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THE SHORT-TIME COMPENSATION PROGRAM IN FRANCE: AN EFFICIENT MEASURE AGAINST REDUNDANCIES?

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ABSTRACT

The short-time compensation (STC) program aims at avoiding redundancies in case of short-term downturns. This paper investigates the relationship between the STC recourse and establishment redundancy behaviour over the period 1996-2004. We test panel data models with sample selection, endogenous explanatory variable and unobserved heterogeneity developed by Semykina and Wooldridge (2007). We work with an unbalanced panel which results from the matching of five administrative databases. Our panel includes more than 36,000 establishments with at least 50 employees and 204,000 observations. According to our results, the participation in the STC program does not protect from redundancies.

Key words: Short-time compensation program, redundancies, fixed effects, instrumental variables, sample selection.

Codes JEL : J20, J63, C23

Chômage partiel et licenciements économiques

Résumé

Le chômage partiel est un dispositif légal qui permet aux établissements d'éviter les licenciements économiques en cas de difficultés passagères. Mais est-ce réellement le cas ? Notre papier analyse le lien entre le recours au chômage partiel et les licenciements économiques entre 1996 et 2004. Nous estimons l'effet du chômage partiel sur les licenciements économiques à l'aide de modèles en données de panel développés par Semykina et Wooldridge (2007). Nous travaillons avec un panel non-cylindré qui est obtenu en appariant cinq sources de données. L'échantillon final contient plus de 36 000 établissements d'au moins 50 salariés. Selon nos travaux, le recours au chômage partiel ne protège pas des licenciements économiques.

Mots-clefs : *chômage partiel, licenciements économiques, effets fixes, variables instrumentales, biais de selection.*

INTRODUCTION[1]

This paper investigates the relationship between the short-time compensation (STC) recourse and establishment redundancy behavior in France between 1996 and 2004 and discusses the efficiency of the program. STC is a protective device since it aims at avoiding redundancies in case of short-term downturns or exceptional circumstances (disasters, important building work and restructuring, supplying difficulties). Most developed countries propose a STC program to avoid redundancies: The "chômage partiel" device in France, the Italian "Cassa Integrazione Guadagni", the German "Kurzarbeitergeld", the "Short-Time Compensation Program" (United States). By applying STC, French establishments can temporarily reduce their activity below the legal working time or stop a part or their entire activity. STC allows employees to keep a contractual bond with their employer. Employees perceive a compensation for their wage loss caused by the temporary interruption of activity. Although STC programs in North America are relatively new and underutilized, they have been widespread in Europe since the 1920s. However, in both regions, STC remains a rare phenomenon. For example, between 1995 and 2005, STC authorizations affected less than 1% of French establishments and 2% of their employees (Calavrezo et al., 2007).

From a theoretical perspective, STC literature (Burdett and Wright, 1989; Abraham and Houseman, 1994; Van Audenrode, 1994) clearly distinguishes the security and flexibility roles of STC programs, which differentiate North America and continental Europe. Because it is more difficult to fire a worker in the continental European countries, STC has a more important flexibility role. The argument holds for France and explains why French firms use STC as an internal flexibility device. Abraham and Houseman (1994) argue that STC constitutes a cheaper labour force adjustment device than redundancies in France. The flexibility role of STC is not a predominant characteristic of the US system. External flexibility is there less expensive and the STC program is relatively more costly than in Europe: STC mainly fills its job security role.

From an empirical perspective, analyses of the efficiency of STC programs lead to mitigated results. Although STC has been in place longer and more extensively in Europe, studies conducted in North America have been more consistent. Results are not directly comparable since devices are quite different. But according to European and Canadian experiences, the STC program would avoid or delay redundancies, while in the US experience, STC would not fulfil its job protection role.

