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Reducing Working Time and Inequality: What Has the French 35-Hour Work Week Experience Thaught Us?

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03 – 07

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Reducing working time and inequality: what has the French 35-hour work week experience taught us?*

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March 2003; revised version

Abstract

To evaluate the inequality effects of implementing the 35-hour work week, we have used a very general labor demand framework that takes into account various skills and the impact of work duration on wages, hourly productivity and labor organization. Numerical simulations include several components of Aubry devices and consider wide but realistic ranges for the various parameters. The 35-hour work week always increases the employment level but has a negative effect on working hours. Moreover, it reduces employment and wage inequality across the whole labor force and among workers, while probably raising welfare inequality.

Key words: working time reduction, labor demand, inequality.
***JEL* Classification :** D63, J23, J38.

1. Introduction

The effects of the 35-hour work week on employment have already been analyzed in forward-looking[3] and backward-looking[4] studies. However, their inequality effects have as yet been largely ignored. Crucial parameters at work differ among workers. This is notably the case for hourly wage increases, which are higher when wages are initially low and close to the minimum wage (SMIC), as well as when the new measures to lower employers' social

* The authors are particularly grateful to Marc-Arthur Diaye, Jean-Olivier Hairault, Pierre Morin, Marie-Claire Villeval as well as to the participants to Journées de Microéconomie Appliquée (university of Rennes 1 - June 2002), to the T2M meeting (university of Evry-Val-d'Essonne -- June 2002), to the Congrès de l'Association Française de Science Economique, to the European Association of Labour Economists (September 2002), where preliminary drafts were presented. This paper originated as part of the "ACI program" commissioned by the French Ministry of Research and the DARES from the French Ministry of Labor and Social Affairs. We would like to thank both of these organisms for their financial support. Views expressed there are those of the authors and do not necessarily represent those of DARES and French Ministry of Labor and Social Affairs. However, any mistake remains our own. This paper was written before the enforcement of the relaxing law of 35-hour work week on previous October. Hence, it only takes account for Aubry II law.

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[3]See for example P. Cahuc and P. Granier [1997], J. P. Laffargue and A. Saint-Martin [2000].

[4]For instance, M. Fiole, V. Passeron and M. Roger [2000].

security contributions for low and medium wage workers have been implemented. Incentive tax cuts are the strongest at 1.3 SMIC with regard to the previous device. The 35-hour work week will thus not benefit all employees in the same way.

To study these effects, it is important to build a theoretical framework considering all the usual mechanisms to describe working duration effects on employment as well as allowing these mechanisms to be differentiated depending on the workers under consideration. In this study, we use a reduced form of a labor demand equation that is at once very general in theory while also taking into account the hours of work, heterogeneity of employees and the variety of their situations in terms of labor productivity gains, social contribution exemptions, reorganization of production and wage compensation, induced by the collective working time reduction (WTR). This reduced form involves a small number of crucial parameters, which are simulated on wide but realistic ranges of variation.

From a theoretical point of view, we first show that the parameters influencing job creation and inequality are not the same. For instance, the elasticity of the demand with respect to price impacts a lot on employment but does not play on inequality among workers. Productivity gains and production process reorganization are two positive factors for employment but the former benefits low wages more, the latter high wages, skilled employees being less readily substitutable in the capital than less skilled.

Our simulations result in a favorable effect of the 35-hour work week on employment levels, but unfavorable effects on working hours: job creations fall between 15-50% of the arithmetic rule of three. The 35-hour work week would reduce wage inequality among the various categories of employees and within the whole working population, as well as between employed and unemployed populations. A uniform financing of incentive tax cuts leaves our main result unchanged.

Finally, we have determined "borderline conditions" for the ratio of marginal utility of leisure for skilled relative to unskilled employees, such as the WTR increase in welfare inequality. Our calculations lead to a ratio which should be at least 1.6 points; consequently, WTR probably increases welfare inequality.

2. The theoretical effects of reducing working time on labor demand

In this section, we first call to mind the hypotheses and the results of the neo-classical labor demand model when work duration is taken into account and when the labor force is homogeneous. Secondly, the model is extended to the cases of various workers with a variety of productivity and wage levels.

1. The model

Within the neo-classical framework, work duration (see for instance d'Autume and Cahuc [1997]) and the behavior of firms can be broken down into two stages:

- A company chooses quantity of capital ($\tilde{K}$) and number of individuals (N) so as to minimize its production costs for a given production level (Y):

$$\min_{K,L} \Omega HN + R\tilde{K} \tag{1}$$

where Ω (or R respectively) is the hourly nominal cost (respective of unit cost of capital $\tilde{K}$);

- Knowing its cost function $C(\Omega, R, Y)$, the company determines the quantity of goods to produce which will maximize its profit Π in monopolistic competition:

$$\max_{Y} \Pi = P(Y)Y - C(\Omega, R, Y) \tag{2}$$

with: $P \equiv$ (selling) price of the company output; Y is obtained owing to a technology F which we assume to be increasing, concave and homogeneous of degree θ: $Y \leq F(\tilde{K}d(H), Ne(H))$; $e(H)$ represents the individual efficiency function that is supposed to increase in weekly working time H[5]; $d(H)$ is the Duration of Equipment Use (DEU - duration of capital utilization): if the elasticity of $d(H)$ in the work duration $\left(\eta_H^d\right)$ is smaller than one, WTR will occur with the process of production reorganizations, through a higher utilization of shift work, for example[6]. Then, taking into account wage compensation degree γ employees get the following WTR:

$$\Omega H^{\gamma} = A,\ A \equiv \text{positive constant} \tag{3}$$

If γ is one, the hourly wage rate (and also hourly labor cost) increase is equal to the WTR in absolute value; and vice-versa if $\gamma = 0$.

