Eq. (30) is the labour-market supply. The unemployment flow value increases with the labour-market tightness $\theta_n$, unemployment benefits $b_q$, the minimum wage $w_{0n}$ and the CDI worker's bargaining power $\gamma_{1n}$.

$$\theta_n m_n(\theta_n) = \frac{(rV_{un} - b_n)(r + \lambda_{0n})}{\Lambda_n^{(o)}} \tag{30}$$

with:

$$\Lambda_n^{(o)} = w_{0n} - rV_{un} - \frac{\lambda_{0n}\gamma_{1n}}{\rho_{1n}(r + \lambda_{1n})} \int_{\tilde{z}_{dn}}^{\infty} \underline{\varepsilon}_n(z_d) dF_{zn}(z_d) \tag{31}$$

For a tightness $\theta_n$, $c_{0n}$ increases the probability of being hired under a permanent contract and consequently the unemployment flow value $V_{un}$. By contrast, $d_{1n}$ decreases the probability of obtaining a CDI, reducing $V_{un}$. The impact of $c_{1n}$ is undetermined because it decreases the probability of a CDI hiring but increases employment duration and the negotiated wage. The tax wedge for CDDs $\rho_{0n}$ and the hiring cost $d_{0n}$ have no impact on the labour-supply equation, as the wage is not negotiated in CDD. Consequently, the costs are entirely supported by the firm. $\rho_{1n}$ decreases $V_{un}$ because it reduces the probability of being hired under a CDI, as the wage is negotiated.

*A.3.2.3. Equilibrium.* As with skilled workers, equilibrium is obtained from the labour supply and demand equations. Labour market tightness decreases with the cost of a vacancy $h_n$, unemployment benefits $b_n$, the minimum wage $w_{0n}$ and the CDI worker's bargaining power $\gamma_{1n}$. By contrast, it rises with CDD productivity $z_{0n}$. The unemployment flow value $V_{un}$ decreases with $h_n$ and increases with $b_n$ and $z_{0n}$. The impact of the minimum wage $w_{0n}$ and the CDI worker's bargaining power $\gamma_{1n}$ on $V_{un}$ are undetermined. They increase wages for CDDs and CDIs respectively, but reduce hirings.

*A.3.3. Unemployment rate*

In equilibrium, the CDD exit flow should be equal to the CDD hiring flow, i.e. $\lambda_{0k} l_{0k} = \theta_k m_k(\theta_k) u_k$.

Let $G_k$ the cumulative distribution function of the initial productivities of the current CDIs, $z_d$. For low values of $dz_d$, the exit flow for initial productivities between $z_d$ and $z_d + dz_d$ is the approximation $\lambda_{1k} F_{\varepsilon k}(\underline{\varepsilon}_k(z_d))[G_k(z_d + dz_d) - G_k(z_d)] l_{1k}$. The entry flow is equal to $\lambda_{0k}[F_{zk}(z_d + dz_d) - F_{zk}(z_d)] l_{0k}$. Let $f_{zk}$ and $g_k$ be the density functions for $F_{zk}$ and $G_k$. We obtain:

$$\forall\, z_d > \tilde{z}_{dk},\ \ \lambda_{0k} f_{zk}(z_d) l_{0k} = \lambda_{1k} F_{\varepsilon k}(\underline{\varepsilon}_k(z_d)) g_k(z_d) l_{1k}. \tag{32}$$

With $\int_{\tilde{z}_{dk}}^{\infty} g_k(z_d) dz_d = 1$, we deduce the relation (33):

$$l_{1k} = \frac{\lambda_{0k}}{\lambda_{1k}} \int_{\tilde{z}_{dk}}^{\infty} \frac{dF_{zk}(z_d)}{F_{\varepsilon k}(\underline{\varepsilon}_k(z_d))} l_{0k} \tag{33}$$

From Eq. (33) and the previous relation between $l_{0k}$ and $u_k$, we deduce $l_{1k} = \frac{\theta_k m_k(\theta_k)}{\lambda_{1k}} \int_{\tilde{z}_{dk}}^{\infty} \frac{dF_{zk}(z_d)}{F_{\varepsilon k}(\underline{\varepsilon}_k(z_d))} u_k$. Using $1 = u_k + l_{0k} + l_{1k}$, we obtain Eq. (34), which gives the unemployment rate.

The Beveridge curve, shown in Eq. (34), gives the unemployment rate. The latter decreases with labour market tightness. It increases with the probability of a productivity shock during a permanent contract $\lambda_{1k}$, the probability of CDD termination $\lambda_{0k}$, and the probability of being unemployed at the end of a short-term contract $F_{zk}(\tilde{z}_{dk})$.

$$u_k = \frac{1}{1 + \theta_k m_k(\theta_k) \left[ \frac{1}{\lambda_{0k}} + \frac{1}{\lambda_{1k}} \int_{z_{dk}}^{\infty} \frac{dF_{zk}(z_d)}{F_{\varepsilon k}(\underline{\varepsilon}_k(z_d))} \right]} \tag{34}$$

*A.3.4. Labour market participation and State*

An individual decides to enter the labour market regarding on the utilities of working or not. If she decides to enter the market, her utility is $U(V_{uk})$ where $U$ is a growing and concave function. If she stays inactive, her utility is $U(\zeta/r) + \xi$ with $\zeta$ the inactivity earnings, $\zeta/r$ is the flow value of this income and $\xi$ the preference for leisure. $\xi$ et $\zeta$ are random variables, observed during the choice. Note the law of $U^{-1}(U(\zeta/r) + \xi)$, a priori different for each skill level, and $\Psi_k$ its cumulative distribution function. Then, $\Psi_k(V_{uk})$ is the rate of labour market participation.