Compared with the US, the STC program essentially improves workforce adjustments in Europe (Abraham and Houseman, 1994). This flexibility role passes through an increase in work sharing and avoids redundancies (Burdett and Wright, 1989). The French case offers a good example of this "work sharing effect" associated with STC. In France between 1995 and 2005, the working time reduction (WTR) policy represented an important shock which influenced the STC recourse. It led to a fall in the STC recourse. This evolution is due to a substitution effect between STC and WTR. The WTR policy would have refocused STC on

[1] This paper is a prolongation of a project financed by the Statistical Department of the French Labour Ministry (DARES). We would like to thank Marianne Cornu-Pauchet for her useful suggestions. We would also like to thank Jean-Paul Pollin, Régis Breton, Christophe Hurlin, Sébastien Ringuedé, Emmanuel Duguet and Alberto Lopez, as well as participants at the 2008 Latin American Meeting of Econometric Society, the 20th EALE conference, the 2008 CAED Conference, the 2008 JMA Conference and the 57th AFSE conference. All remaining errors and shortcomings remain our own.

its initial job protection role (Calavrezo et al., 2007). Vroman (1992) studies the efficiency of STC between 1970 and 1991 in Germany. He shows that STC stabilizes employment in the short-term, but its effects do not necessarily last over time. The Canadian Ekos research (1993) provides similar results. Canadian employers report that on average, STC firms would have laid off for economic reasons 40% of their workforce in absence of STC. However, Canadian employers finally laid off for economic reasons 12% of their employees after program participation. The Ekos research also suggests that STC does not fully avoid redundancies but reduces them significantly.

Discussions on how STC affects redundancies in the US only inform in an indirect way of the debate in Europe. Kerachsky et al. (1986) determine whether a STC use in cyclical situations implies higher costs for the unemployment insurance system than outright redundancies in three States (Oregon, California and Arizona). They show that redundancies remain predominant in STC firms. However, Schiff (1986) and Morand (1990) qualify this conclusion because they disapprove the methodology of the counterfactuals used by Kerachsky et al. (1986). Needels et al. (1997) also come to similar conclusions when they analyse the impact of STC on mass redundancies in five States (California, Florida, Kansas, New-York and Washington). STC firms are more likely to undergo large-scale workforce reductions than others, even when controlling for observable characteristics. Abraham and Houseman (1994) put these results into perspective by showing that unemployment effects depend on the redundancy subsidy.

Our contribution is empirical. We test panel data models with sample selection, endogenous explanatory variable and unobserved heterogeneity on an unbalanced panel of more than 36,000 establishments with at least 50 employees. Our work is an application of a recent econometric panel data model developed by Semykina and Wooldridge (2007). We use a rich dataset obtained by matching five administrative data sources. The sample contains approximately 204,000 observations.

The rest of the paper proceeds as follows. Section 2 describes the data used. Section 3 presents the empirical strategy. The results are presented and discussed in section 4, while Section 5 offers some concluding remarks.

1. DATA

We use an original statistical dataset obtained from matching five administrative databases[2] (Appendix 1 precisely explains the construction of the different indicators used in this work).

Monthly STC authorization databases: When facing a strong economic downturn an employer can ask for a number of STC days. If the request is justifiable, the French administration authorizes the use of STC. Files give information about the STC authorizations obtained by French establishments between 1995 and 2005. The authorized STC imperfectly measures the compensated STC that establishments really use and for which they get a financial compensation. Indeed some establishments can decide not to use the STC authorized days. In the database, the number of compensated days is not available at establishment or firm level. Thus, we measure the number of authorized STC days. It is the superior limit of the compensated days which represents an indicator of the employer anticipations. From these databases we constitute

[2] They are produced by the Statistical Department of the French Labour Ministry (Dares) and the French National Institute of Statistics (Insee).

an exhaustive STC panel. It covers more than 93,000 French establishments in all industries, which have at least one STC authorization between 1995 and 2005. This panel provides for each establishment *i* and for each year *t* information on the STC authorized days (STC_days_{it}), the number of employees concerned by the authorizations (STC_emp_{it}) and the average STC duration per employee (AP_STC_{it}).

The "Déclarations des Mouvements de Main-d'Œuvre" (DMMO) files are quarterly exhaustive administrative databases over the period 1996-2004. They measure all workforce movements for establishments with at least 50 employees. These files inform about all the workers' entries and exits and also give establishment industry and establishment size (EST_size_{it}). We calculate the annual number of redundancies (RED_{it})[3].

The "Working Time Reduction" database contains the declarations and the agreements of establishments which reduced their effective working time in order to benefit from the social security exemption. WTR_{it} is a dummy variable which indicates if an establishment reduced its working time.