However, given the conditions necessary for implementing the 35-hour work week, it seems realistic to make a distinction between these mechanisms among employees. The Aubry II law stipulates that people who earn the SMIC (French minimum wage) cannot be subjected to a deduction in their monthly gross wage. The monthly guarantee system which has been set up allows minimum wage workers to maintain their purchasing power at the initial level: for companies which implemented the 35-hour work week from July 1^{st}, 2000, 13.6% of employees (approximately 2 million individuals) working in non-agricultural trades were thus able to benefit from the 2.85% increase in the SMIC (P. Combault [2001]). For other employees, the benefits depend on the results of agreements within the company or even at the branch level. Overall, the wage compensation will thus benefit low wage earners more.

We introduce n categories of employees and suppose that their individual efficiency varies similarly following the decline in the work duration $\left(\text{i.e. } \eta_H^{e_i} = \eta_H^e, \forall i\right)$. We also assume that initial hours of work are the same for all and equal to the legal duration[7]. We differentiate them only by hourly unit labor cost Ω_i and the wage compensation degree γ_i. The unconditional employment elasticity for the category i in the work duration is then:

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[5]Like many others in the same literature, we assume $e(H)$ concave in H, at least up from a threshold value. Hence, following working time reduction (denoted by WTR), we get hourly productivity gains $\left(\frac{\partial \frac{e(H)}{H}}{\partial H} < 0\right)$ if the elasticity of individual effort in the weekly time of work $\left(\eta_H^e\right)$ is smaller than unity (that is to say, the decrease in the fatigue effects is higher than the increase in production slack periods).

[6]Contrary to P. Cahuc and A. Zylberberg [2000], we do not impose the DEU as constant over working time H $\left(\eta_H^d \neq 0\right)$: it could be so in the long run, but not necessarily in the short/ mid run (see G. Cette and D. Taddei [1995]).

[7]This last hypothesis can seem strong. However, since 1983, the actual weekly duration for full-time employees is relatively stable and close to legal duration: 38.91 hours over the period 1993-1997 according to the ACEMO; more than 70% of the full-time employees of the not agricultural private sector worked 38 - 39 hours in 1998 (M. Fiole, V. Passeron and M. Roger [2000]).

$$\eta_H^{N_i} = \eta_{W_i}^{L_i}\eta_H^{W_i} + \sum_{j\neq i,j=1}^{n} \eta_{W_j}^{L_i}\eta_H^{W_j} + \eta_r^{L_i}\eta_H^r - \eta_H^e \tag{4}$$

where $\eta_{W_i}^{L_i}$ (or $\eta_{W_j}^{L_i}$ respectively) is the elasticity of efficient labor for workers of type i in its cost (respective of the cost of labor of type j) ; assuming imperfect competition (D. Hamermesh $[1986,1993]$), we get:

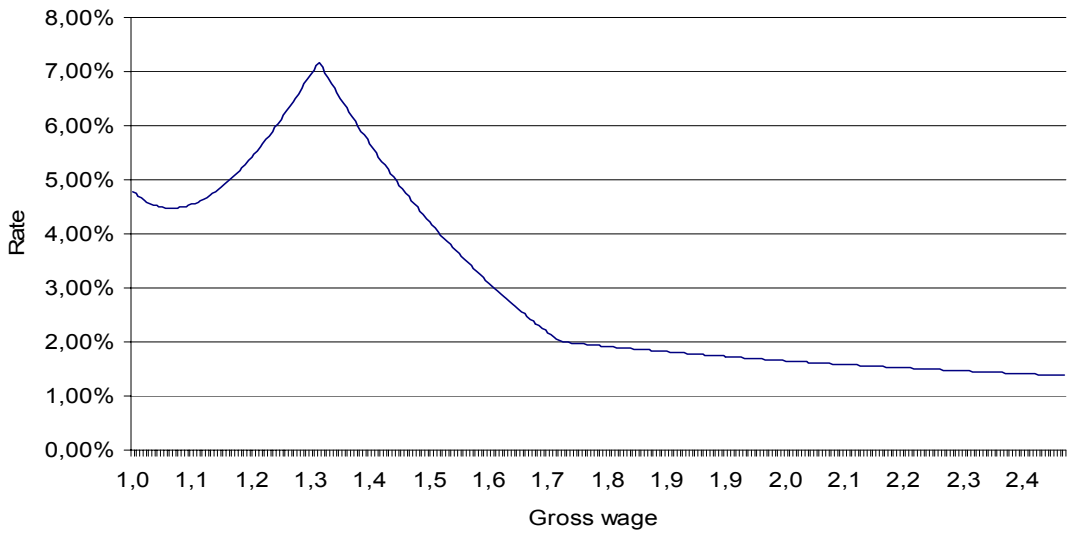
$$\eta_{W_j}^{L_i} = s^j\left(\sigma_j^i - \frac{\upsilon}{\upsilon-\theta}\right) \tag{5}$$

$$\eta_{W_i}^{L_i} = -\sum_{j\neq i,j=1}^{n} s^j\sigma_j^i - \frac{\upsilon}{\upsilon-\theta}s^i \tag{6}$$

where: $s^j \equiv \frac{W_j L_j}{C}$ $\equiv$ share of labor in the production costs; $\sigma \equiv$ capital to labor elasticity of substitution; $\upsilon \equiv \frac{1}{1+\eta_Y^P} \equiv$ one plus the mark up rate ($\eta_Y^P \equiv$ elasticity of the price of goods to produced quantity[8]).