General government is funded by payroll taxes, capital taxes, and taxes generated by labour market flows. General government has fixed expenditures and distributes unemployment benefits.

*A.3.5. Calculation of average CDI stock and CDI exit flows*

*A.3.5.1. Proportion of CDI employees, who have not experienced a productivity shock.* For given values of $k$ and $z_d$, we distinguish between CDI workers who did not experience a productivity shock (they represent $\pi_k(z_d)$ of all CDI workers), and those who did.

Between $z_d$ and $z_d + dz_d$ and for a duration of $dt$, with low values for $dz_d$ and $dt$, the number of workers who have experienced an initial productivity shock and remain in CDIs is $\lambda_{1k}(1 - F_{\varepsilon k}(\underline{\varepsilon}_k(z_d)))g_k(z_d) l_{1k} \pi_k(z_d)\, dz_d dt$. The number of workers having undergone an initial productivity shock and having experienced a new shock that leads to a contract termination is approximately $\lambda_{1k} F_{\varepsilon k}(\underline{\varepsilon}_k(z_d)) g_k(z_d) l_{1k}(1 - \pi_k(z_d)) dz_d dt$. At equilibrium, the stability of the number of CDI workers having experienced a productivity shock requires the following condition: $(1 - F_{\varepsilon k}(\underline{\varepsilon}_k(z_d)))\pi_k(z_d) = F_{\varepsilon k}(\underline{\varepsilon}_k(z_d))(1 - \pi_k(z_d))$. Wz deduce that $\pi_k(z_d) = F_{\varepsilon k}(\underline{\varepsilon}_k(z_d))$.

*A.3.5.2. Cumulative distribution functions $G_k$ of initial productivities.* From Eqs. (32) and (33), it follows that the density $g_k$ of CDI initial productivities is given by:

$$g_k(z_d) = \frac{\frac{f_{zk}(z_d)}{F_{\varepsilon k}(\underline{\varepsilon}_k(z_d))}}{\int_{\tilde{z}_{dk}}^{\infty} \frac{dF_{zk}(z_d)}{F_{\varepsilon k}(\underline{\varepsilon}_k(z_d))}} \text{ pour } z_d \in [\tilde{z}_{dk}, +\infty[. \tag{35}$$

*A.3.5.3. Average CDI productivity.* Distinguishing between CDI workers before and after a productivity shock and using $\pi_k(z_d) = F_{\varepsilon k}(\underline{\varepsilon}_k(z_d))$, we obtain:

$$E_k^{\text{CDI}}[z|z_d] = z_d + \int_{\underline{\varepsilon}_k(zd)}^{\infty} \varepsilon dF_{\varepsilon}(\varepsilon).$$

In practice, with $F_{\varepsilon k}$ uniform on $[\varepsilon_k^{min}, 0]$, we obtain $\int_{\underline{\varepsilon}_k(zd)}^{\infty} \varepsilon dF_{\varepsilon k}(\varepsilon) = \int_{\underline{\varepsilon}_k(zd)}^{0} \frac{\varepsilon d\varepsilon}{-\varepsilon_k^{min}} = (1 - F_{\varepsilon k}(\underline{\varepsilon}_k(z_d)))\frac{\underline{\varepsilon}_k(z_d)}{2}$, yielding:

$$E_k^{\text{CDI}}[z|z_d] = z_d + (1 - F_{\varepsilon k}(\underline{\varepsilon}_k(z_d)))\frac{\underline{\varepsilon}_k(z_d)}{2}.$$

Average CDI productivity is logically given by:

$$E_k^{\mathrm{CDI}}[z] = \int_{\tilde{z}_{dk}}^{\infty} E_k^{\mathrm{CDI}}[z|z_d]dG_k(z_d).$$

*A.3.5.4. Average CDI wage and average wage at CDI termination.* Using $w_{1k}(z_d,\varepsilon) = (1-\gamma_{1k})rV_{uk} + \frac{\gamma_{1k}}{\rho_{1k}}(z_d+\varepsilon+rc_{1k})$ (cf. Appendix A.2), we calculate the average CDI wage:

$$E_k^{CDI}[w] = (1-\gamma_{1k})rV_{uk} + \frac{\gamma_{1k}}{\rho_{1k}}\left(E_k^{\mathrm{CDI}}[z] + rc_{1k}\right).$$

Moreover, $E_k^{CDI}[w|z_d] = (1-\gamma_{1k})rV_{uk} + \frac{\gamma_{1k}}{\rho_{1k}}(z_d + \int_{\underline{\varepsilon}} k^{\infty}(z_d)\varepsilon dF_{\varepsilon k}(\varepsilon) + rc_{1k})$.