Firm databases (the "Bénéfices Réels Normaux" files) give information about the firms to which establishments belong to over the period 1994-2003. They contain firm size (F_size_{it}) and various economic indicators: Value-added (VA_{it}); capital investment (K_INV_{it}); firm profit (Π_{it}).

Establishment files (UNEDIC) are annual exhaustive administrative sources relating to establishments affiliated to the unemployment insurance system over the period 1995-2003. These files contain information about establishment size.

We impose five stages in the "cleaning" process of the data. The first stage consists in replacing missing values of the establishment size calculated from the DMMO databases with the values from the UNEDIC files (only if the information regarding redundancies is available). In the second stage, we erase establishments which have two or more years with missing values on the 1996-2004 period. For establishments with a missing year, we replace the absent values for firm size, value-added, capital investment, firm profit and establishment size by the means of these variables calculated on the previous and next year. Concerning the number of redundancies, we replace the missing values by 0 because calculating the mean for redundancies is meaningless. In the third stage, we control for outliers for the Var_VA_{it} and PR_{it} indicators. For the variation of value-added rate, we remove establishments which have at least for one year a value-added rate lower than -500% or greater than 500%. Establishments with annual profitability rate values out of the interval [-200%, 200%] are also eliminated. In the fourth stage, due to their small proportion among STC establishments, establishments belonging to the following four industries are removed: Electricity, gas and water supply industry; financial intermediation; real estate activities and administration. For the same motivation, we also group together the "personal services" industry and the "education and health" industry. In the last stage, we pay a particular attention to establishments which have 0 employees[4]. This is due to registration delays because the establishment has just opened or it has just closed. This type of value needs a particular control. We remove establishments which have 0 employees for one year but have redundancies. For establishments which have a

[3] For the robustness of the results we also calculate dummies for the presence of redundancies and mass redundancies (see appendix 1).

[4] According to the data collecting rules, establishment size can be inferior to 50 employees.

number of redundancies greater than the number of employees, we replace establishment size with establishment size of the previous year[5]. The final check is on establishment size. We decide to remove establishments that have a strong increase (or a strong decrease) of at least 50 employees for two following years and have an initial (respectively final) size inferior to 10 employees. We remove 31 incoherent establishments.

Table 1: Descriptive statistics

Variable	Description	Global sample (204,396 obs.)	STC establishments (9,132 obs.)	Non-STC establishments (195,264 obs.)
STC	Dummy for STC participation	0.04	1.00	
		(0.21)		
STC_days	STC authorized days	88.19	1974.01	
		(2228.86)	(10367.26)	
STC_emp	Employees affected by STC authorizations	4.75	106.42	
		(80.00)	(363.93)	
AP_STC	Average period of STC affectation per employee	0.32	7.11	
		(1.87)	(5.47)	
LAY	Dummy for presence of redundancies	0.19	0.39	0.18
		(0.39)	(0.49)	(0.39)
LAY10	Dummy for presence of mass redundancies	0.03	0.10	0.02
		(0.16)	(0.30)	(0.15)
RED	Number of redundancies	1.25	4.76	1.08
		(8.09)	(20.20)	(6.99)
WTR	Dummy for WTR not for defensive reasons	0.31	0.16	0.31
		(0.46)	(0.37)	(0.46)
EST_size	Establishment size	176.50	219.75	174.48
		(332.52)	(658.51)	(308.82)
Var_F_size 1	Firm size variation rate (lagged by one year)	0.03	-0.002	0.03
		(0.25)	(0.20)	(0.25)
Var_VA1	Value-added variation rate (lagged by one year)	0.05	-0.01	0.05
		(0.34)	(0.32)	(0.34)
PR1	Profitability rate (lagged by one year)	0.22	0.13	0.22
		(0.35)	(0.32)	(0.35)

***Note*:** Sample standard deviations are in parentheses below sample averages.
***Field*:** French establishments with at least 50 employees.

By merging the five datasets we finally work with an unbalanced panel of more than 36,000 establishments with at least 50 employees, which contains around 204,000 observations and covers the 1996-2004 period[6].

Table 1 presents descriptive statistics for the main variables. Since we work with establishments with at least 50 employees, average establishment size on the total sample is quite high

[5] There are only 279 observations in this situation. These situations are due to the fact that we summed up the number of redundancies over the year, but we are working with the average establishment size over the quarters.