Moreover, to determine labor cost elasticity in the work duration, it is necessary to account for legal amendments designed to lower an employer's tax contributions. Within the framework of the 35-hour work week, the State replaced prior amendments to lower an employer's tax contributions on low salaries by a new one (to be applied to low and medium wages) decreasing the SMIC by up to 1.8 points. Differentials in decreases and the resulting labor cost increase may cause substitutions among workers, particularly among those paid at about 1.3 of the SMIC.

Graph 1. Differentials in decreases in an employer's tax contributions.



Notes: X-axis: ratio of the gross salary to the SMIC; Y-axis: additional decline in the labor cost.
Sources: Authors' calculations.

[8] η_Y^P corresponds to the inverse of demand to price elasticity.

Noting β_i as the percentage of decline of the (*ex-ante*) labor cost generated by the new device for category i of workers, we can then rewrite the labor cost elasticity in the weekly duration of the work as:

$$\eta_H^{W_i} = 1 - \gamma_i - \beta_i \left(\frac{dH}{H} \right)^{-1} - \eta_H^e \tag{7}$$

The presence of the term $\left(\frac{dH}{H}\right)^{-1}$ is linked to the fact that the more there is a decline in working time, the lower the wage compensation degree compatible with a preservation of the costs– the amount of the decreases in an employer's social security contributions being independent from the variation of the decline of duration (beyond the necessary 10% to benefit from it). Thanks to (4), (5), (6) and (7), one finds:

$$\begin{aligned} \eta_H^{N_i} = & \left[-(1-s)\sigma_k^i (1 - \gamma_i - \beta_i \left(\frac{dH}{H} \right)^{-1} - \eta_H^e + \eta_H^d) - \eta_H^e \right] \\ & - \frac{\upsilon}{\upsilon - \theta} \left[-\eta_H^e s - \eta_H^d (1-s) + \sum_{j=1}^{n} \left(1 - \gamma_j - \beta_j \left(\frac{dH}{H} \right)^{-1} \right) s^j \right] \\ & + \sum_{j \neq i, j=1}^{n} s^j \sigma_j^i \left[\left(\gamma_i - \gamma_j \right) + \left(\beta_i - \beta_j \right) \left(\frac{dH}{H} \right)^{-1} \right] \end{aligned} \tag{8}$$

where: $s \equiv \sum_{j=1}^{n} s^j$; σ_j^i (respectively σ_k^i) is the substitution elasticity of the employees of type j (respective of the capital) to those of type i.

2. Theoretical results

The first two terms of (8) represent effects that are specific to each type of worker: the first one is the substitution effect between employed individuals and capital, the second one is the income effect. Under the substitution effect, hourly labor productivity gains and reorganizations have different impacts on job creation: the more productivity gains are high ($\eta_H^e \longrightarrow 0$), the less the substitution effect is marked and the more the employment effect will be positive; the less reorganizations are important ($\eta_H^d \longrightarrow 1$), the more the employment effect will be positive, because a work duration decline strongly decreases the DEU and thus increases the capital user cost, which reduces substitutions of labor to capital. Nevertheless, going from efficient employment to employment level, productivity gains impact negatively on employment and this effect always dominates the former as soon as $(1-s)\sigma < 1$. Finally, a high wage compensation favors substitution which will reduce the positive impact of the WTR on employment level. Income effects due to productivity gains and reorganizations go in the same direction: the higher they are (i.e. $\eta_H^e \longrightarrow 0, \eta_H^d \longrightarrow 0$), the more job creations there will be (second part of (8)).

The third term corresponds to the substitution effects between categories of employees who depend only on differentials of wage compensation degrees and on the rates that an employer's social security contributions have been lowered.

The first result is that the value of the demand to price elasticity $\left(\eta_P^Y = \frac{1}{\eta_Y^P}\right)$ and the returns to scale (θ) have no impact on employment inequality (table 1). These parameters

intervene only in the income effects $\frac{\upsilon}{\upsilon-\theta}$ which will be identical for all categories $\left(\sum_{j=1}^{n}\left(1-\gamma_j-\beta_j\left(\frac{dH}{H}\right)^{-1}\right)s^j\right)$.

The second result refers to the fact that re-organizations benefit the most skilled employees more. They are the least substitutable in the capital according to all the empirical studies (see F. Mihoubi [1996] and P. Biscourp and C. Gianella [2001]). Stronger re-organizations (lower value for η_H^d) moderate the increase in the capital user cost, which benefits most categories of employees who are the most complementary to it. On the other hand, small re-organizations increase the cost of the capital, which favors unskilled and more substitutable workers.

The third result is that the productivity gains benefit skilled workers more. Stronger productivity gains schedules $\left(\eta_H^e \to 0, \text{soit } \eta_H^{\frac{e(H)}{H}} \to -1\right)$ imply a capital-labor substitution all the greater since workers are substitutable for capital.

Fourth, the wage compensation, stronger for "low wages" than for "high wages", worsens the disparities of employment while the degression of the device decrease national insurance contributions reduces these disparities. If i represents the category of unskilled workers and j that of the more skilled[9], $\left(\gamma_i-\gamma_j\right)$ is positive, which increases the disparities of employment (the compensation being stronger for the unskilled). This effect is "counterbalanced" by the device for lowering national insurance contributions $\left(\beta_i > \beta_j\right)$.