To calculate the average wage at the end of a CDI (needed to calibrate unemployment benefits $b_k$ and the firing costs $c_{1k}$), we note that $E_k^{\mathrm{fin\ CDI}}[w|z_d] = E_k^{CDI}[w|z_d]$. As CDI exit and entry flows are equal, the cumulative distribution function of $z_d$ is identical for the both flows. Hence:

$$E_k^{\mathrm{fin\ CDI}}[w] = \int_{\tilde{z}_{dk}}^{\infty} E_k^{CDI}[w|z_d]\frac{dF_z(z_d)}{1-F_z(\tilde{z}_{dk})}.$$

## Appendix B. Calibration

### *B.1. Measurement of labour market flows*

We estimate labour-market flows from the French labour-force survey (Enquête Emploi), used as a quarterly panel. Individuals are classified by skill level, using the standard French socio-occupational categories: "skilled workers" comprise executives, higher intellectual occupations, and intermediate occupations; other categories are classified as "unskilled workers." We also classify individuals by employment status: CDI (after the trial period), CDD (short term contracts and CDI during the trial period), unemployed, and inactive.

Workers in a trial period are identified as CDI workers with less than 3 months' tenure. All job changes away from CDIs are treated as transitions from the CDI category to the CDD category.

**Table 6**
Transition probabilities before reprocessing (matrixes $\Gamma_k$).

Skilled workers

| From… \ To… | Inactivity | Unemployment | CDD | CDI |
|---|---|---|---|---|
| Inactivity | -0.15 | 0.08 | 0.05 | 0.02 |
| Unemployment | 0.88 | -2.14 | 1.25 | 0.01 |
| CDD | 0.23 | 0.39 | -1.39 | 0.77 |
| CDI | 0.05 | 0.02 | 0.03 | -0.10 |

Unskilled workers

| From… \ To… | Inactivity | Unemployment | CDD | CDI |
|---|---|---|---|---|
| Inactivity | -0.15 | 0.09 | 0.05 | 0.01 |
| Unemployment | 0.89 | -2.07 | 1.17 | 0.02 |
| CDD | 0.28 | 0.65 | -1.52 | 0.58 |
| CDI | 0.07 | 0.04 | 0.04 | -0.15 |

We consider that an individual's state is defined by a Markov chain, which supposes the absence of memory effects in the transition probabilities.

For each skill level $k$ and on average during the 2003–2011 period, we calculate the state-transitions matrix $T_k^{1/4}$ by quarter. Using this matrix, we calculate the stationary distribution $\omega_k$ (which is close to the proportion observed in the LFS in 2003–2011) and the generator matrix $\Gamma_k$ of the Markov process, with $T_k^{1/4} = \exp(-\Gamma_k/4)$ (cf. Table 6). Indexes $(i,j)$ of matrix $\Gamma_k$, for $i \neq j$, correspond to the parameter of the exponential law for the transition from state $i$ to state $j$. The diagonal terms are defined by $(\Gamma_k)_{ii} = -\sum_{j\neq i}(\Gamma_k)_{ij}$.

Next, we need to reprocess the generator matrixes to allow for the fact that some flows cannot occur in the model framework. These flows need to be constrained by treating them as transitions through one or more intermediate states. For instance, we consider that an observed transition from a CDI to a CDD corresponds in the model to an initial transition to unemployment followed by a second transition to a CDD. In this framework, all flows between the model's scope of coverage and the "out-of-scope" status (economic inactivity) go through the unemployment state.[11] For entries into the model's scope, our choice reflects the fact that all transitions into (payroll) employment necessarily involve a job-seeking period, however brief. By contrast, for exits from the model, our choice enables us to capture all exits from employment. In particular, if we were to ignore exits to retirement, we would greatly underestimate CDI exit rates and therefore estimate average CDI durations inconsistent with reality. Our modelling choice implies shorter unemployment spells than in reality. This reflects the fact that, in the framework of our model, exits from unemployment encompass all successful job searches, including those that do not entail an actual unemployment spell in the strict sense.

In practice, we reprocess the matrixes as follows. First, we weight the $\Gamma_k$ lines by the stationary distribution $\omega_k$. The matrix obtained is written $(\omega_k\Gamma_k)$. During a short period $dt$, the value of the flow from the state $i$ to the state $j$ $(j \neq j)$ is $(\omega_k\Gamma_k)_{ij}dt$. If this transition is not possible in the model framework and needs to pass through the intermediary state $e$, the reprocessing of the matrix $(\omega_k\Gamma_k)$ involves setting the coefficient $(i,j)$ to 0, adding $(\omega_k\Gamma_k)_{ij}$ to the coefficients $(i,e)$ and $(e,j)$ and subtracting $(\omega_k\Gamma_k)_{ij}$ from the coefficient $(e,e)$. The reprocessing matrix $\hat{\Gamma}_k$ is calculated by linking the lines of the processed matrix $(\omega_k\hat{\Gamma}_k)$ to the stationary distribution $\omega_k$.

The matrix $\hat{\Gamma}_k$ (see Table 7) also give the transition probabilities in continuous time from one state to another (parameters of exponential laws). For instance, the duration of the transition from unemployment to CDD for a skilled worker follows an exponential law of parameter 2.58, which represents an average unemployment duration of 5 months.