[6] Establishments with at least 50 employees cover 70% of the total number of employees concerned by STC and approximately 64% of the total number of STC authorized days on the period 1996-2004.

(177 employees). STC establishments are bigger than the non-STC establishments (220 against 174 employees). Establishments also differ in average as regards to their working time reduction (WTR) behaviour. Fewer STC establishments reduce their working time (by nearly 16%) in comparison with non-STC establishments (31%). This result confirms the conclusions of Calavrezo et al. (2007) paper. Table 1 points out that STC establishments have more economic difficulties in comparison with non-STC establishments. STC establishments have negative average firm size variation rate and negative average value-added variation rate. Profitability rate is also more important for non-STC establishments. There are also some differences at industry level. Globally, as expected, agriculture is marginally represented. STC establishments are mainly concentrated in the "manufacture of intermediate goods" industry (42% of STC establishments).

2. ECONOMETRIC STRATEGY

We implement a panel data model with sample selection, endogenous explanatory variable as well as unobserved heterogeneity. It is an application of the econometric model proposed by Semykina and Wooldridge (2007). This relevant methodology takes into account the structure of our unbalanced panel.

Longitudinal redundancy behaviour equations for establishments are likely to suffer from unobserved heterogeneity, selection bias and endogeneity. Unobserved heterogeneity can be associated with management behaviour, political orientations and workforce managerial preferences of employers. Since these factors are likely to be correlated with the STC behaviour, simple estimation methods will not produce consistent estimators. There can also be a problem of endogeneity because the relationship between STC and redundancies is unclear. STC annual indicators aggregate monthly information. On the other hand, annual redundancy indicators aggregate quarterly information. There is a possible problem of simultaneity related to the construction of these indicators: STC can be affected by the establishment redundancy behaviour during a year. Selection can also be a potential problem because the use of STC is not randomly distributed among French establishments: Establishments which have STC authorizations might do it as a consequence of their internal strategy. In order to control for these three biases, we implement the following two-stage model.

2.1 The first stage of the model

The first stage of the model consists in the selection rule standing for the STC program participation (s_{it}). An establishment is considered to be a participant in the STC program if it has a number of STC authorized days greater than zero. The main problem is the existence of an unobserved effect inside the index of the probit selection model. Provided we make appropriate linearity assumptions about the conditional expectations of the unobserved effect as in Mundlak (1978), we can obtain valid selection correction. In this way, the selection equation can be written as follows:

$$s_{it} = 1[s_{it}^{*} > 0] = 1[\eta + WTR_{it}\delta_0 + z_{it}\delta_1 + \overline{WTR}_i\xi_0 + \bar{z}_i\xi_1 + \sum_{t=1}^{T} I_t^w + v_{it} > 0] \qquad (1)$$

where $1[\bullet]$ is the indicator function, *t* represents time ($t = 1,\ldots,T$), *i* the establishment ($i = 1,\ldots,N$) and v_{it} is the error term which follows a normal distribution. z_{it} represents the set of explanatory variables: Firm size variation rate (lagged by one year), establishment size, profitability rate (lagged by one year) and value-added variation rate (lagged by one year). Mundlak's method (1978) is usually developed for unbalanced panels and it consists in calculating for each establishment and for each explanatory variable (*z*) the average value on the period of establishment presence in the data ($\overline{z}_i$). In Mundlak's method $\overline{z}_i$ is introduced to control for unobserved heterogeneity. As we are working with an unbalanced panel, for each establishment, we introduce time dummies weighted by the establishment presence during the 1996-2004 period[7] (I_t^w).

We introduce another explanatory variable (WTR_{it}) used in the same way as the *z* matrix. Calavrezo et al. (2007) showed that, apart from economic situation, WTR is the only other major determinant of the STC use. WTR is a device that French firms have implemented heterogeneously in a number of different laws (see Askenazy (2008) for details about WTR implementation in France). From the "Working time reduction" database we can identify if an establishment reduced its working time to prevent from redundancies or not. We use this information as our exclusion variable: WTR_{it} equals to 1 when establishments reduced their working time without preventing from redundancies (see appendix 1). We think that there is no direct relationship between this WTR indicator and redundancies. If this type of WTR affects redundancies, the effect does not transit through a direct transmission channel. To our knowledge, there is no empirical or theoretical proof regarding the direct relationship between this kind of WTR and establishment redundancy behaviour.

