

DISCUSSION PAPER SERIES

IZA DP No. 11010

**Inefficient Short-Time Work**

Pierre Cahuc  
Sandra Nevoux

SEPTEMBER 2017

## DISCUSSION PAPER SERIES

IZA DP No. 11010

# Inefficient Short-Time Work

**Pierre Cahuc**

*Crest-Ensaë, École Polytechnique, IZA and CEPR*

**Sandra Nevoux**

*Crest-Ensaë, École Polytechnique*

SEPTEMBER 2017

Any opinions expressed in this paper are those of the author(s) and not those of IZA. Research published in this series may include views on policy, but IZA takes no institutional policy positions. The IZA research network is committed to the IZA Guiding Principles of Research Integrity.

The IZA Institute of Labor Economics is an independent economic research institute that conducts research in labor economics and offers evidence-based policy advice on labor market issues. Supported by the Deutsche Post Foundation, IZA runs the world's largest network of economists, whose research aims to provide answers to the global labor market challenges of our time. Our key objective is to build bridges between academic research, policymakers and society.

IZA Discussion Papers often represent preliminary work and are circulated to encourage discussion. Citation of such a paper should account for its provisional character. A revised version may be available directly from the author.

## ABSTRACT

---

### **Inefficient Short-Time Work**

This paper shows that the reforms which expanded short-time work in France after the great 2008-2009 recession were largely to the benefit of large firms which are recurrent short-time work users. We argue that this expansion of short-time work is an inefficient way to provide insurance to workers, as it entails cross-subsidies which reduce aggregate production. An efficient policy should provide unemployment insurance benefits funded by experience rated employers' contributions instead of short-time work benefits. We find that short-time work entails significant production losses compared to an unemployment insurance scheme with experience rating.

**JEL Classification:** J63, J65

**Keywords:** short-time work, unemployment insurance, experience rating

**Corresponding author:**

Pierre Cahuc  
Laboratoire de Macroéconomie  
CREST  
15 Boulevard Gabriel Péri  
92245 Malakoff Cedex  
France  
E-mail: [cahuc@ensae.fr](mailto:cahuc@ensae.fr)

# 1 Introduction

Also called short-time compensation, short-time work is a public program targeted at firms facing temporary negative shocks. The design aims at reducing job destruction by subsidizing firms to lower hours of work and provide earnings support to workers facing reduced hours. Short-time work can avoid inefficient job destruction induced by firms facing limited access to credit due to capital market imperfection.

In France, before the great 2008-2009 recession, the short-time work scheme was very limited, with a tiny budget fluctuating between 5 and 10 million euros per year. However, in 2009, the budget expanded significantly, to about 300 million euros. This expansion was induced by a strong increase in the demand from firms in distress but also by the government, which decided to facilitate access to short-time work and to raise short-time work subsidies in order to sustain employment. In November 2009, a government report,<sup>1</sup> co-directed by three representatives of large firms and one civil servant, recommended pursuing the expansion of short-time work beyond the end of the recession. In January 2012, once the recession was over, employers' organizations and trade unions signed a national agreement to enlarge the program further and to raise the subsidies. This national agreement was implemented by a number of decrees enacted to raise the budget devoted to short-time work. As a consequence, from 2013 on, the expenditure on short-time work was multiplied by about 20 compared with its pre-recession level.

Relying on rich data providing detailed information about all short-time work subsidies from 2002 to 2014, we show that this hike in public expenditure primarily benefited large firms which recurrently use short-time work to deal with seasonal activity fluctuations. Then, we present a model which shows that this expansion of short-time work induces cross-subsidies towards recurrent short-time work users, which reduce aggregate production. Our model shows that an efficient policy should instead provide unemployment insurance benefits funded by experience rated employers' contributions. In the unemployment insurance scheme with experience rating, employers can lay the workers off during the unproductive periods but have to pay for the induced cost to unemployment insurance. This system induces employers to internalize the costs of their layoffs. It incentivizes employers to keep their employees during unproductive periods to avoid increasing unemployment insurance contributions. Conversely, short-time work

---

<sup>1</sup>Brunet et al. (2009).

is not incentive compatible if it is experience rated, since the introduction of experience rating in short-time work reduces its attractiveness for employers and hence diminishes short-time work take-up. Obviously, short-time work is a means to keep employees in their jobs if it induces small costs to the employers. However, this is an inefficient way to provide insurance, as it entails cross-subsidies towards short-time work users which reduce aggregate production. Nevertheless, this is the path taken by French reforms after the recession, under the pressure of industries which could prospectively benefit from the short-time work subsidies. Relying on our model, we arrive at the assessment that the production loss associated with short-time work, compared to a system of unemployment insurance with experience rating, is significant: it amounts to about 50% of the total amount of short-time work subsidies targeted at recurrent short-time work users.

These results are a call for a careful design of short-time work and unemployment insurance. In all countries where short-time work exists, the short-time work hourly benefits paid to the employees for each unworked hour represent a fraction of the hourly wage. In some countries, the employers pay a portion of the benefits and the other part is financed by public subsidies.<sup>2</sup> In other countries, the benefits are entirely financed by public subsidies<sup>3</sup> but experience rated social contributions entail that employers have to pay back a fraction of the short-time work cost through higher social contributions in the future.<sup>4</sup> In yet other countries, employers bear no short-time work cost at all.<sup>5</sup> Our results stress that systems where employers contribute little to short-time work induce firms facing strong seasonal revenue fluctuations to make recurrent use of short-time work, which reduces aggregate production. Given that, it is important to limit the recurrent use of short-time work. An efficient way to achieve this objective may be to rely on an experience rated system, where employers have to pay back a fraction of the short-time work cost through higher social contributions in the future. This system allows firms facing short-term financial constraints to sustain employment without inducing cross-subsidies which reduce aggregate production. Since the introduction of experience rating in short-time work reduces its attractiveness for employers, it induces a reduction in the short-time work take-up

---

<sup>2</sup>This is the case in Austria, Czech Republic, France, Germany, Hungary, Italy, Japan, Korea, Luxembourg, Netherlands, New-Zealand, Norway, Poland, Portugal, Slovakia and Switzerland (Hijzen and Venn (2011)). The employer's participation in short-time work might be subject to specific conditions (differentiated schedule of payment, short-time work duration, establishment's or firm's size, training, collective agreements).

<sup>3</sup>These public subsidies can be paid by the unemployment insurance system and/or by the state.

<sup>4</sup>This is the case in Italy and in the United-States.

<sup>5</sup>Belgium, Canada, Denmark, Finland, Ireland, Spain and Turkey (Hijzen and Venn (2011)).

rate. Accordingly, this system should be complemented by mandatory unemployment insurance with experience rated employers' contributions to insure workers.

This paper is related to different strands of the literature. Several theoretical papers have shown that short-time work is favorable to employment at the cost of distorting downwards the number of hours worked per employee<sup>6</sup> and the allocative efficiency of the labor market,<sup>7</sup> that it improves welfare by mitigating distortions caused by public unemployment insurance<sup>8</sup> and that it is welfare-improving when firms cannot fully insure workers against income shocks.<sup>9</sup> We complement this literature by focusing on short-time work used by firms facing seasonal fluctuations in their revenue, instead of temporary shocks, which is the case usually considered. Surprisingly, this issue has been neglected so far, although it is important inasmuch as the recurrent use of short-time work is a common feature of many short-time work systems.<sup>10</sup> We show that short-time work is inefficient if it induces net transfers towards firms which make recurrent use of short-time work. In that case, short-time work reduces aggregate production because it shifts the labor force towards sectors which are less productive, as their manpower is idle for part of the year. Introducing experience rating is a way to solve this problem. This result is in line with the literature which has shown that short-time work should be experience rated to avoid inefficient hours of work per worker<sup>11</sup> and that unemployment benefits must be experience rated to avoid excessive layoffs.<sup>12</sup> This result is also in line with the literature which shows that badly designed public policies can be important sources of misallocation of resources across firms and sectors, reducing aggregate productivity.<sup>13</sup>

The paper is organized as follows. Section 2 provides information about the short-time work scheme and the reforms implemented during and after the recession. Section 3 describes the increase in short-time work expenditure and its beneficiaries. Section 4 presents a simple model which shows that short-time work use is inefficient and induces production losses compared to an unemployment insurance scheme with experience rating. Section 5 uses the model to quantify the production losses associated with the recurrent use of short-time work. Section 6 concludes.

---

<sup>6</sup>Burdett and Wright (1989), Van Audenrode (1994).

<sup>7</sup>Cooper, Meyer and Schott (2017).

<sup>8</sup>Braun and Brügemann (2014).

<sup>9</sup>Tilly and Niedermayer (2016).

<sup>10</sup>Boeri and Bruecker (2011).

<sup>11</sup>Burdett and Wright (1989).

<sup>12</sup>Feldstein (1976), Blanchard and Tirole (2007), Cahuc and Zylberberg (2008).

<sup>13</sup>This literature is surveyed by Restuccia and Rogerson (2017).