**Table 7**
Transition probabilities after reprocessing (matrixes $\hat{\Gamma}_k$).

Skilled workers

| de… \ vers… | Inactivity | Unemployment | CDD | CDI |
|---|---|---|---|---|
| Inactivity | -0.15 | 0.15 | 0 | 0 |
| Unemployment | 2.00 | -4.59 | 2.58 | 0 |
| CDD | 0 | 0.62 | -1.52 | 0.90 |
| CDI | 0 | 0.10 | 0 | -0.10 |

Unskilled workers

| de… \ vers… | Inactivity | Unemployment | CDD | CDI |
|---|---|---|---|---|
| Inactivity | -0.15 | 0.15 | 0 | 0 |
| Unemployement | 1.66 | -3.75 | 2.09 | 0 |
| CDD | 0 | 0.94 | -1.64 | 0.70 |
| CDI | 0 | 0.15 | 0 | -0.15 |

[11] The reprocessing thus consists of the following operations:

- CDI → CDD = CDI → unemployment + unemployment → CDD
- unemployment → CDI = unemployment → CDD + CDD → CDI
- inactivity → CDD = inactivity → unemployment + unemployment → CDD
- inactivity → CDI = inactivity → unemployment + unemployment → CDD + CDD → CDI
- CDD → inactivity = CDD → unemployment + unemployment → inactivity
- CDI → inactivity = CDI → unemployment + unemployment → inactivity.

### B.2. Calibration

After arbitrarily choosing the $h_k$ and setting the $z_{0k}$ values in the interval $[z_{dk}^{min}, z_{dk}^{max}]$, no degrees of freedom remain in the model. The reason is that five parameters need to be determined in each labour market: $\lambda_{1k}$, $z_{dk}^{min}$, $\varepsilon_k^{min}$ and $M_{0k}$, as well as $w_{0n}$ for unskilled workers and $\gamma_{0q}$ for skilled workers. These five parameters must comply with the following five constraints: average CDI and CDD wage rate, average unemployment duration, average CDI duration, CDI tenure, and proportion of CDDs converted to CDIs. These five parameters are obtained by numerical optimization.

However, $d_{1k}$, $c_{1k}$ and $b_k$ are known only conditional upon CDI entry and exit wages. In practice, we determine these three parameters determined by iteration. Their values quickly converge in two or three steps.

We arbitrarily set $z_{dq}^{max}$ to 1. We then take all variables relating to skilled workers and fit them proportionally to ensure that the average–wage ratio between skilled and unskilled workers matches the LFS observations.

## Appendix C. Simulations

**Table 8**
Impact of a hiring tax…(equal to 0.1% of GDP).

| | | …on CDD | …on CDI | …on all contract |
|---|---|---|---|---|
| Unskilled workers | $V_{un}$ | −0.020 | −0.024 | −0.022 |
| | $F_{zn}(\tilde{z}_{dn})$ (%) | −0.30 | +0.83 | +0.20 |
| | Average unemployment duration (months) | +0.23 | +0.13 | +0.19 |
| | Average CDI duration (years) | +0.23 | +0.39 | +0.30 |
| | Unemployment rate (% of working population) | +0.07 | −0.07 | +0.01 |
| | CDD employment rate (ditto) | −0.50 | −0.43 | −0.47 |
| | CDI employment rate (ditto) | +0.43 | +0.50 | +0.46 |
| | CDD hirings (ditto) | −0.82 | −0.70 | −0.77 |
| | CDI hirings (ditto) | −0.28 | −0.50 | −0.38 |
| | Average CDD net wage (%) | +0.00 | +0.00 | +0.00 |
| | Average CDI net wage (%) | −0.46 | −0.56 | −0.50 |
| | CDI productivity (%) | −0.68 | −0.84 | −0.75 |
| | Productivity (%) | −0.49 | −0.64 | −0.56 |
| | Working population (%) | −0.05 | −0.07 | −0.06 |
| Skilled workers | $V_{uq}$ | −0.019 | −0.034 | −0.025 |
| | $F_{zq}(\tilde{z}_{dq})$ (%) | −0.28 | +0.83 | +0.21 |
| | Average unemployment duration (months) | +0.01 | +0.02 | +0.02 |
| | Average CDI duration (years) | +0.11 | +0.30 | +0.19 |
| | Unemployment rate (% of working population) | −0.06 | −0.06 | −0.06 |
| | CDD employment rate (ditto) | −0.13 | −0.14 | −0.13 |
| | CDI employment rate (ditto) | +0.19 | +0.20 | +0.19 |
| | CDD hirings (ditto) | −0.20 | −0.21 | −0.21 |
| | CDI hirings (ditto) | −0.08 | −0.25 | −0.15 |
| | Average CDD net wage (%) | −0.99 | −0.75 | −0.89 |
| | Average CDI net wage (%) | −0.17 | −0.30 | −0.23 |
| | CDI productivity (%) | −0.21 | −0.35 | −0.27 |
| | Productivity (%) | −0.18 | −0.31 | −0.24 |
| | Working population (%) | −0.03 | −0.05 | −0.04 |
| Economy | Average unemployment duration (months) | +0.17 | +0.10 | +0.14 |
| | Average CDI duration (years) | +0.20 | +0.37 | +0.27 |
| | Unemployment rate (% of working population) | +0.02 | −0.06 | −0.02 |
| | CDD employment rate (ditto) | −0.36 | −0.32 | −0.34 |
| | CDI employment rate (ditto) | +0.30 | +0.33 | +0.31 |
| | CDD hirings (ditto) | −0.59 | −0.52 | −0.56 |
| | CDI hirings (ditto) | −0.20 | −0.41 | −0.29 |
| | Average CDD net wage (%) | −0.21 | −0.17 | −0.20 |
| | Average CDI net wage (%) | −0.34 | −0.47 | −0.39 |
| | Employment (thousands) | −15 | +3 | −8 |
| | Pay roll (%) | −0.23 | −0.29 | −0.26 |
| | CDI productivity (%) | −0.46 | −0.62 | −0.27 |
| | Productivity (%) | −0.29 | −0.45 | −0.12 |
| | Value added (%) | −0.35 | −0.44 | −0.39 |
| | Fiscal balance (% of GDP) | +0.03 | +0.02 | +0.03 |