2.2 The second stage of the model

In the second stage of the model, in order to control for the endogeneity bias of STC indicators, we estimate the number of redundancies with a 2SLS model. As we also want to control for the selection bias related to the STC recourse, we only concentrate on the establishments which use STC authorizations ($s_{it} = 1$) by introducing the inverse Mills ratios ($\hat{\lambda}_{it}$) previously calculated with the equation (1). Unobserved heterogeneity is controlled as well by using Mundlak's method. The final estimated equation of the second stage can be written as follows:

$$RED_{it} = \phi + \hat{STC}_{it}^{j}\beta_0 + z_{it}\beta_1 + \overline{WTR}_i\mu_0 + \overline{z}_i\mu_1 + \gamma\hat{\lambda}_{it} + \sum_{t=1}^{T} I_t + u_{it} \qquad (2)$$

where the dependent variable RED_{it} is the annual number of redundancies. The vector of explanatory variables z_{it} is the same as in equation (1). $\hat{STC}_{it}^{j}$ is the predicted value of the OLS estimation of each STC^j variable on its lagged value by one year, the inverse Mills ratio, z_{it}, $\overline{z}_i$, $\overline{WTR}_i$, and time dummies. *j* gives the different STC measures: $j \in \{STC\_days, STC\_empl, AP\_STC\}$ (see appendix 1). We finally have three versions of the model (a version for each STC measure). STC indicators lagged by one year represent our instrumental variables. They explain the STC recourse for the year *t*, but they are not correlated with the error term of the redundancy equation.

[7] Nearly 30% of the establishments appear on the whole period.

In comparison with the model developed by Semykina and Wooldridge (2007), our methodology is slightly different. In Semykina and Wooldridge (2007), the selection equation is estimated separately for each time period. So, they calculate for each time period an inverse Mills ratio for each individual (*lambda*). In the main equation they introduce *lambda* but also the interaction terms between *lambda* and time dummies. In this way they control for the selection bias year by year. In our case, the inverse Mills ratios are directly calculated per year and per individual in a unique selection equation where we control for time dummies. Our model can be seen as a restricted form of the Semykina and Wooldridge's model since we are controlling for the selection bias on the 1996-2004 period. In order to check if these two methods provide different estimators for the number of redundancies, we exactly implement the Semykina and Wooldridge's model and we finally obtain very similar results.

3. EMPIRICAL RESULTS

3.1 Estimation results

Table 2 presents the results for the first stage of the model. It is computed on the global sample, i.e. 204,396 observations. Establishment size, establishment economic performance and working time reduction (WTR) indicator are all significantly correlated with the probability to participate in the STC program.

Table 2: Selection regression estimates for STC recourse

Variable	Estimation	Standard error	
Intercept	-1.3829	0.0133	***
EST_size	0.000190	0.000068	***
Var_VA1	-0.0501	0.0198	**
Var_F_size1	-0.00538	0.0286	ns
PR1	-0.0790	0.0258	***
WTR	-0.1218	0.0186	***
$\overline{EST\_size}$	-0.00008	0.000070	ns
$\overline{Var\_VA1}$	-0.6346	0.0534	***
$\overline{Var\_F\_size1}$	-0.2991	0.0722	***
$\overline{PR1}$	-0.4145	0.0325	***
$\overline{WTR}$	-0.0901	0.0227	***
Chi^2		3052.05	
N total		204 396	

***Field*:** French establishments with at least 50 employees.

***Note*:** Probit coefficient estimates. Regression also includes time dummies (weighted by establishment presence in the sample). ** indicates significance at 5%, *** indicates significance at 1% and ns indicates non-significance at 10%.

The probability to use the device increases with establishment size. One possible explanation is that big establishments are more likely to have a Human Resources department better informed about STC rules and procedures. Poor economic health of establishment – measured with value-added rate and profitability rate – also increases the probability to participate in the STC program. This negative relationship is easy to understand since the establishment has to provide the proof of strong unpredictable economic difficulties if it participates in the STC program. Establishments which reduced their working time (without preventing from redundancies) participate less frequently in the STC program. The significance of the WTR variable partially confirms that it is a good exclusion variable[8]. This negative relationship between participation in STC and WTR confirms previous conclusions of Calavrezo et al. (2007). They empirically highlight a substitution effect between STC and WTR due to their internal flexibility roles.