## 2 Short-time work policy

Short-time work regulations have changed multiple times since the inception of the policy, in 1951. In this section, we start by describing the general features of short-time work before presenting the reforms implemented during and after the great 2008-2009 recession.

### 2.1 General features of short-time work

All private business establishments located in France are eligible for short-time work.

There are six potential valid motives when applying for short-time work: (i) economic situation; (ii) modernization, restructuring and transformation; (iii) problems in the provision of raw materials and energy; (iv) accident; (v) exceptionally adverse weather conditions; (vi) other exceptional circumstances. We will restrict our analysis to the first motive, which was the main subject of the reforms under scrutiny in this paper.

Short-time work applies to hours unworked below the weekly legal duration (35 hours, or below the weekly collectively-agreed or contractual duration when it is below 35 hours). The yearly number of subsidized hours per employee and per year cannot exceed a certain threshold. For any employee, periods of short-time work cannot exceed a maximum number of consecutive weeks (in the case of complete suspension of activity). At that point, she becomes unemployed.

Under short-time work, the employee receives short-time work benefits from the establishment for each non-worked hour amounting to a fraction of her hourly wage. The establishment is then reimbursed by the state. Additionally, if the monthly sum of the net wage and the net short-time work benefits is inferior to the monthly net minimum wage (computed according to the number of hours of work stipulated in the labor contract), both the establishment and the state have to finance the difference equally in order for the employee to be paid at least the net monthly minimum wage.

The procedure granting an establishment the use of short-time work has three steps: application, examination and consumption. First, the establishment and its works council discuss the possibility of using short-time work. At the end of this consultation, the works council issues a written recommendation. Then, the establishment sends the short-time work application form (including the reason, period, number of covered employees, number of hours and corresponding level of subsidies) together with a document proving its economic difficulties to the local (département-level) agency in charge of labor relations (DIRECCTE). Second, the

local public authority decides either to reject or approve the application.

Third, when the subsidy is granted, the establishment may use short-time work within the limits set by the local authority. In case it is used, the establishment sends to the local authority a reimbursement form (including the number of employees and hours that effectively used short-time work during the month, and the corresponding level of short-time work subsidies). Upon receipt, the local authority checks the validity of the request and pays the establishment the corresponding subsidies.

## 2.2 The reforms

The large expansion in short-time work at the start of the recession resulted from a deliberate effort by public decision-makers, who enacted laws, expanded the budget, released circulars and directives to boost short-time work usage.

In December 2008, the maximum number of short-time work hours per employee per year increased from 600 to 800 (1000 hours in the industries most severely hit by the recession; in particular the textile and automobile industries) and the maximum short-time work duration in case of total suspension of activity was expanded from 4 to 6 weeks. In January 2009, the short-time work benefits received by employees for each subsidized hour increased from 50 to 60% of their previous gross hourly wage; as well, the lower limit associated with these benefits rose from 4.42 to 6.84€. Simultaneously, the subsidy received by the establishment was expanded: it increased from 2.44 to 3.84€ in the case of firms with 250 employees or less, and from 2.13 to 3.33€ for firms with 251 employees or more. In May 2009, a special scheme called “long-term short-time work” was created, whose duration was set between 3 and 12 months. Under long-term short-time work, the benefit perceived by the employee for each short-time work hour was set to 75% of her previous gross hourly wage and the establishment received an additional subsidy.<sup>14</sup> Moreover, during this period, several ministerial circulars and directives were sent to the local authorities, calling for easier access to the policy. In particular, the local authorities were asked to interpret the eligibility conditions in a flexible way, resulting in an increased acceptance of applications.

After the end of the recession, in response to the requests formulated by employers’ organi-

---

<sup>14</sup>This subsidy was set to 1.90€ per hour up to the 50th long-term short-time work hour of a given employee and to 3.90€ beyond the 50th hour.



zations and trade unions in a national collective agreement,<sup>15</sup> new reforms were implemented in 2012 and 2013, again expanding access to short-time work. These reforms extended the maximum duration of short-time work, increased the benefit and the subsidy per hour<sup>16</sup> and shortened the maximum response time of the local agency in charge of labor relations.

### 3 The budget expansion and its beneficiaries

In this section, we start by describing the data used to characterize the recurrent use of short-time work. We show that the reforms implemented after the great 2008-2009 recession dramatically expanded the expenditure on short-time work. Then, we describe the beneficiaries of this budget expansion.

#### 3.1 Data

Information about short-time work comes from “Sinapse-Chômage Partiel” (from 2002 to 2014) and “Extranet-Activité Partielle” (since 2014), two administrative sources produced by the Statistical Department of the French Labor Ministry (DARES) in collaboration with the Employment and Vocational Training Agency (DGEFP) which cover all French establishments using short-time work. We use information about the applying establishment (identification number, name, city, labor pool, département, region, industry, weekly legal and collective work duration, number of employees), the nature of the reduction in hours (reason, area, repeated use, hourly public subsidy, maximum number of short-time work hours per employee and per year, works council recommendation, labor inspection recommendation, application date) and short-time work consumption (monthly number of employees effectively under short-time work, monthly number of short-time work hours consumed and the associated subsidies).

We also use the “Déclaration Annuelle de Données Sociales” at the establishment level (DADS-Établissements). The DADS is an administrative dataset produced by the French National Institute for Statistical and Economic Studies (Insee) which provides information about wages, labor costs, employment and hours of work aggregated at the establishment level

---

<sup>15</sup>Accord National Interprofessionnel, 13th of January 2012.

<sup>16</sup>In March 2012, the standard subsidy was raised by 1€ and the additional subsidy was set to 2.90€. In July 2013, short-time work and long-term short-time work were merged in a single scheme: the benefit was set to 70% of the previous gross hourly wage; the subsidy was set to 7.74€ for establishments belonging to firms with 250 employees or less and 7.23€ for establishments belonging to firms with 251 employees or more.

for all French establishments.

### 3.2 The cost of the reforms

Figure 1 shows that the post-recession reforms induced a strong hike in the hourly subsidy provided to employers, which doubled from 2011 to 2014.<sup>17</sup> It is clear that the total short-time work expenditure increased much faster than the number of short-time work hours. In 2014, the total number of short-time work hours was the same as in 2012, but the expenditure increased by 60% between these two dates. Hence, over the 2002-2014 period, the total amount spent on short-time work, initially correlated with its use, has been progressively disconnected from the total number of short-time work hours due to the successive reforms of the scheme in 2009, 2012 and 2013, to mostly reflect the increase in the hourly short-time work subsidy.

The increase in the hourly short-time work subsidy has led to a dramatic drop in the cost supported by employers, as shown by Figure 2. For employees paid at the minimum wage, who had 100% net replacement rate,<sup>18</sup> employers had to cover around 50% of the short-time work cost before January 2009. In July 2013, the employers' contribution dropped to zero, due to the increase in the subsidy. Figure 2 shows that the cost decreased by the same amount for wages above the minimum wage, implying that the short-time work labor cost increases with the wage. However, short-time work employees are concentrated in the low part of the wage distribution.<sup>19</sup> Hence, the vast majority of short-time work employees benefit from a 100% net replacement rate over the period 2002-2014 and the firms using short-time work face almost no short-time work cost since July 2013.

### 3.3 The beneficiaries of the reforms

Very few firms use short-time work. As we see in Figure 3, in 2009, in the core of the recession, about 1.2% of firms used short-time work. After the recession, this proportion fell to 0.3% and increased afterwards thanks to the expansion of the scheme. However, this proportion remains low, well below 1%. Short-time work hours also represent a tiny fraction of total hours of work:

---

<sup>17</sup>Note that the average hourly subsidy in 2013 is lower than in 2014 because the last reform which raised the subsidy was passed in July 2013.

<sup>18</sup>The monthly sum of the net wage and the net short-time work benefit cannot be inferior to the monthly net minimum wage corresponding to the number of hours of work stipulated in the labor contract.

<sup>19</sup>Calavrezo and Lodin (2012).