**Table 9**
Impact of a termination tax…(equal to 0.1% of GDP).

| | | …on CDD | …on CDI | …on all contract |
|---|---|---|---|---|
| Unskilled workers | $V_{un}$ | −0.013 | −0.020 | −0.017 |
| | $F_{zn}(\tilde{z}_{dn})$ (%) | −1.45 | +0.79 | −0.11 |
| | Average unemployment duration (months) | +0.30 | +0.12 | +0.20 |
| | Average CDI duration (years) | +0.04 | +0.41 | +0.25 |
| | Unemployment rate (% of working population) | +0.20 | −0.12 | +0.02 |
| | CDD employment rate (ditto) | −0.52 | −0.46 | −0.48 |
| | CDI employment rate (ditto) | +0.32 | +0.59 | +0.47 |
| | CDD hirings (ditto) | −0.85 | −0.76 | −0.79 |
| | CDI hirings (ditto) | −0.02 | −0.52 | −0.31 |
| | Average CDD net wage (%) | +0.00 | +0.00 | +0.00 |
| | Average CDI net wage (%) | −0.30 | −0.53 | −0.43 |
| | CDI productivity (%) | −0.45 | −0.90 | −0.70 |
| | Productivity (%) | −0.29 | −0.68 | −0.51 |
| | Working population (%) | −0.04 | −0.05 | −0.05 |
| Skilled workers | $V_{uq}$ | −0.006 | −0.027 | −0.018 |
| | $F_{zq}(\tilde{z}_{dq})$ (%) | −1.28 | +0.81 | −0.04 |
| | Average unemployment duration (months) | +0.00 | +0.02 | +0.01 |
| | Average CDI duration (years) | −0.05 | +0.32 | +0.16 |
| | Unemployment rate (% of working population) | −0.07 | −0.07 | −0.07 |
| | CDD employment rate (ditto) | −0.13 | −0.16 | −0.14 |
| | CDI employment rate (ditto) | +0.20 | +0.23 | +0.21 |
| | CDD hirings (ditto) | −0.20 | −0.24 | −0.22 |
| | CDI hirings (ditto) | +0.07 | −0.26 | −0.12 |
| | Average CDD net wage (%) | −1.20 | −0.74 | −0.94 |
| | Average CDI net wage (%) | −0.07 | −0.25 | −0.18 |
| | CDI productivity (%) | −0.10 | −0.38 | −0.26 |
| | Productivity (%) | −0.08 | −0.33 | −0.23 |
| | Working population (%) | −0.01 | −0.04 | −0.03 |
| Economy | Average unemployment duration (months) | +0.21 | +0.09 | +0.14 |
| | Average CDI duration (years) | +0.01 | +0.39 | +0.23 |
| | Unemployment rate (% of working population) | +0.09 | −0.10 | −0.02 |
| | CDD employment rate (ditto) | −0.37 | −0.35 | −0.35 |
| | CDI employment rate (ditto) | +0.25 | +0.41 | +0.34 |
| | CDD hirings (ditto) | −0.60 | −0.56 | −0.57 |
| | CDI hirings (ditto) | +0.01 | −0.42 | −0.24 |
| | Average CDD net wage (%) | −0.29 | −0.16 | −0.22 |
| | Average CDI net wage (%) | −0.19 | −0.44 | −0.33 |
| | Employment (thousands) | −30 | +16 | −4 |
| | Pay roll (%) | −0.17 | −0.19 | −0.19 |
| | CDI productivity (%) | −0.27 | −0.67 | −0.50 |
| | Productivity (%) | −0.12 | −0.49 | −0.33 |
| | Value added (%) | −0.24 | −0.43 | −0.35 |
| | Fiscal balance (% of GDP) | +0.05 | +0.05 | +0.05 |

**Table 10**
Impact of an increase in the tax wedge…(equal to 0.1% of GDP).

| | | …on CDD | …on CDI | …on all contract |
|---|---|---|---|---|
| Unskilled workers | $V_{un}$ | −0.019 | −0.012 | −0.012 |
| | $F_{zn}(\tilde{z}_{dn})$ (%) | −0.29 | +0.06 | +0.02 |
| | Average unemployment duration (months) | +0.22 | +0.02 | +0.04 |
| | Average CDI duration (years) | +0.21 | −0.04 | −0.02 |
| | Unemployment rate (% of working population) | +0.07 | +0.10 | +0.10 |
| | CDD employment rate (ditto) | −0.47 | +0.07 | +0.02 |
| | CDI employment rate (ditto) | +0.40 | −0.16 | −0.12 |
| | CDD hirings (ditto) | −0.78 | +0.11 | +0.03 |
| | CDI hirings (ditto) | −0.27 | +0.03 | +0.01 |
| | Average CDD net wage (%) | +0.00 | +0.00 | +0.00 |
| | Average CDI net wage (%) | −0.43 | −0.13 | −0.16 |
| | CDI productivity (%) | −0.64 | +0.12 | +0.05 |
| | Productivity (%) | −0.47 | +0.08 | +0.04 |
| | Working population (%) | −0.05 | −0.03 | −0.03 |