The second stage of the model enables us to discuss the impact of the participation in the STC program on establishment redundancy behaviour. Table 3 summarizes the results of three regressions on the number of redundancies (*RED*) by considering successively the three different dimensions of STC (regressions are computed on 9,132 observations). Even if we do not report estimates associated with all introduced variables to simplify the presentation, one should notice that estimates associated with the inverse of Mills ratios are generally significantly positive. It indicates the presence of a selection bias that was controlled by the model.

Table 3: Summary of results for annual number of redundancies

	RED
Number of STC authorized days (STC_days)	0.0010 ***
	(0.0001)
Number of employees concerned by STC(STC_emp)	0.0242 ***
	(0.0067)
Duration of STC authorized day per employee (AP_STC)	0.7578 ***
	(0.1592)

***Field*:** French establishments with at least 50 employees. N: 9132 observations.

***Note*:** Standard errors are given in parentheses. They are corrected using a procedure developed by Semykina and Wooldridge (2007). * indicates significance at 10%, ** indicates significance at 5%, *** indicates significance at 1% and ns indicates non-significance at 10%. The sample includes 9,132 observations. The inverse Mills ratio is significant at 10% in almost all the regressions.

By using the annual number of redundancies as dependant variable, all estimates are positive. This strong result means that participation in the STC program does not decrease redundancies. The recourse to STC seems to announce redundancies instead of avoiding them whatever the STC indicator. For example, STC duration per employee shows that putting a large number of employees under STC for short duration has not the same consequences than putting a small number of employees under the STC program for long duration: The former solution would involve more redundancies than the latter. Therefore, in France, the longer duration of STC episodes for a rather limited number of employees in the clothing industry is more worrying for employment than the shorter episodes that concern a large number of employees in the motor vehicles industry.

[8] By regressing directly WTR_{it} on the redundancy indicator, its coefficient is not significantly different from zero.

The STC program does not appear to be an efficient instrument to protect employment when establishments have economic difficulties. To interpret this positive relationship between STC authorizations and the number of redundancies, we can imagine that STC recourse is the ultimate (inefficient) solution to avoid redundancies. From that perspective, STC and redundancies would be complementary to face economic difficulties. Another interpretation is that participation in the STC program can be considered as a way for establishments to calm down the social tensions before a planned redundancy scheme. We can also consider the STC program as a policy that aims at accompanying establishments in structural decline.

3.2 Generalisation and robustness of the results

In order to generalize and test our results we introduce four main changes in our empirical approach: We introduce two new redundancy variables, we differently consider the nature of the annual number of redundancies, we focus on establishments with multiple STC authorizations and we introduce additional explanatory variables.

First, we successively characterize the redundancy behaviour with two new variables: The dummy variable LAY_{it} which indicates if the establishment has at least one redundancy within a year and the dummy variable $LAY10_{it}$ which indicates if the establishment has at least ten redundancies within a year. We consider the latter as a mass redundancy dummy (see appendix 1 for more details). As these two measures are dummy variables, in the second stage of the econometric strategy we can not perform anymore a 2SLS regression. We then implement a different two-stage model: We estimate STC indicators as mentioned in Section 3.2 and we introduce their predicted values in probit estimations performed for each redundancy dummy. For example, for the LAY_{it} variable, equation (2) can be written as follows:

$$Lay_{it} = 1\left[Lay_{it}^{*} > 0 \right] = 1\left[\varphi + S\hat{T}C_{it}^{j}\beta_0 + z_{it}\beta_1 + \overline{WTR}_i\mu_0 + \overline{z}_i\mu_1 + \gamma\hat{\lambda}_{it} + \sum_{t=1}^{T} I_t + u_{it} > 0 \right] \quad (3).$$

From now on, we call this model an OLS-Probit model.