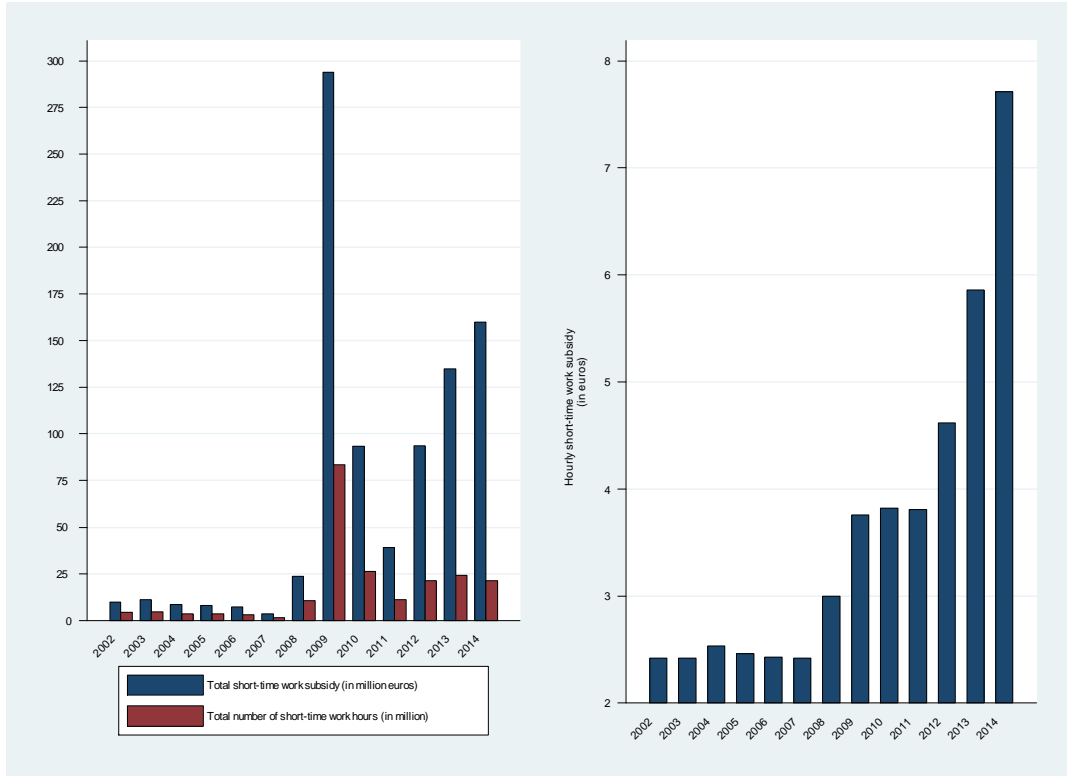


Figure 1: Total short-time work subsidy, total number of short-time work hours (left-hand side) and hourly short-time work subsidy (right-hand side).

Sources: DADS (Insee), Sinapse (DGEFP) and Extranet (ASP).

Scope: mainland France excluding Corsica; market sectors excluding agriculture; firms using short-time work for economic reasons.

Definition: the hourly short-time work subsidy is defined as the total short-time work subsidy divided by the total number of short-time work hours.

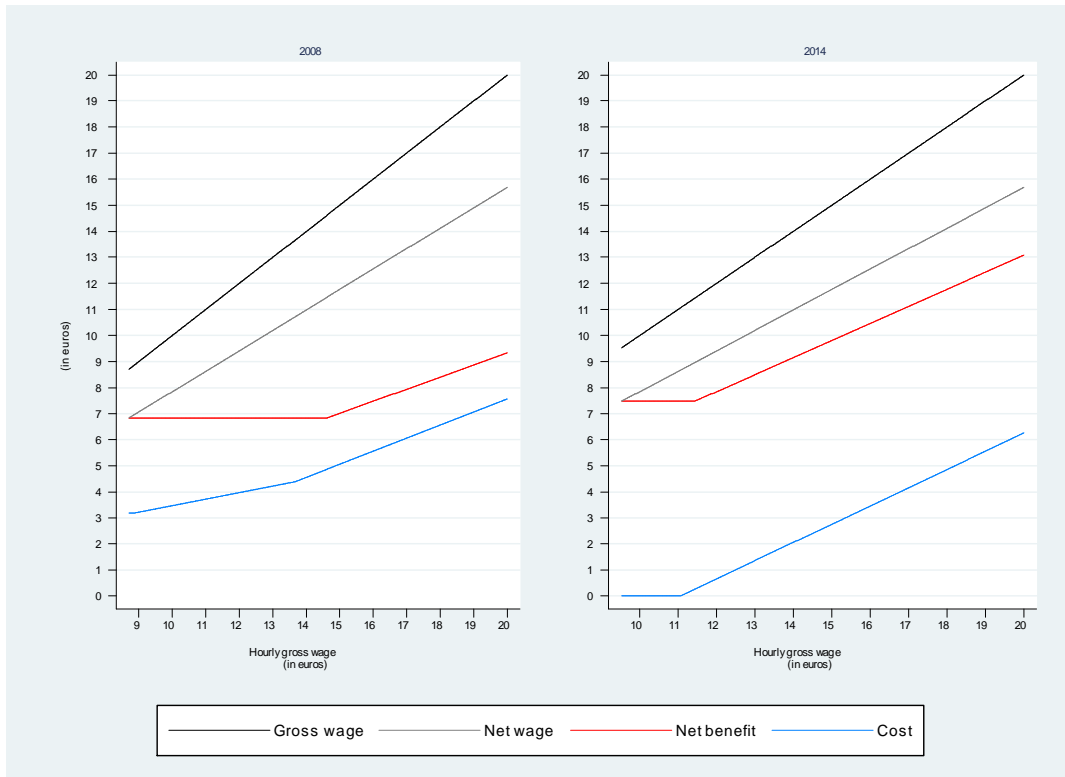


Figure 2: Short-time work benefit and short-time work labor cost in 2008 (left-hand side) and in 2014 (right-hand side).

Note: the origin of the horizontal axis corresponds to the labor cost at the minimum wage level. The net wage is equal to the gross hourly wage minus the employees' social contributions. "Cost" stands for the cost per non-worked hour to the employer. "Net benefit" stands for the net income of employees per non-worked hour.

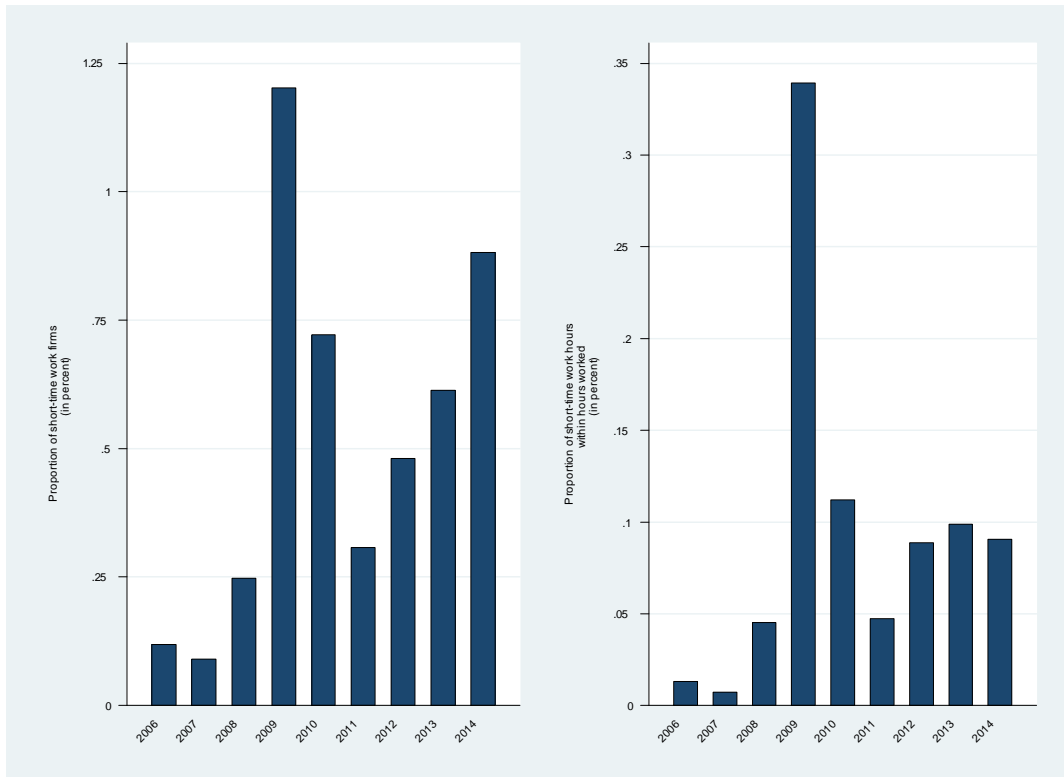


Figure 3: Proportion of short-time work firms (left-hand side) and proportion of short-time work hours within hours worked (right-hand side).

Sources: DADS (Insee), Sinapse (DGEFP) and Extranet (ASP).

Scope: mainland France excluding Corsica; market sectors excluding agriculture; firms using short-time work for economic reasons or not using short-time work at all for any reason over the entire period.

it lies below 0.1% in normal times and reached only 0.34% in 2009.