**Table 10** (*continued*)

| | | …on CDD | …on CDI | …on all contract |
|---|---|---|---|---|
| Skilled workers | $V_{uq}$ | −0.023 | −0.022 | −0.022 |
| | $F_{zq}(\bar{z}_{dq})$ (%) | −0.34 | +0.06 | +0.02 |
| | Average unemployment duration (months) | −0.05 | +0.01 | +0.01 |
| | Average CDI duration (years) | +0.13 | −0.02 | −0.01 |
| | Unemployment rate (% of working population) | −0.15 | +0.03 | +0.02 |
| | CDD employment rate (ditto) | −0.15 | +0.03 | +0.01 |
| | CDI employment rate (ditto) | +0.30 | −0.06 | −0.02 |
| | CDD hirings (ditto) | −0.23 | +0.04 | +0.01 |
| | CDI hirings (ditto) | −0.09 | +0.01 | +0.00 |
| | Average CDD net wage (%) | −1.71 | +0.03 | −0.14 |
| | Average CDI net wage (%) | −0.21 | −0.16 | −0.17 |
| | CDI productivity (%) | −0.26 | +0.04 | +0.02 |
| | Productivity (%) | −0.22 | +0.04 | +0.01 |
| | Working population (%) | −0.03 | −0.03 | −0.03 |
| Economy | Average unemployment duration (months) | +0.14 | +0.02 | +0.03 |
| | Average CDI duration (years) | +0.19 | −0.03 | −0.01 |
| | Unemployment rate (% of working population) | −0.02 | +0.07 | +0.06 |
| | CDD employment rate (ditto) | −0.35 | +0.05 | +0.01 |
| | CDI employment rate (ditto) | +0.33 | −0.15 | −0.11 |
| | CDD hirings (ditto) | −0.57 | +0.08 | +0.02 |
| | CDI hirings (ditto) | −0.20 | +0.02 | +0.00 |
| | Average CDD net wage (%) | −0.52 | −0.00 | −0.06 |
| | Average CDI net wage (%) | −0.33 | −0.13 | −0.14 |
| | Employment (thousands) | −6 | −27 | −26 |
| | Pay roll (%) | −0.21 | −0.26 | −0.25 |
| | CDI productivity (%) | −0.44 | +0.10 | +0.05 |
| | Productivity (%) | −0.29 | +0.07 | +0.04 |
| | Value added (%) | −0.31 | −0.04 | −0.07 |
| | Fiscal balance (% of GDP) | +0.05 | +0.01 | +0.02 |

**Table 11**
Neutral ex ante impact of reforms.

| | | Decreasing contrib. | Termination tax | Italian style |
|---|---|---|---|---|
| Unskilled workers | $V_{un}$ | −0.007 | −0.004 | +0.005 |
| | $F_{zn}(\bar{z}_{dn})$ (%) | −0.32 | −0.14 | −1.13 |
| | Average unemployment duration (months) | +0.19 | +0.16 | +0.08 |
| | Average CDI duration (years) | +0.25 | +0.27 | −0.15 |
| | Unemployment rate (% of working population) | −0.03 | −0.09 | +0.11 |
| | CDD employment rate (ditto) | −0.53 | −0.51 | −0.07 |
| | CDI employment rate (ditto) | +0.55 | +0.59 | −0.04 |
| | CDD hirings (ditto) | −0.86 | −0.83 | −0.12 |
| | CDI hirings (ditto) | −0.29 | −0.32 | +0.23 |
| | Average CDD net wage (%) | +0.00 | +0.00 | +0.00 |
| | Average CDI net wage (%) | −0.30 | −0.27 | +0.11 |
| | CDI productivity (%) | −0.74 | −0.76 | +0.15 |
| | Productivity (%) | −0.53 | −0.56 | +0.14 |
| | Working population (%) | −0.02 | −0.01 | +0.01 |
| Skilled workers | $V_{uq}$ | +0.004 | +0.004 | +0.011 |
| | $F_{zq}(\bar{z}_{dq})$ (%) | −0.30 | −0.06 | −1.19 |
| | Average unemployment duration (months) | +0.00 | +0.00 | −0.07 |
| | Average CDI duration (years) | +0.12 | +0.17 | −0.16 |
| | Unemployment rate (% of working population) | −0.08 | −0.09 | −0.10 |
| | CDD employment rate (ditto) | −0.14 | −0.15 | −0.02 |
| | CDI employment rate (ditto) | +0.22 | +0.24 | +0.12 |
| | CDD hirings (ditto) | −0.21 | −0.23 | −0.03 |
| | CDI hirings (ditto) | −0.08 | −0.13 | +0.16 |
| | Average CDD net wage (%) | −0.86 | −0.81 | −0.93 |
| | Average CDI net wage (%) | −0.00 | −0.01 | +0.08 |
| | CDI productivity (%) | −0.23 | −0.28 | +0.08 |
| | Productivity (%) | −0.20 | −0.24 | +0.07 |
| | Working population (%) | +0.01 | +0.01 | +0.02 |