Fifth result: the possibilities of substitution between the categories of employees amplify the net effects of this differential of labor costs on the disparities of employment. Inequalities are reduced if the impact of the tax cut differential exceeds that of wage increase differential, that is, if $\left(\gamma_i-\gamma_j\right)+\left(\beta_i-\beta_j\right)\left(\frac{dH}{H}\right)^{-1}<0$, especially when the degree of substitution between categories of workers $\left(\sigma_j^i\right)$ is high (see (8)). Also, σ_k^i only reinforces the net balance of η_H^e and η_H^d: if the net effect decreases disparities, the phenomenon will be increased all the more as σ_k^i will be high; conversely for σ_k^j.

[9]One should continue to assimilate employees with "low wages " to "less skilled" individuals, and employees with "high wage income" to "highly skilled" individuals, although both sets of groups correspond just more or less (see C.S.E.R.C. [1996]).

Table 1. Impact of variables on aggregate employment and on inequality as working time legally decreases.

Variable	Job creations	Decrease in inequality (in terms of jobs)
σ_k^i, σ_k^j	undetermined [a]	reinforce the net balance of η_H^e and η_H^d
σ_j^i [b]	undetermined	+/ - [c]
γ_i	-	-
γ_j	-	+
$\gamma_i - \gamma_j$	-	-
β_i	+	+
β_j	+	-
$\beta_i - \beta_j$	+	+
η_H^e	undetermined	-
η_H^d	undetermined	+
η_P^Y	undetermined	0
θ	undetermined	0

Notes: [a] presumption; [b] $i \equiv$ unskilled ; $j \equiv$ skilled ; [c] It depends on the importance of $\left(\beta_i - \beta_j\right)$ differential relative to that of $\left(\gamma_i - \gamma_j\right)$.

Sources: Author's results based on (8).

From the purely theoretical level, the balance in employment as well as the balance in inequality is indefinite. It depends on the value of all these parameters. A numerical simulation is thus necessary to conclude.

3. Numerical simulations

If one wants to simulate equation (8), the first step is to choose realistic values for all parameters.

1. Calibration

Given the high number of parameters, the value of which are not known with certainty (substitution elasticities between factors, the elasticity of the DEU and the individual efficiency in the time of work, the elasticity of the demand for prices and returns to scale), we considered only two categories of employees: the skilled and the unskilled. In spite of the problems caused by inaccurate correspondence between skill degrees and level of payment as well as the fact that employer's social security contributions cuts apply to levels of salaries

and not of skill, we shall consider that the less skilled workers are the lowest paid individuals and that the high salaries represent more skilled employees[10].

To determine the initial structure of employment, we used the 1996 Annual Statements of Social Data (DADS) in the fields of full-time workers in the non-agricultural trade sectors. Salaries were uniformly revalued with the progress of the payments for the "non-agricultural trade sector" between 1996 and 2001 figures which were provided by the Activity and the Conditions of Employment of the Workforce (ACEMO). We excluded all individuals whose wage was lower than the SMIC (considered on July 1^{st}, 2001 on a basis of 169 monthly hours, either 1126.37 euros), which is a little less than 5% of the initial sample. We also retained a part of the capital in total production cost of 33%.

For the substitution elasticity between both categories of workers, we were inspired by results of studies applied to French data, which are rather variable according to the definition of skilled and unskilled labor, the period of estimation and the considered model. If H. Sneessens and F. Shadman-Mehta [1995] establish a range of fluctuation from 0.18 to 0.88 according to the imposed constraints, the more recent analyses of F. Mihoubi [1996] and P. Biscourp and C. Gianella [2001] lean more toward a unitarian elasticity (or a higher one).

For the elasticity of substitution between unskilled labor and capital, these two last studies definitely suggest a unitarian elasticity[11]. The elasticity of substitution between skilled workers and capital is weaker: from 0.5 according to P. Biscourp and C. Gianella [2001] to a near-complementarity, according to F. Mihoubi [1996].

As to the degrees of wage compensation and observed from actual signed agreements (L. Doisneau and B. Fournier [1999]), 87.7% of the employees seemed to have been promised that their wage income level would, for the moment at least, be maintained: three quarters of them should expect to see their salaries "frozen" (about 44% of all cases) or see less of an increase in the two or three years following the implementation of the 35 hour work week. Consequently, wage compensation degrees were maintained at about 0.95 for the unskilled and 0.75 for the skilled.

The price to demand elasticity should be kept between –2.2 and –1.92[12] points and returns to scale supposed constant, which seems empirically relatively relevant, according to B. Crepon, R. Desplatz and J. Mairesse [1999], for example.

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[10]The separation of both categories was made at the level of the median salary of the sample. Nevertheless, we shall also do simulations by considering separation at 1.3 times the SMIC to see if the increase / reduction of the disparities further to WTR process is not sensitive to the composition of both groups.

[11]H. Sneessens and F. Shadman-Mehta [1995] impose the equality between the degree of substitutability of skilled workers for capital and that of unskilled for capital, the equality being set to 0.6 only.

[12]These two values correspond to the elasticities estimated on individual data by B. Crepon and C. Gianella [2001], for the industry and service sectors in France respectively.

Table 2. Ranges of variation for the parameters of the model.