Moreover, short-time work hours are strongly concentrated in a small subset of firms among short-time work users and a large share of those use short-time work recurrently. In order to precisely define recurrent short-time work use, we distinguish three categories of firms: (i) the occasional, or non-recurrent users, whose consumption spans 1 to 2 years in the last 5 years; (ii) the repeat users, whose consumption spans 3 to 4 years in the last 5 years; (iii) the systematic users, whose consumption spans the last 5 years. As shown by Figure 4, recurrent short-time work has swollen importance both in absolute and relative terms. The number of short-time work hours consumed by systematic users steadily increased from 2 million to more than 10 million from 2006 to 2014. Their weight within overall short-time work hours also expanded: it laid below 50% from 2006 to 2008, it dropped to 25% in 2009 and 2010 (in a countercyclical

Table 1: Systematic short-time work firms in 2008 and in 2014

	Nb of systematic users in 2008	Proportion of systematic users in 2008 which are still systematic users in 2014
Total	486	0.26
Among top 50% users	244	0.30
Among top 10% users	49	0.29
Among top 1% users	5	0.60

Source: DADS (Insee), Sinapse (DGEFP) and Extranet (ASP). Scope: mainland France excluding Corsica; market sectors excluding agriculture; firms using short-time work for economic reasons. Note: There are 2501 systematic users in 2014.

way), and it increased to over 50% after the recession.

The expansion of short-time work has essentially yielded benefits to a small fraction of short-time work firms. As shown by Figure 5, the top 1% of firms using the highest number of short-time work hours used about 50% of all those hours over the period 2006-2014. This is related to the fact that short-time work firms are much larger than non short-time work firms, as shown by Figure 6. Moreover, the size of firms increases with the degree of recurrence of short-time work and systematic users account for a significant portion of the intensive short-time work users.

It is striking that the most important recurrent beneficiaries of short-time work tend to remain present over the whole period 2008-2014 covered by our study, as shown by Table 1. The proportion of systematic short-time work users in 2008 which are still short-time work users in 2014 is quite high and increases as the sample is restricted to the top of the distribution of short-time work users according to the number of short-time work hours in 2008. Overall, a large number of firms that recurrently and massively used short-time work in 2008 appear to remain recurrent users in 2014, highlighting the fact that the pool of recurrent short-time work users barely changes between 2008 and 2014. These firms, which are large, have strong incentives to lobby for the expansion of this scheme and to oppose a system of unemployment insurance with experience rating.

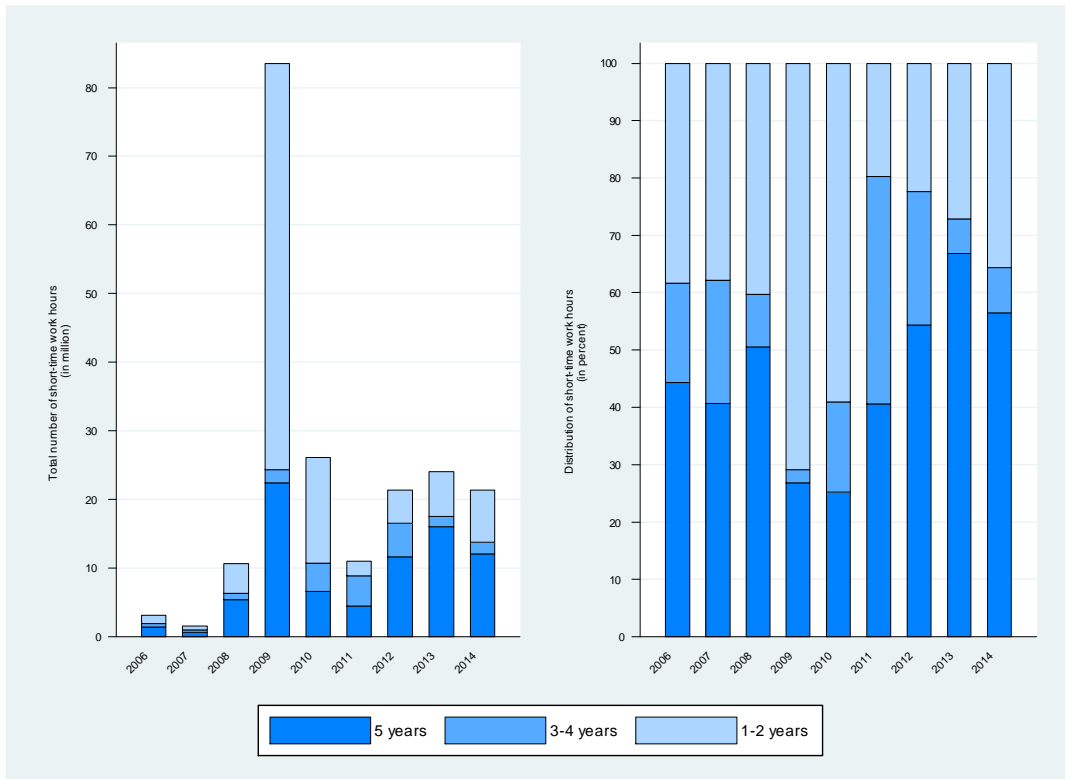


Figure 4: Total number (left-hand side) and distribution (right-hand side) of short-time work hours according to the degree of recurrence of short-time work.

Sources: DADS (Insee), Sinapse (DGEFP) and Extranet (ASP).

Scope: mainland France excluding Corsica; market sectors excluding agriculture; firms using short-time work for economic reasons.

Note: “5 years” stands for the systematic users, whose consumption spans the last 5 years; “3-4 years” stands for the repeat users, whose consumption spans 3 to 4 years in the last 5 years; “1-2 years” stands for the occasional, or non-recurrent users, whose consumption spans 1 to 2 years in the last 5 years.

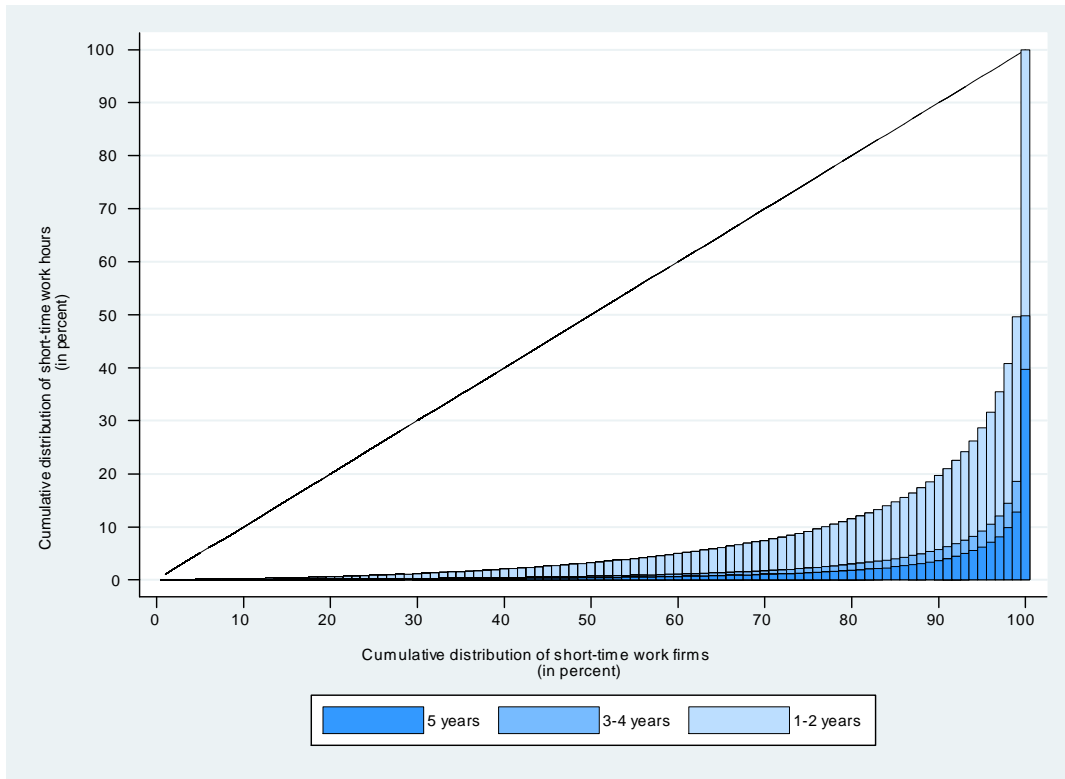


Figure 5: Cumulative distribution of short-time work hours among short-time work firms according to the degree of recurrence of short-time work over the period 2006-2014.

Sources: DADS (Insee), Sinapse (DGEFP) and Extranet (ASP).

Scope: mainland France excluding Corsica; market sectors excluding agriculture; firms using short-time work for economic reasons.

Note: “5 years” stands for the systematic users, whose consumption spans the last 5 years; “3-4 years” stands for the repeat users, whose consumption spans 3 to 4 years in the last 5 years; “1-2 years” stands for the occasional, or non-recurrent users, whose consumption spans 1 to 2 years in the last 5 years.