Second, in Section 3 we consider the annual number of redundancies as a continuous variable. But the RED_{it} variable is a discrete number with a lot of zero values (more than 60%). We then implement an alternative model on the 9,132 observations: We estimate STC indicators as mentioned in Section 3.2 and we introduce their predicted values in a zero inflated negative binomial (ZINB) model. This model permits to take into account the nature of the RED_{it} variable. From now on, we call this model an OLS-ZINB model.

Third, we restrict our selection sample by considering only establishments with multiple STC recourses. We define a recurrent STC establishment as an establishment which has at least two STC recourses[9]. On the global sample, only 6% of the establishments have at least two STC recourses during the whole period (2,286 establishments representing 6,519 observations). As recurrent STC establishments are supposed to belong to industries in structural decline, we want to test if the results change when focusing on this category of establishments.

[9] We consider this threshold of two STC uses because of the rarity of the phenomenon.

Fourth, we introduce some additional explanatory variables: Establishment industry (at an 11 level classification[10]) and establishment region (following to the French National Institute of Statistics definition, we use the main 8 regions of France[11]). As these variables do not change over time, we cross them with firm value-added variation rate. These crossed effects can capture some industrial characteristics like the structural decline of some industries. We perform these tests on the recurrent STC sample (6,519 observations).

Table 4: Summary of robustness tests

	RED		**Lay**	**Lay10**
	2SLS	*OLS-ZINB*	*OLS-Probit*	*OLS-Probit*
Sample of 9,132 observations				
STC_days	+++	+++	0	+++
STC_emp	+++	++	0	0
AP_STC	+++	+++	+++	+++
Sample of 6,519 observations (recurrent establishments)				
STC_days	+++	++	0	0
STC_emp	+++	0	0	+
AP_STC	+++	+++	+++	+++
Introduction of new explanatory variables (sample of recurrent establishments)				
STC_days	+++	++	0	0
STC_emp	+++	0	0	0
AP_STC	+++	+++	+++	+++

***Field*:** French establishments with at least 50 employees.

***Note*:** Standard errors are corrected using a procedure developed by Semykina and Wooldridge (2007). The inverse Mills ratio is significant at 10% in almost all the regressions. + represents a positive significant impact at 10%, ++ at 5%, +++ at 1% and 0 represents a non-significant impact.

Table 4 summarizes the results. Each coefficient comes from a different estimation. When we consider the other two redundancy variables, on the 9,132 observation sample we find similar results. None of the coefficients is negative. Moreover, the duration per employee of the STC authorizations is the key variable that always determines the decision to lay off one or ten employees for economic reasons. More than the number of employees concerned by STC authorizations, it is their duration that "announces" redundancies. As regards to the number of redundancies, considering it as a discrete variable with a lot of zeros does not change the results on the 9,132 observation sample (see column OLS-ZINB in table 4). Also working on STC recurrent establishments strengthens our previous conclusions. Whatever the STC indicator, it is associated with an increase in the number of redundancies for the 2SLS models. For OLS-ZINB models results are quite similar, excepting for the number of employees on STC which does not affect anymore the number of redundancies. It seems that relationship between STC indicators and redundancies does not change when focusing on

[10]Agriculture, forestry and fishing; Manufacture of food products; Manufacture of consumer goods; Manufacture of motor vehicles; Manufacture of capital equipment; Manufacture of intermediate goods; Construction; Wholesale and retail trade, repairing; Transportation; Firm services; Personal services, education and health.

[11] Ile-de-France; Centre-North; Nord-Pas De-Calais; East; North West Atlantic; South West; Centre South; Midi Mediterranean.

recurrent STC establishments. Moreover, introducing new explanatory variables confirms our results.

4. CONCLUDING REMARKS

According to our results, participation in the STC program involves an increase in redundancies for French establishments (with at least 50 employees). More precisely, long durations of STC indicate that establishments will lay off employees for economic reasons. We can interpret this positive and significant relationship between STC authorizations and redundancies in different ways. First, using STC authorizations would be the ultimate inefficient solution to avoid redundancies. Second, STC authorizations and redundancies could complement each other to face economic difficulties. Third, the STC program would be a policy for establishments in structural decline. And finally, establishments could use STC to calm down the social tensions before a planned redundancy scheme. Whatever the true interpretation, the STC program does not fully protect from redundancies in French establishments (with at least 50 employees) that face economic difficulties. Does it mean that the STC program is a totally inefficient policy? Several additional studies have to be done. The most obvious for us is to test the impact of the STC program on establishment survival. With a similar matched database, we are analyzing the link between the STC recourse and the demography of French establishments.