Parameters	Values
$(1-s)$	33%
σ_j^i	from 0.2 to 2
σ_k^i ($i \equiv$ the unskilled)	1
σ_k^j ($j \equiv$ the skilled)	from 0 to 0.5
γ_i	0.95
γ_j	0.75
η_p^Y	from –2.2 to –1.92
θ	1
η_H^e	from 0.5 to 0.75
η_H^d	from –0.1 to 0.1

Note: [a] $i \equiv$ unskilled ; $j \equiv$ skilled.

Sources: Results from various applied studies (see references).

For the elasticity of efficiency with respect to the work duration, E. Malinvaud [1973] estimated that the increase of productivity stood at 50% of the WTR, on the basis of a study of the INSEE led in 1963 on sample companies with at least twenty employees. Taking into account the fact that the work week is much shorter today, we can envisage weaker labor productivity gains, at one third or even a quarter of the WTR (as G. Cette [1998] recommends). Nevertheless, in the absence of more precise indications, one should take η_H^e as part of $[0.5;0.75]$.

Finally, as to the sensitivity of the DEU to working time, it is also difficult to name a precise value. Unless we focus on a medium or long run: the DEU would be relatively stable (G. Cette and D. Taddéi [1995]). We shall thus take η_H^d as an element of $[-0.1;0.1]$[13]. All the variables considered as well as their respective ranges of value appear in Table 2.

2. Results

Under these hypotheses, the 35 hour work week would increase the employment level by 15 points in 50% of the rule of three, or 1.5-5% of the initial employed population[14], the

[13] According to the study headed by these authors, the DEU was about the same in France in 1990 and in 1962. In recent years, the authors recognize that they have too little distance for a proper view. Besides, the evolution of the DEU seems to show more fluctuations in the short term (see the table 3 in G. Cette and D. Taddéi [1995]).

[14] We first exclude workers whose wage income is below one SMIC. The remaining sample is composed of 10.2 million individuals. Considering that only 67% of workers are concerned with WTR (A. Brahami [2001]), the 35-hour work week implementation would create 702,000 jobs according to the "rule of 3".

dimension of the variation of the DEU and the productivity gains schedules (figure 1). This result is hardly insensitive to the degree of substitutability among skilled and unskilled employees: shifting from $\sigma_j^i = 0.2$ to $\sigma_j^i = 2$, we obtain 2.7 points of additional jobs created with regard to "the rule of 3", this regardless of the value of η_H^e and η_H^d; also, a variation of σ_k^j from 0 to 0.5) changes the results very little.

Table 3. Job creations after implementation of the Aubry device.

Situation [a] / **Demand for price elasticity**	$\eta_p^Y = -2,2$	$\eta_p^Y = -1,92$
$\eta_H^e = 0.75$ and $\eta_H^d = 0.1$ [b]	16.13 [d]	23.50
$\eta_H^e = 0.75$ and $\eta_H^d = 0$	21.04	27.41
$\eta_H^e = 0.62$ and $\eta_H^d = 0.1$	25.64	30.42
$\eta_H^e = 0.75$ and $\eta_H^d = -0.1$	25.95	31.33
$\eta_H^e = 0.62$ and $\eta_H^d = 0$	30.55	34.33
$\eta_H^e = 0.5$ and $\eta_H^d = 0.1$	34.41	36.80
$\eta_H^e = 0.62$ and $\eta_H^d = -0.1$	35.45	38.24
$\eta_H^e = 0.5$ and $\eta_H^d = 0$	39.32	40.71
$\eta_H^e = 0.5$ and $\eta_H^d = -0.1$ [c]	44.23	44.62

Notes: [a] Assumptions: $\sigma_j^i = 0.2$ and $\sigma_k^j = 0.5$. [b,c] The less (or most) favorable case. [d] Increase in aggregate employment (in percentage of the rule of three).
Sources: DADS, URSSAF ("Union de Recouvrement des dépenses de Sécurité Sociale et d'Allocation Familiale"), IRIS ("Initiative Régionale pour l'Insertion et la Solidarité") and authors' simulations on the basis of equation (8).

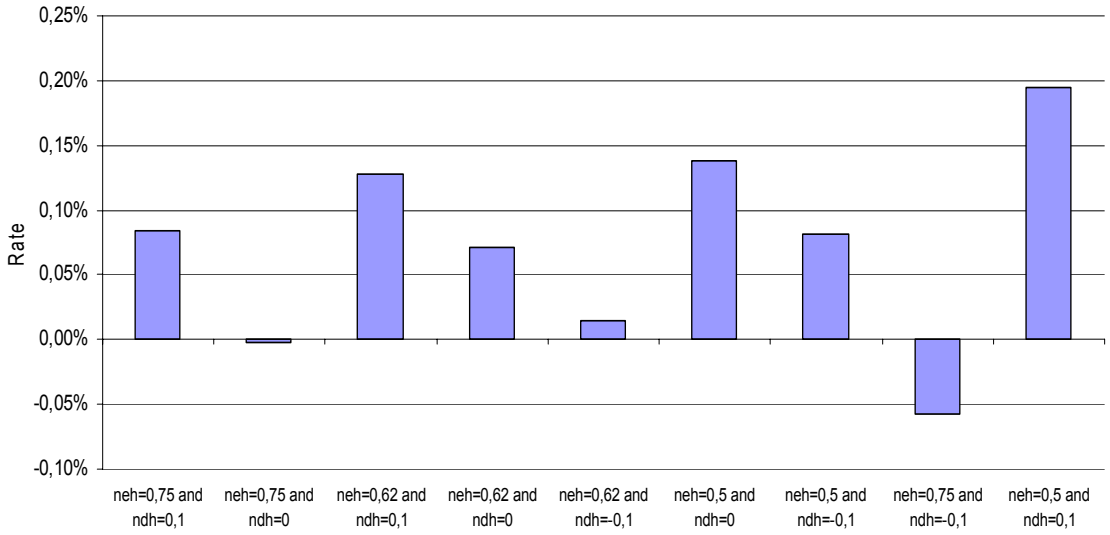
The reduced work week would mainly benefit unskilled workers' jobs as opposed to those of skilled workers, even if the unskilled benefit from a stronger pay rise schedule. This results from the superimposing of two effects of opposite significance. On the one hand, the effects of lowering an employer's social security contributions override those of wage compensation[15]. As a result, the substitution effects between both categories of employees also act in favor of unskilled labor employment (see graph 3 for example). Thus, either the WTR will result in an increase of the effective labor cost in every category or it will not - which we could not assert before the simulation of the model. On the other hand, the substitution effects of every category in the capital acts in favor of more skilled workers (because $\eta_H^e > \eta_H^d$, for all the values of η_H^e and η_H^d envisaged among those that we had[16]).