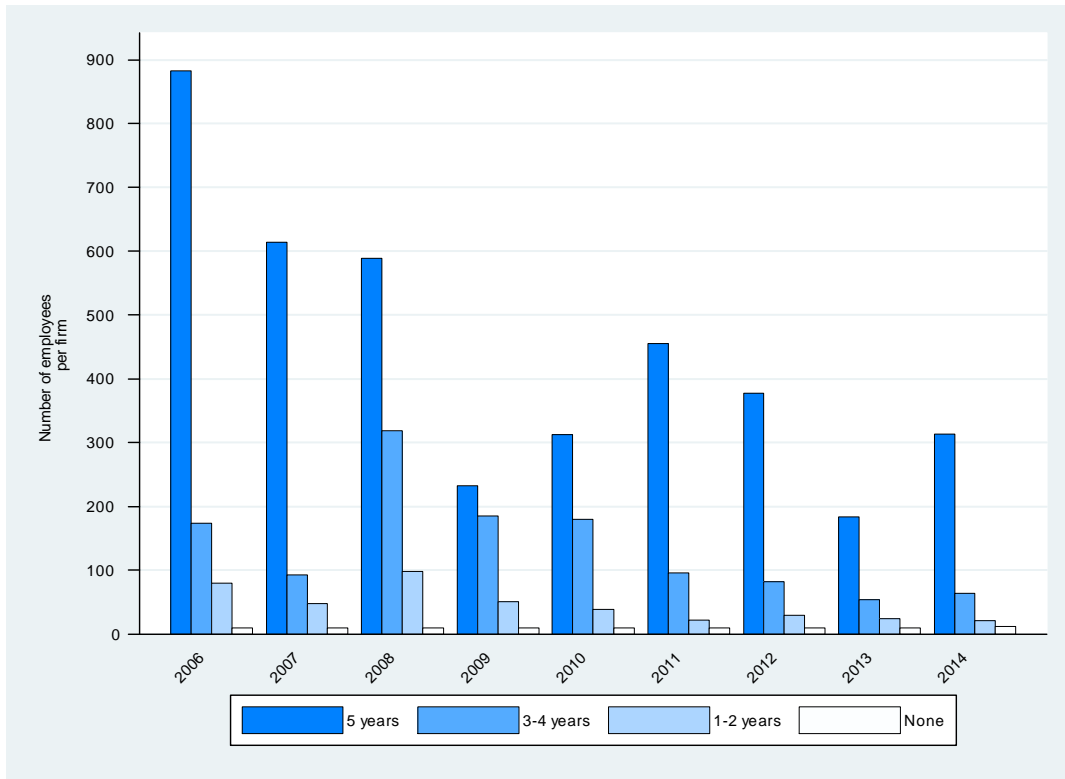


Figure 6: Number of employees per firm according to the degree of recurrence of short-time work.

Sources: DADS (Insee), Sinapse (DGEFP) and Extranet (ASP).

Scope: mainland France excluding Corsica; market sectors excluding agriculture; firms using short-time work for economic reasons (blue) or not using short-time work at all for any reason over the entire period (white).

Note: “5 years” stands for the systematic users, whose consumption spans the last 5 years; “3-4 years” stands for the repeat users, whose consumption spans 3 to 4 years in the last 5 years; “1-2 years” stands for the occasional, or non-recurrent users, whose consumption spans 1 to 2 years in the last 5 years; “None” stands for non-short-time work users.

## 4 Model

In order to analyze the consequences of recurrent short-time work, we present a model of an economy where a subset of firms face seasonal fluctuations in their revenue. Henceforth, we designate these firms as belonging to the seasonal sector. We start by describing the technology of firms and the preferences of workers before defining the social optimum and its implementation in the market economy.

We consider a one period economy in which a final output, which is the numéraire, is produced in quantity  $Y$  with two intermediate products thanks to the technology

$$Y = F(Y_s, Y_n)$$

where  $F$  is a constant returns to scale production function increasing and concave with respect to its two arguments;  $Y_i$  is the quantity of intermediate product  $i = s, n$ . Subscript  $s$  stands for seasonal industry and  $n$  for non-seasonal industry. Intermediate products are produced with labor only. One unit of labor produces one unit of intermediate product per period in each sector. Labor is productive during a fraction  $\lambda \in (0, 1)$  of the period in the seasonal industry and it is productive throughout the period in the non-seasonal industry. Workers produce  $c_0$  units of final output with home production technology in the fraction  $1 - \lambda$  of the year where they are unproductive in the seasonal industry.

The economy is populated by a continuum of measure one of identical workers. They consume the final product. Their preferences are represented by the concave utility function  $u(c_j)$ , where  $c_j$  denotes the quantity of consumption of final product of worker  $j$ . Each worker offers one unit of labor inelastically. Workers irreversibly choose the firm where they work at the start of the period. This assumption accounts for moving costs across jobs in a simple way as it implies that workers who choose to work in firms in the seasonal sector remain attached to their firm when the firm is unproductive. Let  $S$  denote the number of workers in the seasonal industry, the production of intermediate products is

$$Y_n = 1 - S \text{ and } Y_s = \lambda S.$$

## 4.1 Social optimum

The social planner chooses the quantity of labor allocated to each sector and the consumption of each worker that maximize the sum of the utilities subject to the feasibility constraint:

$$\begin{aligned} & \max_{\{c_j, S\}} \int_0^1 u(c_j) dj \\ \text{s.t. } & \int_0^1 c_j dj \leq F(1 - S, \lambda S) + (1 - \lambda)S c_0 \end{aligned}$$

Let us denote by  $\mu$  the multiplier associated with the feasibility constraint. The Lagrangian is

$$L = \int_0^1 u(c_j) dj + \mu \left[ F(1 - S, \lambda S) + (1 - \lambda)S c_0 - \int_0^1 c_j dj \right]$$

The first-order conditions are

$$\begin{aligned} u'(c_j) &= \mu \text{ for all } j \\ F_1(1 - S, \lambda S) &= \lambda F_2(1 - S, \lambda S) + (1 - \lambda)c_0 \end{aligned}$$

where  $F_i, i = 1, 2$ , denotes the partial derivative with respect to argument  $i$ . Thus, the socially optimal allocation is the set  $(\{c_j^*\}, S^*)$  which satisfies:

$$\begin{cases} c_j^* = F(1 - S^*, \lambda S^*) + (1 - \lambda)S^* c_0 & \text{for all } j \\ F_1(1 - S^*, \lambda S^*) = \lambda F_2(1 - S^*, \lambda S^*) + (1 - \lambda)c_0 \end{cases} \quad (1)$$

Henceforth, it is assumed that

$$F_2(1 - S^*, \lambda S^*) > c_0$$

to ensure that workers are more productive when they work on their job during productive periods than when they work at home during unproductive periods.

At the social optimum, workers are fully insured inasmuch as they get the same consumption whether they work in the seasonal or the non-seasonal industry. Workers are allocated between sectors in order to equalize the marginal productivity of labor in each sector. In this context, if the fraction of the year  $\lambda$  when labor is productive diminishes, it is efficient to reduce the share of workers employed in the seasonal industry and to continue providing the same consumption to all workers independently of the sector where they work.

## 4.2 Decentralized equilibrium

In the decentralized economy, all markets are competitive and the timing of decisions is the following. First, the state announces the level of benefits provided to workers in the periods when they are unproductive in the seasonal industry, together with the taxes necessary to fund these expenses. Second, firms announce their labor demand functions. Third, workers choose the industry in which they will work, being aware that this choice is irreversible.

In the decentralized equilibrium, individuals are indifferent between working either in sector  $n$  or in sector  $s$ . An employee of sector  $n$  gets the wage  $w_n$  and consumes all her wage. In sector  $s$  individuals get the wage  $w_s$  when they work and the benefits  $b$  when they are on the dole. Therefore, workers are indifferent as to which sector they choose if the following no-arbitrage condition is fulfilled:

$$u(w_n) = \lambda u(w_s) + (1 - \lambda)u(b + c_0). \quad (2)$$

Let  $p_i$  denote the unit price of intermediate product  $i$ . Profit maximization of firms which produce the final product yields the demands for intermediate products

$$F_1(Y_n, Y_s) = p_n \text{ and } F_2(Y_n, Y_s) = p_s.$$

In the intermediate product industry, firms pay the wage  $w_i$  plus taxes  $t_i$  on labor to fund the benefits paid to workers during unproductive periods in the seasonal industry. It is assumed that firms of the seasonal sector cannot commit to pay workers when they are unproductive. This impossibility can arise, for instance, from the difficulty of verifying by a third party the size of the drop in the revenue of the firm due to unproductive periods or from limited access to credit due to capital market imperfection. Thus, in both intermediate sectors, workers get income from firms only when they work. Assuming unitary returns to effective labor, we can express the profit maximization problem in the intermediate sector  $i$  as

$$\max p_i Y_i - (w_i + t_i) Y_i,$$

which implies that

$$p_i = w_i + t_i, i = n, s.$$

In the decentralized equilibrium, labor demand is equal to labor supply in each industry, implying that  $Y_n = 1 - S$  and  $Y_s = \lambda S$ . Therefore, the decentralized equilibrium value of

$(w_n, w_s, S)$  is defined by the following system:

$$\begin{cases} u(w_n) = \lambda u(w_s) + (1 - \lambda)u(b + c_0) \\ F_1(1 - S, \lambda S) = w_n + t_n \\ F_2(1 - S, \lambda S) = w_s + t_s \end{cases} \quad (3)$$

This decentralized equilibrium is feasible if the budget constraint of the state

$$(1 - \lambda)Sb \leq \lambda S t_s + (1 - S)t_n + \tau \quad (4)$$

is satisfied, where  $\tau$  denotes a lump sum tax.