**Table 11** (*continued*)

| | | Decreasing contrib. | Termination tax | Italian style |
|---|---|---|---|---|
| Economy | Average unemployment duration (months) | +0.13 | +0.11 | +0.04 |
| | Average CDI duration (years) | +0.21 | +0.25 | −0.15 |
| | Unemployment rate (% of working population) | −0.05 | −0.09 | +0.03 |
| | CDD employment rate (ditto) | −0.37 | −0.37 | −0.05 |
| | CDI employment rate (ditto) | +0.41 | +0.45 | +0.04 |
| | CDD hirings (ditto) | −0.61 | −0.59 | −0.08 |
| | CDI hirings (ditto) | −0.21 | −0.25 | +0.20 |
| | Average CDD net wage (%) | −0.15 | −0.16 | −0.33 |
| | Average CDI net wage (%) | −0.20 | −0.19 | +0.12 |
| | Employment (thousands) | +11 | +22 | −3 |
| | Pay roll (%) | +0.02 | +0.07 | +0.09 |
| | CDI productivity (%) | −0.51 | −0.55 | +0.14 |
| | Productivity (%) | −0.33 | −0.37 | +0.14 |
| | Value added (%) | −0.28 | −0.29 | +0.13 |
| | Fiscal balance (% of GDP) | +0.02 | +0.04 | +0.03 |

**Table 12**
Neutral ex post impact of reforms.

| | | Decreasing contrib. | Termination tax | Italian style |
|---|---|---|---|---|
| Unskilled workers | $V_{un}$ | +0.006 | +0.022 | +0.027 |
| | $F_{zn}(\bar{z}_{dn})$ (%) | −0.35 | −0.19 | −1.17 |
| | Average unemployment duration (months) | +0.15 | +0.07 | +0.01 |
| | Average CDI duration (years) | +0.27 | +0.32 | −0.12 |
| | Unemployment rate (% of working population) | −0.14 | −0.30 | −0.06 |
| | CDD employment rate (ditto) | −0.55 | −0.56 | −0.10 |
| | CDI employment rate (ditto) | +0.69 | +0.86 | +0.16 |
| | CDD hirings (ditto) | −0.91 | −0.92 | −0.17 |
| | CDI hirings (ditto) | −0.31 | −0.35 | +0.21 |
| | Average CDD net wage (%) | +0.00 | +0.00 | +0.00 |
| | Average CDI net wage (%) | −0.13 | +0.05 | +0.39 |
| | CDI productivity (%) | −0.80 | −0.89 | +0.07 |
| | Productivity (%) | −0.58 | −0.65 | +0.08 |
| | Working population (%) | +0.02 | +0.06 | +0.07 |
| Skilled workers | $V_{uq}$ | +0.028 | +0.052 | +0.051 |
| | $F_{zq}(\bar{z}_{dq})$ (%) | −0.33 | −0.10 | −1.23 |
| | Average unemployment duration (months) | −0.00 | −0.01 | −0.09 |
| | Average CDI duration (years) | +0.12 | +0.19 | −0.14 |
| | Unemployment rate (% of working population) | −0.09 | −0.12 | −0.13 |
| | CDD employment rate (ditto) | −0.15 | −0.17 | −0.03 |
| | CDI employment rate (ditto) | +0.24 | +0.29 | +0.16 |
| | CDD hirings (ditto) | −0.23 | −0.26 | −0.05 |
| | CDI hirings (ditto) | −0.09 | −0.14 | +0.15 |
| | Average CDD net wage (%) | −0.71 | −0.52 | −0.70 |
| | Average CDI net wage (%) | +0.18 | +0.34 | +0.38 |
| | CDI productivity (%) | −0.24 | −0.31 | +0.05 |
| | Productivity (%) | −0.21 | −0.27 | +0.05 |
| | Working population (%) | +0.04 | +0.08 | +0.08 |
| Economy | Average unemployment duration (months) | +0.10 | +0.04 | −0.02 |
| | Average CDI duration (years) | +0.23 | +0.28 | −0.13 |
| | Unemployment rate (% of working population) | −0.12 | −0.23 | −0.08 |
| | CDD employment rate (ditto) | −0.39 | −0.40 | −0.07 |
| | CDI employment rate (ditto) | +0.53 | +0.68 | +0.22 |
| | CDD hirings (ditto) | −0.63 | −0.64 | −0.11 |
| | CDI hirings (ditto) | −0.22 | −0.26 | +0.20 |
| | Average CDD net wage (%) | −0.09 | −0.03 | −0.24 |
| | Average CDI net wage (%) | −0.04 | +0.10 | +0.38 |
| | Employment (thousands) | +39 | +77 | +41 |
| | Pay roll (%) | +0.29 | +0.61 | +0.53 |
| | CDI productivity (%) | −0.57 | −0.67 | +0.05 |
| | Productivity (%) | −0.37 | −0.46 | +0.07 |
| | Value added (%) | −0.21 | −0.15 | +0.24 |
| | Fiscal balance (% of GDP) | 0.00 | 0.00 | 0.00 |

## References


Abowd, J., Allain, L., 1996. Compensation structure and product market competition. Ann. Econ. Stat. 41–42, 207–217.

Abowd, J., Kramarz, F., 2003. The costs of hiring and separations. Labour Econ. 10 (5), 499–530.

Aeberhardt, R., Givord, P., Marbot, C., 2012. Les effets de difffusion du SMIC sur la distribution de salaires: régression de quantiles inconditionnels. Présentation au séminaire Fourgeaud le 7/3/2012.

Bassanini, A., Garnero, A., 2013. Dismissal protection and worker flows in OECD countries: evidence from cross-country/cross-industry data. Labour Econ. 21 (C), 24–41.

Bentolila, S., Dolado, J., 1994. Labour flexibility and wages: lessons from Spain. Econ. Policy 18, 55–99.