[15]According to the cut made from the sample, one has: $\beta_i = 4.79\%$ and $\beta_j = 1.42\%$, if "i" represents the average individual earning a low wage and "j" the employees whose wages are the highest.

[16]Based on the assumptions made for the values of the parameters, one has: $\left(-\eta_H^e + \eta_H^d\right) \in [-0.85; -0.4]$. As soon as productivity gains are not maximal $\left(\eta_H^e \neq 0.5\right)$ or the reorganization is nearly complete, the $\left(-\eta_H^e + \eta_H^d\right)$ effect dominates the pure labor cost effect

The first consequence we quoted surpasses the second in most cases since the possibilities for replacement between both categories of employees are not too small ($\sigma_j^i > 0.4$) or since skilled labor is not too complementary in the capital ($\sigma_k^j > 0.1$), which seems empirically verified. So, in the case of Graph 2 – for which one considered the value of σ_k^j to be the least favorable for the success of the WTR in terms of aggregate employment, the WTR policy is carried out at the expense of unskilled employment only if very small productivity gains schedules are associated with a very strong reorganization of the production process ($\eta_H^e = 0.75$ and $\eta_H^d = -0.1$ or $\eta_H^d = 0$).

Graph 2. Variation of the composition of the employed population following the Working Time Reduction policy, depending on the values for η_H^d and η_H^e.

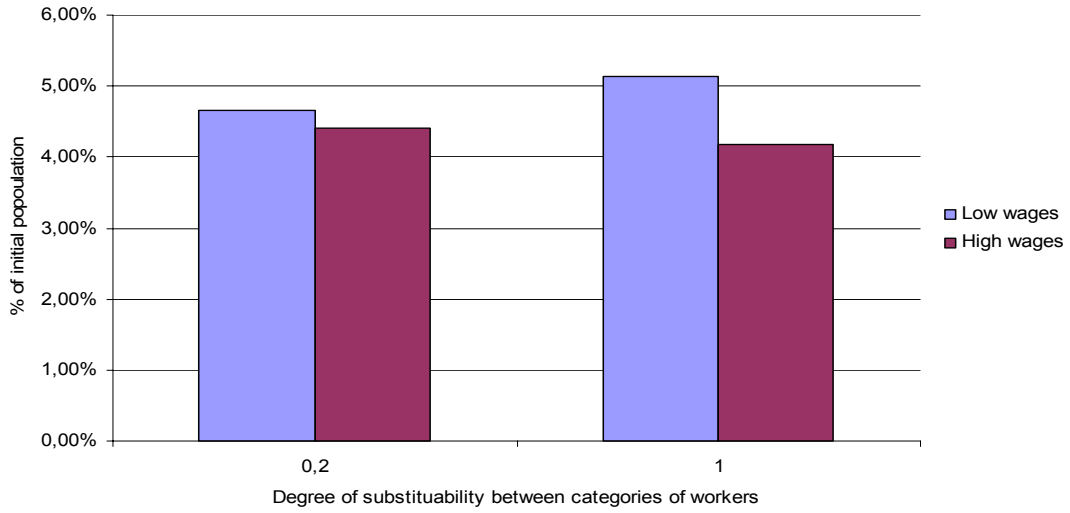


Notes: Assumptions : $\eta_P^Y = -\frac{8}{3}$, $\sigma_k^j = 0,5$ et $\sigma_j^i = 0,2$. Y-axis: percentage of initial share of unskilled workers.

Sources: Authors' calculations on the basis of equation (8).

$\left(1 - \gamma_i - \beta_i \left(\frac{dH}{H}\right)^{-1}\right)$. Capital – labor substitutions are then made at the expense of employment and more particularly of the unskilled with regard to that of skilled workers.

Graph 3. Job creations following the WTR policy when one has a higher value for σ_j^i.



Notes: Assumptions for the construction of the graph: $\eta_H^d = -0.1$, $\eta_H^e = 0.5$, $\eta_P^Y = -\frac{8}{3}$ et $\sigma_k^j = 0.5$.

Sources: Authors' calculations thanks to DADS and equation (8).