### 4.3 Social optimum implementation

The government can choose the value of  $(b, t_s, t_n, \tau)$  which implies that the decentralized equilibrium yields the social optimum. Equations (1), (3) and (4) imply that the allocation of the decentralized equilibrium is a social optimum if the following conditions are satisfied:

$$\begin{aligned} b + c_0 &= w_n = w_s = F_1(1 - S^*, \lambda S^*) \\ t_n &= \tau = 0 \\ t_s &= b \frac{1 - \lambda}{\lambda}. \end{aligned}$$

where  $S^*$  designates the socially optimal value of seasonal employment, defined by equation (1).

This result shows that the social optimum is reached with benefits which fully insure workers against the drop in their income during the unproductive periods in the seasonal sector. It is also clear that these benefits have to be financed with full experience rating, since  $t_n = \tau = 0$  and  $t_s = b(1 - \lambda)/\lambda$ . This means that there are no cross-subsidies between sectors. The seasonal sector totally funds the expenses induced by the benefits paid to idle workers. The amount of tax paid by the seasonal industry during the productive periods, equal to  $\lambda t_s S$ , matches the total amount of benefits given to the workers when they are idle, equal to  $(1 - \lambda)bS$ .

In the laissez-faire economy, where  $b = t_n = t_s = t = 0$ , the size of the seasonal industry is too small relative to its socially optimal size because risk aversion implies that workers need a wage premium bigger than the loss of production induced by the unproductive periods in the seasonal industry before they will accept to work in this industry. The size of the seasonal

sector increases monotonically as  $b$  increases from 0 to its socially optimal value if benefits  $b$  are exclusively funded by the seasonal sector.<sup>20</sup>

However, the size of the seasonal sector can be too large if the seasonal sector does not fully fund the benefits. To show this, let us compute the decentralized equilibrium when short-time work provides full insurance,  $b + c_0 = w_n = w_s$ . Labor demands imply

$$F_1(1 - S, \lambda S) - F_2(1 - S, \lambda S) = t_n - t_s. \quad (5)$$

The left hand side is an increasing function of  $S$ . Therefore, starting from a situation of full experience rating, where  $t_s = b(1 - \lambda)/\lambda$  and  $t_n = 0$ , which implements the socially optimal allocation, any decrease in  $t_s$ , associated with an increase in either  $t_n$  or  $\tau$  to satisfy the budget constraint of the state, raises the share of the seasonal industry above its socially optimal value. More generally, there is a non-monotonic relation between aggregate production,  $O = Y + (1 - \lambda)Sc_0$ , and the feasible size of the seasonal sector when  $b$  increases if there is no experience rating, as shown by Figure 7 (see Appendix A).<sup>21</sup>

Our model shows that an efficient policy should provide unemployment insurance benefits funded by experience rated employers' contributions instead of short-time work benefits financed by public expenditure. In the system of unemployment insurance with experience rating, employers can lay their workers off during the unproductive periods but have to pay for the induced cost to unemployment insurance. This system can incentivize employers to keep their employees during unproductive periods. By contrast, if short-time work is strongly experience rated and there is no experience rated unemployment insurance, employers prefer to get rid of

<sup>20</sup>To show this, let us write the no-arbitrage equation (2) at the decentralized equilibrium, assuming that  $t_n = 0$  and that short-time work benefits are funded by the seasonal industry exclusively, i.e.  $t_s = b(1 - \lambda)/\lambda$ . We get

$$u[F_1(1 - S, \lambda S)] = \lambda u \left[ F_2(1 - S, \lambda S) - \frac{1 - \lambda}{\lambda} b \right] + (1 - \lambda)u(b + c_0).$$

Differentiation with respect to  $S$  and  $b$  yields

$$\frac{dS}{db} = \frac{(1 - \lambda)[u'(b + c_0) - u'(w_s)]}{u'(w_n)(\lambda F_{12} - F_{11}) + \lambda u'(w_s)(F_{21} - \lambda F_{22})}.$$

The numerator is positive if  $b + c_0 < w_s$ . Since the production function is continuously twice derivable and homogeneous of degree 1, we have  $F_{12} = F_{21} > 0$ . This implies that the denominator of this expression is positive.

<sup>21</sup>Note that there exists a value of  $b$  which induces the socially optimal size of the seasonal sector  $S^*$  in Figure 7. However, the allocation is not socially optimal because workers are not fully insured (i.e.  $b + c_0 < w$ ) for this value of  $b$ .

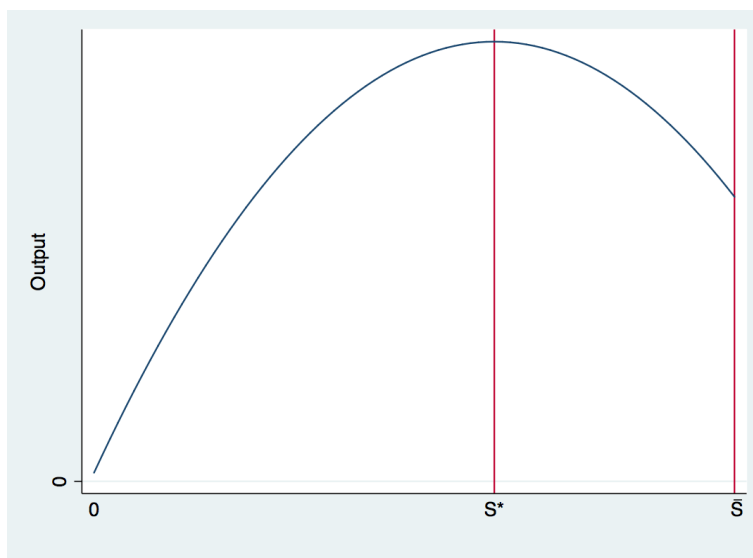


Figure 7: The relation between the size of the seasonal sector and output.

Note:  $S^*$  stands for the size of the seasonal industry at the social optimum and  $\bar{S}$  at its maximum size, which arises when short-time work provides full insurance to workers and short-time work is not experience rated.

their employees during unproductive periods in order to avoid paying the cost associated with short-time work. Obviously, if short-time work is strongly funded by the state and induces very small cost to the employers, short-time work becomes attractive for employers and short-time work is then a means to insure workers. However, this is an inefficient way to provide insurance, as it entails cross-sector subsidies which induce a seasonal sector that is too large ( $\bar{S}$  on Figure 7) relative to its socially optimal level. Nevertheless, after the recession, under pressure from industries in a position to benefit from short-time work subsidies, the French reforms have implemented a short-time work scheme strongly funded by the state and inducing a very small cost to the employers. The next section evaluates the cost of this inefficient strategy.

## 5 The evaluation of the cost of inefficient short-time work

The reforms passed after the great 2008-2009 recession aimed at boosting short-time work by reducing its cost to the employers while providing generous replacement incomes to short-time

work employees. Thanks to these reforms, the cost of short-time work to employers dropped dramatically (see Figure 2). In this section, we compare the level of aggregate output after the reforms with the level of output that could be achieved with perfect unemployment insurance and full experience rating, which corresponds to the socially optimal allocation.

At low wage levels, short-time work employees have a very small income drop over the whole 2002-2014 period. In the neighborhood of the minimum wage, there is no income drop (see Figure 2). As short-time work employees are concentrated on the low part of the wage distribution, the case where short-time work employees are fully insured is a relevant approximation of the situation of French workers. At this wage level, the short-time work cost to employers is equal to zero. In this case, the aggregate production loss with respect to the case where there is perfect insurance with full experience rating is (see Appendix B):

$$\Delta O \simeq -\frac{1}{2} (\text{Short-time work public expenditure targeted at systematic users}) \quad (6)$$

The short-time work public expenditure targeted at systematic users comprises the benefits  $b$  paid to idle workers. Equation (6) shows that the short-time work public expenditure has a negative impact on output, with respect to the socially optimal allocation (see Figure 7). Output is lower than at the socially optimal allocation because employment is higher in the seasonal sector, where workers are less productive, when workers are insured with short-time work benefits financed by public expenditure. This mechanism entails major production losses as each euro of short-time work expenditure entails a drop in production of about 0.5 euro.

According to equation (6), the production loss induced by systematic short-time work users can be computed merely from their short-time work subsidies. As shown by Figure 8, systematic short-time work users obtained about 55% of total short-time work subsidies after the reforms. Therefore, the output loss induced by the short-time work subsidies targeted at systematic users is equal to  $0.5 \times 0.55 \simeq 0.27$  times the total public expenditure on short-time work. As public expenditure on short-time work reached about 150 million euros in 2014, after the reforms (see Figure 1), the production loss induced by short-time work amounts to about 40 million euros in 2014.