Blanchard, O., Landier, A., 2002. The perverse effects of partial labour market reform: fixed-term contracts in France. Econ. J. 112, F189–F213.

Blanchard, O., Tirole, J., 2003. Protection de l'emploi et procédures de licenciement. Discussion Paper 480. Conseil d'Analyse Economique.

Bonnet, X., Mahfouz, S., 1996. The influence of different specifications of wages spirals on the measure of the NAIRU: the case of France. Document de travail de la direction des Études et Synthèses économiques, Inseep. G9611.

Borowczyk-Martins, D., Jolivet, G., Postel-Vinay, F., 2012. Accounting for endogeneity in matching function estimation. Rev. Econ. Dyn. 16 (3), 440–451.

Brown, A., Merkl, C., Snower, D., 2011. Comparing the effectiveness of employment subsidies. Labour Econ. 18, 168–179.

Cahuc, P., Carcillo, S., 2007. The shortcomings of a partial release of employment protection laws: the case of the 2005 French Reform. IMF Working Papers 06/301.

Cahuc, P., Kramarz, F., 2004. De la précarité à la mobilité: vers une Sécurité sociale professionnelle. Discussion paper. Conseil d'Analyse Économique.

Cahuc, P., Malherbet, F., 2001. Faut-il moduler les cotisations patronales à l'assurance chômage? Rev. Econ. 52 (3), 695–703.

Cahuc, P., Malherbet, F., 2004. Unemployment compensation finance and labor market rigidity. J. Public Econ. 88 (3–4), 481–501.

Cahuc, P., Postel-Vinay, F., 2002. Temporary jobs, employment protection and labor market performance. Labour Econ. 9 (1), 63–91.

Cahuc, P., Zylberberg, A., 1999. Job protection, minimum wage and unemployment. IZA Discussion Paper 95.

Cahuc, P., Zylberberg, A., 2008. Optimum taxation and layoff taxes. J. Public Econ. 92 (10–11), 2003–2019.

Cahuc, P., Charlot, O., Malherbet, F., 2015. Explaining the spread of temporary jobs and its impact on labor turnover. Int. Econ. Rev. (forthcoming).

Charlot, O., Malherbet, F., 2010. Réforme de la protection de l'emploi et inégalités face au chômage dans un modèle d'appariement. Rech. Econ. Louvain 76 (1), 57–112.

Cheron, A., 2009. La protection des emplois en France et ses effets différenciés selon l'âge: une évaluation quantitative structurelle. Rev. Econ. Polit. 119 (1), 41–70.

Chetty, R., 2012. Bounds on elasticities with optimization frictions: a synthesis of micro and macro evidence on labor supply. Econometrica 80 (3), 969–1018.

Ciani, E., de Blasio, G., 2015. Getting stable: an evaluation of the incentives for permanent contracts in Italy. IZA J. Eur. Labor Stud. 4 (6).

Coquet, B., 2010. Assurance chômage et emplois précaires. Contrats courts et segmentation du marché du travail en France. Futuribles 368 (368), 22–38.

Cotis, J.-P., Méary, R., Sobczak, N., 1998. Le chômage d'équilibre en France: une évaluation. Rev. Econ. 49 (9), 921–935.

Goarant, C., Muller, L., 2011. *Emploi et salaires — Édition 2011*chap. Les effets des hausses du SMIC sur les salaires mensuels dans les entreprises de 10 salariés ou plus de 2006 à 2009 (INSEE Références).

Koubi, M., Lhommeau, B., 2007. *Les salaires en France — Édition 2007*chap. Les effets de diffusion de court terme des hausses du Smic dans les grilles salariales des entreprises de dix salariés ou plus sur la période 2000–2005 (INSEE Références).

Kramarz, F., Michaud, M., 2009. The shape of hiring and separation costs in France. Labour Econ. 17 (1), 27–37.

L'Haridon, O., Malherbet, F., 2010. Réforme de la protection de l'emploi et performance du marché du travail dans un modèle d'appariement. Ann. Econ. Stat. 99/100 (3), 247–284.

L'Horty, H., Sobczak, N., 1997. Les déterminants du chômage d'équilibre: estimation d'un modèle WS–PS. Écon. Prévision 1 (127), 101–116.

Laffargue, J., 1996. Fiscalité, charges sociales, qualifications et emploi. Écon. Prévision 4 (125), 87–105.

Lazear, E., 1990. Job security provisions and employment. Q. J. Econ. 105 (3), 699–726.

Lepage-Saucier, N., Schleich, J., Wasmer, E., 2013. Moving towards a single labour contract: pros, cons and mixed feelings. OECD Economics Department Working Papers 1026.

Maillard, M., 1997. L'appariement des emplois vacants et du chômage en France. Écon. Prévision 1 (127), 157–163.

Petrongolo, B., Pissarides, C., 2001. Looking into the black box: a survey of matching functions. J. Econ. Lit. 39 (2), 390–431.

Picart, C., 2014. Une rotation de la main d'oeuvre presque quintuplée en 30 ans, Plus qu'un essor des formes particulières d'emploi, un profond changement de leur usage. Document de Travail de la DSDSp. F1402.

Pissarides, C., 2000. Equilibrium unemployment theory. 2nd edn. MIT Press Books vol. 1. The MIT Press.

Saint-Paul, G., 1996. Dual Labor Markets. MIT Press, Cambridge, United States.