Consequently, the effect of the 35-hour work week on inequality in terms of wage income distribution among all workers seems ambiguous: the hourly wage rate of the unskilled increases faster (which tends to reduce the disparities), but the creation of unskilled jobs is generally more frequent (thus lowering the median salary). To cut matters short, we calculated the index of Gini (C. Gini [1936]) and Theil (H. Theil [1967], P. Conceiçao and J. K. Galbraith [1998]). Both indexes work well in the sense of a reduction of the disparities, the "wage effect" dominating the "job creation effect": whatever the case, the value of both indexes falls (Figure 2) with regard to the situation before reducing working time.

Naturally, these results reflect only the variation of inequalities between both categories of employees and not within every category. But the same qualitative results are obtained by considering a cut at 1.3 times the SMIC between both categories of workers and on the basis of realistic values of the parameters ($\gamma_i = 0.95$, $\gamma_j \in [0.83;0.85]$; $\sigma_j^i \in [0.2;2]$; $\sigma_k^i = 1$; $\sigma_k^j \in [0;0.5]$)[17].

Finally, the 35-hour work week would reduce the inequality both within the labor force and among workers (i.e. skilled and less skilled)[18].

[17]Except in the marginal case where $\gamma_j = 0.85$, $\sigma_j^i = 2$ (rarely found in the literature) and only through the calculation of the Gini index.

[18]Note, however, that these results do not take into account wage inequality between those who are already employed and those who - thanks to the 35-hour work week - have recently been hired, this because our model is a static one. Moreover, we do not distinguish between the type of company (particularly small or big companies).

4. Some extensions

1. Financing the 35-hour work week

The 35-hour work week enables an organized reduction of the weekly duration of work, a reform of a device designed to lower an employer's social security contributions and a set of measures allowing this reform to be financed. Until now, we modeled only the two first aspects. The terms of financing are not yet known with enough precision to analyze the economic consequences. It is, however, clear that they can strongly modify the conclusions of this study, both in terms of net effects on employment and net effects on inequality, within the employed labor force as well as within the total working population. From there on, the key question today concerns the conditions for the financing of the 35-hour work week, both from the point of view of economic efficiency as well as equality.

A scenario of reference would be one in which financing is uniformly distributed throughout all production factors: a contribution at the same rate t_A, is applied to the capital and to the various categories of employees. If one considers an unfavorable case for the employment of a complete financing of the *ex–ante* cost of implementing the 35-hour work week, this rate must prove:

$$\sum_{j=1}^{n} p_j \beta_j \Omega_j N_j H = t_A \left\{ \sum_{j=1}^{n} \left[p_j \Omega_{1j} N_j H + \left(1 - p_j\right) \Omega_j N_j H \right] + R\tilde{K} \right\} \tag{9}$$

where :

N_j represents the *ex-ante* employment level;

p_j is the proportion of workers of type j whose weekly working time is reduced to a 35-hour work week; we assume that p_j is the same for all categories of workers: $p_j = p$; $\Omega_{1j} H$ represents the *ex-post* individual labor cost for workers whose weekly working time was reduced*:*

$$\Omega_{1j} H = \Omega_j \left(1 + \left(1 - \gamma_j\right) \frac{dH}{H} - \beta_j \right)$$

Therefore, the elasticity of workers in the weekly hours of work is rewritten:

$$\eta_H^{N_i} = \left[-(1-s)\sigma_k^i (1 - \gamma_i - \beta_i \left(\frac{dH}{H} \right)^{-1} - \eta_H^e + \eta_H^d) - \eta_H^e \right]$$

$$- \frac{\upsilon}{\upsilon - \theta} \left[-\eta_H^e s - \eta_H^d (1-s) + t_A \left(\frac{dH}{H} \right)^{-1} + \sum_{j=1}^{n} \left(1 - \gamma_j - \beta_j \left(\frac{dH}{H} \right)^{-1} \right) s^j \right]$$

$$+ \sum_{j \neq i, j=1}^{n} s^j \sigma_j^i \left[\left(\gamma_i - \gamma_j\right) + \left(\beta_i - \beta_j\right) \left(\frac{dH}{H} \right)^{-1} \right] \tag{10}$$

In expression (10), the effects of substitution are unchanged because the tax is the same on all the factors. Consequently, the impact of the 35-hour work week on wage inequality among all workers also remains unchanged. Only the income effects are modified. Thanks to other simulations that take into account taxation, we find that the impact of reducing working time on job creation is divided in two overall. Except in extreme cases where productivity gains are minimal $\left(\eta_H^e = 0.75\right)$, when the duration of equipment use

decreases $\left(\eta_H^d = 0.1\right)$ and when the elasticity price of the demand is strong $\left(\eta_P^Y = -2.2\right)$, the net impact on employment of reducing the weekly duration of work is positive. Globally, as inequality among workers decreases and as the employment level increases, wage disparities within the whole labor force also decrease.

With regard to this reference scenario, the cost of the 35-hour work week can be supported in various manners by production factors. A new set of simulations shows that the most favorable cases for increasing the employment level, as for reducing inequality, are those where the tax on the capital has been raised the most[19]. A slightly less favorable case is one where the financing is mainly supported by skilled workers. The most unfavorable case is one where unskilled workers support the main part of the financing. Only this last scenario leads to an inversion of the effects on employment and disparities. A uniform financing thus leaves our main conclusion qualitatively unchanged.