This is a conservative evaluation, for several reasons. First, a less restrictive definition of recurrent users, including repeat users, who use 60% of total short-time work expenditure, entails an output loss equal to 30% of the change in short-time work public expenditure instead of 27%. Second, our model assumes that the number of short-time work hours per employee



does not depend on the cost of short-time work to employers. The only source of production loss is the displacement of workers from the non-seasonal to the seasonal sector. Including the adjustment of hours of work would increase the production loss induced by short-time work. Third, as the evaluation focuses on recurrent short-time work only, production losses due to the drop in hours of work of non-recurrent short-time work users are neglected.

All in all, it is clear that French reforms to short-time work have not been efficient inasmuch as they have greatly benefited recurrent short-time work users. Now, it is certainly desirable to limit the expansion of short-time work on the part of recurrent users. This can be achieved by increasing the short-time work cost to the employers. The increase in the short-time work cost to the employers should be complemented by mandatory unemployment insurance with experience rating, which is more efficient than short-time work at providing insurance to workers employed in seasonal industries. Our analysis suggests that its implementation would increase output significantly. Obviously, current systematic short-time work users are likely to strongly oppose this reform.

## 6 Conclusion

This paper shows that the French reforms aimed at boosting short-time work after the great 2008-2009 recession have entailed sizeable inefficiencies. These reforms have greatly benefited large firms which are recurrent short-time work users, and have entailed large production losses with respect to a socially optimal allocation, implemented with experience rated unemployment insurance.

This result does not mean that short-time work is useless when combined with unemployment insurance. Short-time work can be useful when firms have limited access to credit due to capital market imperfection.<sup>22</sup> However, more research is needed to gain a better understanding of the optimal way to integrate short-time work and unemployment insurance in a dynamic context with imperfect capital market, when employment can be adjusted at the intensive and the extensive margins.

---

<sup>22</sup>Cahuc, Kramarz and Nevoux (2017).

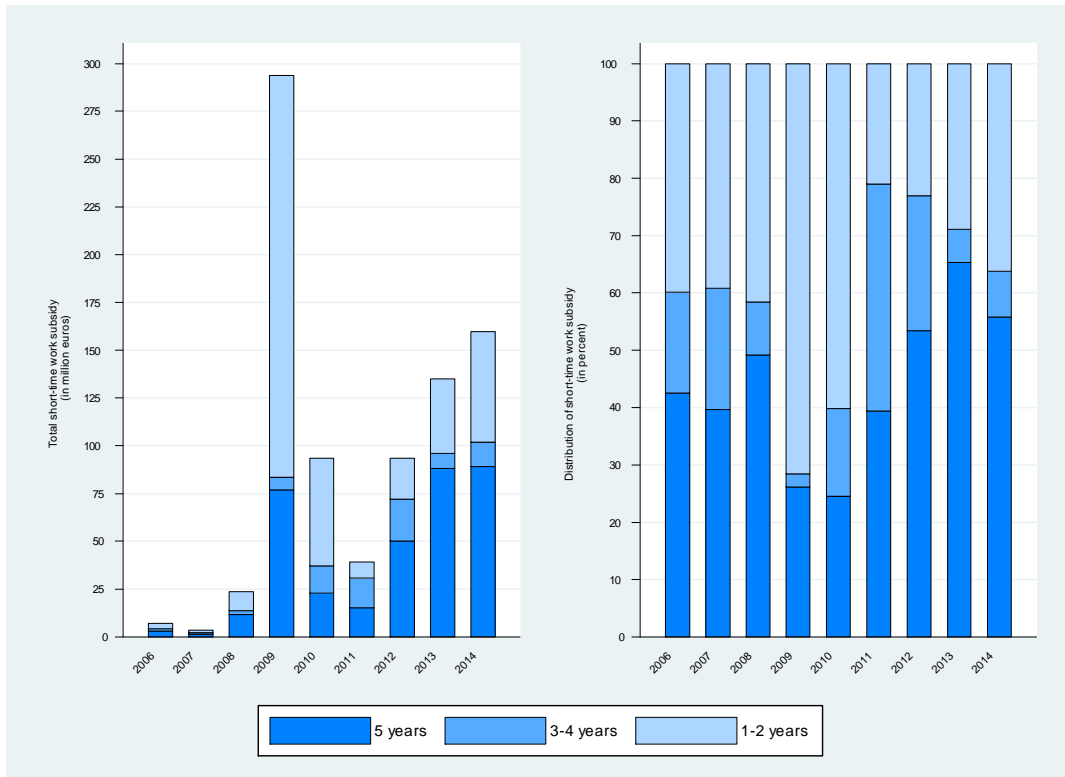


Figure 8: Total (left-hand side) and distribution (right-hand side) of short-time work subsidy according to the degree of recurrence of short-time work.

Sources: DADS (Insee), Sinapse (DGEFP) and Extranet (ASP).

Scope: mainland France excluding Corsica; market sectors excluding agriculture; firms using short-time work for economic reasons.

Note: “5 years” stands for the systematic users, whose consumption spans the last 5 years; “3-4 years” stands for the repeat users, whose consumption spans 3 to 4 years in the last 5 years; “1-2 years” stands for the occasional, or non-recurrent users, whose consumption spans 1 to 2 years in the last 5 years.

## References

- [1] Abraham, K. G. and Houseman, S. N. 1993. Does Employment Protection Inhibit Labor Market Flexibility? Lessons from Germany, France and Belgium, *NBER Working Paper*, No. 4390, National Bureau of Economic Research.
- [2] Abraham, K. G. and Houseman, S. N. 2014. Short-Time Compensation as a Tool to Mitigate Job Loss? Evidence on the U.S. Experience during the Recent Recession, *Industrial Relations*, Vol. 53(4), pp. 543-567.
- [3] Balleer, A., Gehrke, B., Lechthaler, W. and Merkl, C. 2016. Does Short-Time Work Save Jobs? A Business Cycle Analysis, *European Economic Review*, Vol. 84, pp. 99-122.
- [4] Bellmann, L. and Gerner, H. D. 2011. Reversed Roles? Wage and Employment Effects of the Current Crisis. In: Immervoll, H., Peichl, A. and Tatsiramos, K. (eds.), Who Loses in the Downturn? Economic Crisis, Employment and Income Distribution, *Research in Labour Economics*, Vol. 32, Bingley: Emerald, pp. 181-206.
- [5] Bellman, L., Gerner, H. D. and Upward, R. 2015. The Response of German Establishments to the 2008-2009 Economic Crisis. In: Commendatore, P., Kayam, S. and Kubin, I. (eds.), Complexity and Geographical Economics, *Dynamic Modeling and Econometrics in Economics and Finance*, Vol. 19, Heidelberg: Springer, pp. 165-207.
- [6] Blanchard, O. and Tirole, J. 2007. The Optimal Design of Unemployment Insurance and Employment Protection: A First Pass, *Journal of the European Economic Association*, Vol. 6(1), pp. 45-77.
- [7] Boeri, T. and Bruecker, H. 2011. Short-time Work Benefits Revisited: some Lessons from the Great Recession, *Economic Policy*, Vol. 26, Issue 68, pp. 697-765.
- [8] Braun, H. and Brügemann, B. 2014. Welfare Effects of Short-Time Compensation, *IZA Discussion Papers*, No. 8597, German Institute for Labor Economics (IZA).
- [9] Brey, B. and Hertweck, M. 2016. The Extension of Short-Time Work Schemes during the Great Recession: A Story of Success?, *Working Paper Series of the Department of Economics*, No. 2016-05, University of Konstanz.

- [10] Brunet, S., Dorge, P., Geneslay, J.-P. and Biehler, M. 2009. Activité Partielle de Longue Durée : Prévenir les Licenciements et Préparer l’Avenir, *Rapport du Groupe de Travail, Secrétariat d’État à l’Emploi*.
- [11] Burdett, K. and Wright, R. 1989. Unemployment Insurance and Short-Time Compensation: The Effects on Layoffs, Hours per Worker, and Wages, *Journal of Political Economy*, Vol. 97, No. 6, University of Chicago.
- [12] Cahuc, P. and Carcillo, S. 2011. Is Short-Time Work a Good Method to Keep Unemployment Down?, *Nordic Policy Review*, Vol. 1(1), pp. 133-165.
- [13] Cahuc, P., Kramarz, F. and Nevoux, S. 2017, Short-time Work and Employment in the Great Recession in France, Manuscript, Center of Recherche in Economics and Statistics (CREST).
- [14] Cahuc, P. and Zylberberg, A. 2008. Optimum Taxation and Layoff Taxes, *Journal of Public Economics*, Vol. 92, pp. 2003–2019.
- [15] Calavrezo, O., Duhautois, R. and Walkowiak, E. 2010. Short-Time Compensation and Establishment Exit: An Empirical Analysis with French Data, *IZA Discussion Papers*, No. 4989, German Institute for Labor Economics (IZA).
- [16] Calavrezo, O. and Lodin, F. 2012. Short-Time Working Arrangements in France During the Crisis: An Empirical Analysis of Firms and Employees, *Comparative Economic Studies*, No. 54.
- [17] Cooper, R., Meyer, M. and Schott, I. 2017, The Employment and Output Effects of Short-Time Work in Germany, NBER Working Paper N° 23688. National Bureau of Economic Research (NBER).
- [18] Feldstein, M. 1976. Temporary Layoffs in the Theory of Unemployment, *Journal of Political Economy*, Vol. 84, pp. 937–957.
- [19] Hamermesh, D. 2013. Does Labor Cost Affect Companies’ Labor Demand, and Who Cares?, *IZA World of Labor*, German Institute for Labor Economics (IZA).