Our methodology controls for unobserved heterogeneity, selection bias and endogeneity bias. However, a problem can still persist since STC and redundancy indicators are aggregated at annual level and the relationship we want to measure is infra-annual. A way to partially solve this problem would be to use a quarterly panel, but economic and financial firm data are only available at annual level.

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Appendix 1:
Main indicators

Short-Time Compensation indicators	
STC authorized days ***(*** STC_days_{it} ***)***	This indicator is the sum of monthly STC authorized days: $STC_{it} = \sum_{j=1}^{12} STC_{ij}$, where *i* represents the establishment, *t* the year and *j* the month.
Employees concerned by STC authorizations ***(*** STC_emp_{it} ***)***	This indicator is an average and it is calculated over the months during which the establishment is using STC. $STC\_emp_{it} = \frac{1}{k}\sum_{j} STC\_emp_{ij}$ where *i* represents the establishment, *t* the year, *j* the month and *k* is the number of months during which the establishment uses STC.
Average STC duration per employee ***(*** AP_STC_{it} ***)***	This indicator is an average of durations computed over the months during which the establishment recourses to STC: $AP\_STC_{it} = \frac{1}{k}\sum_{j} \frac{STC\_days_{ij}}{STC\_emp_{ij}}$. where *k* is the number of months during which the establishment has recourse to STC
Establishment size indicator	
Annual establishment size indicator ***(*** EST_size_{it} ***)***	If *i* is the establishment, *t* the year, *q* the quarter and *k* is the number of quarters where the establishment appears in the database, the indicator is calculated as follows: $EST\_size_{it} = \frac{1}{k}\sum_{q} EST\_size_{iq}$.
Redundancy indicators	
Annual redundancy ***(*** RED_{it} ***)***	This indicator is obtained by adding up establishment quarterly redundancies. If *i* is the establishment, *t* the year, *q* the quarter, the indicator is calculated as follows: $RED_{it} = \sum_{q} RED_{iq}$.
Presence of redundancies within the year (LAY_{it} ***)***	Dummy variable indicating if the establishment had at least one redundancy during the year: $LAY_{it} = \begin{cases} 1 \text{ if } \mathrm{RED}_{it} > 0 \\ 0 \text{ if } \mathrm{RED}_{it} = 0 \end{cases}$

Presence of mass redundancies ***(*** $LAY10_{it}$ ***)***

In France, like in the U.K., the threshold that releases mass redundancies is 10 redundancies during a month. 75% of the establishments of our global sample that lay off for economic reasons, have at maximum 5 redundancies during a year. Dummy variable indicates if the establishment has at least 10 redundancies during the year as a proxy of mass redundancies:

$$LAY10_{it} = \begin{cases} 1 \text{ if } \text{RED}_{\text{it}} \geq 10 \\ 0 \text{ if } \text{RED}_{\text{it}} < 10 \end{cases}$$

Working Time Reduction indicator

Reducing working time without preventing from redundancies ***(*** WTR_{it} ***)***

Binary indicator equals to 1 only when the establishment reduces its working time without preventing from redundancies:

$$WTR_{it} = \begin{cases} 1 \text{ if WTR without preventing from redundancies} \\ 0 \text{ otherwise} \end{cases}$$

Firm performance indicators

Firm size variation rate ***(*** $Var\_F\_size_{it}$ ***)***

$$Var\_F\_size_{it} = \frac{F\_size_{it} - F\_size_{it-1}}{1/2\,(F\_size_{it} + F\_size_{it-1})},$$

where F_size_{it} represents firm size.

Value-added variation rate ***(*** Var_VA_{it} ***)***

$$Var\_VA_{it} = \frac{VA_{it} - VA_{it-1}}{1/2\,(VA_{it} + VA_{it-1})},$$

where VA_{it} represents value-added.

Profitability rate ***(*** PR_{it} ***)***

$PR_{it} = \dfrac{\Pi_{it}}{K\_INV_{it-1}}$, where Π_{it} represents firm profit and K_INV_{it} represents capital investment.

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