- [20] Hijzen, A. and Martin, S. 2012. The Role of Short-Time Working Schemes During The Global Financial Crisis and Early Recovery: A Cross-Country Analysis. *OECD Social, Employment and Migration Working Papers*, OECD Publishing, Organization for Economic Cooperation and Development (OECD).
- [21] Hijzen, A. and Venn, D. 2011. The Role of Short-Time Work Schemes during the 2008-2009 Recession, *OECD Social, Employment and Migration Working Papers*, No. 115, OECD Publishing, Organization for Economic Cooperation and Development (OECD).
- [22] Kruppe, T. and Scholz, T. 2014. Labour Hoarding in Germany: Employment Effects of Short-Time Work during the Crises, *IAB-Discussion Paper*, No. 17/2014, German Institute for Employment Research (IAB).
- [23] Neumark, D. 2013. Spurring Job Creation in Response to Severe Recessions: Reconsidering Hiring Credits, *Journal of Policy Analysis and Management*, Vol. 32, No. 1, pp. 142-71.
- [24] Niedermayer, K. and Tilly, J. 2016. Getting Paid Not to Work: Employment and Welfare Effects of Short-Time Work in Germany, *mimeo*.
- [25] Restuccia, D. and Rogerson, R. 2017. The Causes and Costs of Misallocation, *Journal of Economic Perspectives*, vol 31(3), pp. 151-174.
- [26] Van Audenrode, M.A. 1994. Short-time Compensation, Job Security, and Employment Contracts: Evidence from Selected OECD Countries, *Journal of Political Economy*, Vol. 102, No. 1, University of Chicago.

## A The relation between aggregate production and the size of the seasonal sector in the absence of experience rating

This appendix describes the relation between aggregate production,  $O = Y + (1 - \lambda)Sc_0$ , and the size of the seasonal sector when the change in the size of the seasonal sector is induced by changes in the benefits  $b$  provided to idle workers in the absence of experience rating. It is assumed that the benefits  $b$  are financed by the lump-sum tax  $\tau$ . The equilibrium size of seasonal employment is determined by

$$u(F_1(1 - S, \lambda S)) = \lambda u(F_2(1 - S, \lambda S)) + (1 - \lambda)u(b + c_0) \quad (7)$$

Equation (7) defines the function  $S(b)$  which fulfills

$$F_1(1 - S(b), \lambda S(b)) - \lambda F_2(1 - S(b), \lambda S(b)) - (1 - \lambda)c_0 = \phi(b) \quad (8)$$

where  $\phi$  is a function whose properties are defined below. These properties are defined for  $b \in [0, F_2(1 - \bar{S}, \lambda \bar{S}) - c_0]$ , where

$$\bar{S} = \{S : F_1(1 - S, \lambda S) = F_2(1 - S, \lambda S)\}, \quad (9)$$

assuming that  $F_2(1 - \bar{S}, \lambda \bar{S}) > c_0$  to ensure that the marginal worker produces more when she works in the seasonal sector during productive periods than at home during unproductive periods. The properties of function  $\phi$  are:

1.  $\phi'(b) > 0$ , because differentiation of equation (7) implies that  $dS/db > 0$ ;
2.  $\phi(0) < 0$ , because, when  $b = 0$ , equation (7) together with the concavity of the utility function  $u$  implies that  $F_1(1 - S, \lambda S) < \lambda F_2(1 - S, \lambda S) + (1 - \lambda)c_0$ ;
3.  $\phi(F_2(1 - \bar{S}, \lambda \bar{S}) - c_0) = (1 - \lambda)[F_2(1 - \bar{S}, \lambda \bar{S}) - c_0] > 0$ , because equation (7) implies that  $S = \bar{S}$  when  $b = F_2(1 - \bar{S}, \lambda \bar{S}) - c_0$ , then, as  $\bar{S}$  satisfies  $F_1(1 - \bar{S}, \lambda \bar{S}) = F_2(1 - \bar{S}, \lambda \bar{S})$ , equation (8) implies that  $\phi(b) = (1 - \lambda)[F_2(1 - \bar{S}, \lambda \bar{S}) - c_0]$  when  $b = F_2(1 - \bar{S}, \lambda \bar{S}) - c_0$ ;
4.  $\phi(b) = 0 \Leftrightarrow S = S^*$ , which is immediate from equation (7) defining  $S^*$

$$F_1(1 - S^*, \lambda S^*) = \lambda F_2(1 - S^*, \lambda S^*) + (1 - \lambda)c_0. \quad (10)$$

and equation (8).

Equations (10) and (9) imply that  $\bar{S} > S^*$  because equation (10) can be written as  $F_1(1 - S^*, \lambda S^*) - F_2(1 - S^*, \lambda S^*) = (1 - \lambda)[c_0 - F_2(1 - S^*, \lambda S^*)] < 0$  which implies that  $S^* < \bar{S}$  since  $F_1(1 - S, \lambda S) - F_2(1 - S, \lambda S)$  increases with  $S$  and  $F_1(1 - \bar{S}, \lambda \bar{S}) - F_2(1 - \bar{S}, \lambda \bar{S}) = 0$ . Therefore, we have  $\bar{S} > S^* > S(0)$  and the properties of  $\phi(b)$  imply that:  $\phi(b) < 0 \Leftrightarrow S(b) < S^*$  and  $\phi(b) > 0 \Leftrightarrow S(b) > S^*$ .

The derivative of aggregate production,  $F(1 - S, \lambda S) + (1 - \lambda)Sc_0$ , with respect to  $S$  is

$$-F_1(1 - S, \lambda S) + \lambda F_2(1 - S, \lambda S) + (1 - \lambda)c_0$$

From equation (8), this term is equal to  $-\phi(b)$ . Therefore, aggregate production increases with  $b$  if  $S(b) < S^*$  and decreases with  $b$  if  $S(b) > S^*$  (see Figure 7).

## B The evaluation of the cost of inefficient short-time work

This appendix presents the impact on aggregate production of changes in the size of the seasonal sector induced by changes in the share of the contributions of employers in the seasonal sector to the cost of short-time work when workers are fully insured (i.e.  $b + c_0 = w$ ), assuming, for the sake of simplicity, that the short-time work expenditure is financed with lump-sum tax  $\tau$  in the absence of experience rating (i.e.  $t_s = t_n = 0$ ). The supplementary cost per unit of labor in the seasonal sector induced by the contribution at rate  $\alpha$  is equal to  $\alpha(1 - \lambda)b/\lambda$ , so that the tax per unit of labor in the seasonal sector is equal to  $\alpha(1 - \lambda)b/\lambda$ . In this context, drops in  $\alpha$  decrease the labor cost in the seasonal sector, which leads to increased employment in that sector at the expense of the non-seasonal sector.

The impact of changes in the size of the seasonal sector on aggregate output,  $O = F(1 - S, \lambda S) + (1 - \lambda)c_0$ , can be computed as:

$$dO = [-F_1(1 - S, \lambda S) + \lambda F_2(1 - S, \lambda S) + (1 - \lambda)c_0]dS \quad (11)$$

From profit maximization, we get  $F_1(1 - S, \lambda S) = w$ ,  $F_2(1 - S, \lambda S) = w + \alpha(1 - \lambda)b/\lambda$ . Perfect insurance implies that  $b = w - c_0$ . Substituting these relations in equation (11) yields:

$$\frac{dO}{dS} = -(1 - \alpha)b(1 - \lambda) \quad (12)$$

We compute the change in output induced by changes in the size of the seasonal sector in the neighborhood of  $\bar{S}$ , where  $\alpha = 0$  (see equation (9)). Evaluating the impact of  $S$  on aggregate output from equation (12) using the slope of the relation between output and  $S$  at  $\bar{S}$  (see Figure 7) over-estimates the impact of changes in  $S$  on aggregate output when  $\alpha$  goes from 0 to 1, or equivalently, when  $S$  goes from  $\bar{S}$  to  $S^*$ . In order to approximate the production loss induced by the short-time work expenditure with no experience rating with respect to the socially optimal allocation  $S^*$ , we evaluate  $dO/dS$  at  $\alpha = 1$  in equation (12), and we use the average of  $dO/dS$  evaluated at these two values, i.e.  $\alpha = 1$  and  $\alpha = 0$ . We get

$$\frac{\Delta O}{\Delta S} \simeq -\frac{b}{2}(1 - \lambda).$$