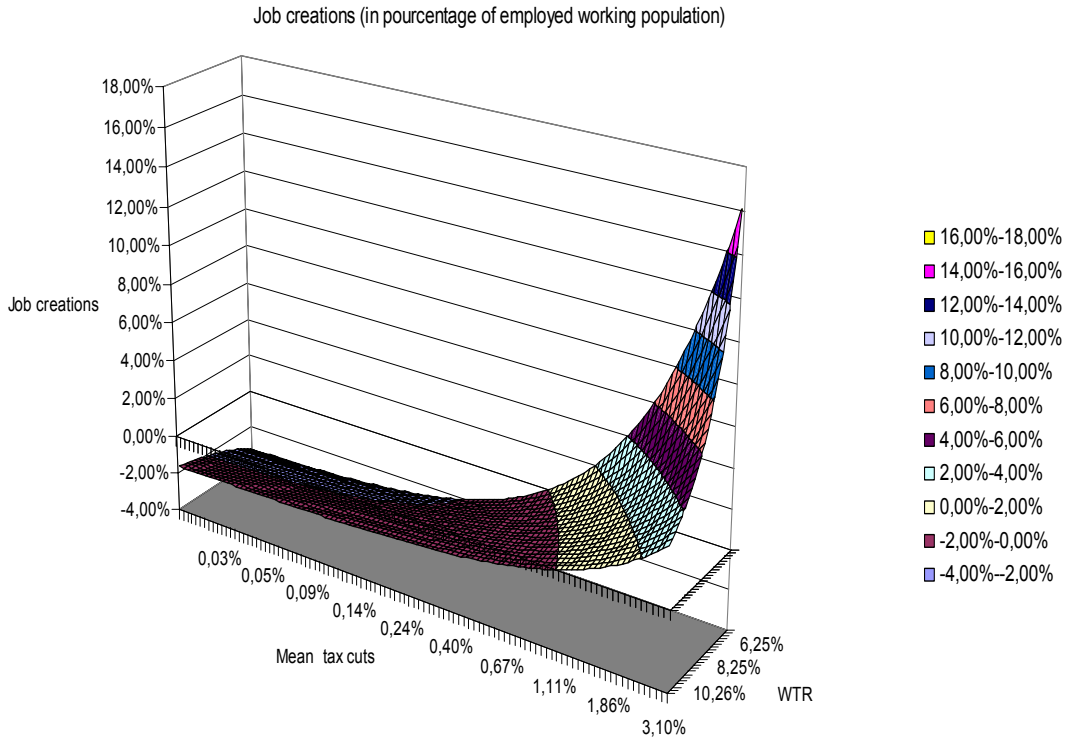
2. Smaller tax cuts, smaller WTR

To complete this evaluation, we can vary the dimension of the WTR such that the employer's social security contributions decrease to determine when we most increase the employment level. Under a median hypotheses (Graph 4), one raises the number of workers less with smaller tax cuts and one increases it more by making a weaker decline of weekly working time. This is not surprising in as far as we considered large wage degrees of compensation. Moreover, a WTR without tax cuts results in job destruction except in optimistic scenarios concerning productivity gains schedules, the degree of reorganization and income effects. Then, the model takes into account only the labor costs "aspects" and consequently, a smaller WTR without any lowering tends to have a less negative impact on the employment level. Finally, if we take into account the overtime cost for firms which have not implemented the 35-hour work week, the number of jobs created will be reduced by 62,500 people[20].

[19]Let us note that one takes into account here only the demand of factors and the demand of goods. Neither are the process of accumulation of equipment and human capital, their long-term effects being on growth and employment, which would imply using a dynamic model.

[20]If we consider 4 overtime hours (39-35), each paid with a 25% premium, and an elasticity of labour in its cost of –0.5.

Graph 4. Job creation as WTR and employers' social security contribution decreases vary.



Notes: Assumptions: $\eta_P^Y = -\frac{8}{3}$, $\sigma_k^j = 0.5$, $\sigma_j^i = 1$, $\eta_H^e = \frac{2}{3}$, $\eta_H^d = 0$.

Sources: Authors' calculations based on equation (8).

3. Impact on welfare inequality

The 35-hour work week does not have the same effect on wage inequality as it does on welfare inequality. More skilled employees earning high wages are expected to have a leisure marginal utility larger than the others (the opposite should be true for the consumption marginal utility). The intensification of the work rhythm is also likely to invert the results obtained until now, in favor of a reduction in disparities (in terms of distribution of the salary mass - except social security contributions and decreases). Our purpose is then to try and determine the ratio of marginal utility of the leisure which would most exactly compensate the income differential reduction, at first between two individuals of both categories under consideration, then between both categories of individuals (i.e. by taking into account the relative variation of workers during the WTR).

Let us consider the standard program of optimization of a consumer - a type i employee whose utility function u_i is increasing and concave in the consumption $cons_i$ and leisure l_i:

$$\max_{cons_i, l_i} u_i\left(cons_i, l_i\right) \text{ subject to} \qquad (11)$$
$$w_i H_i \geq cons_i \text{ and } H_i = T - l_i$$

where: T is the time endowment, identical from one individual to another;

w_i is the real net wage of an employee before WTR: $w_i = \frac{\Omega_i}{P} \times \frac{1-TCSS_i}{1+TCSE_i-\alpha_i}$, $TCSE_i$ ($TCSS_i$ respectively) represents the rate of employers' national insurance contributions (respective to the rate of national insurance contributions on wage) except tax cuts for type i employees ; α_i is the rate of reduction of low salaries (before the implementation of the 35-hour work week), also in a percentage of the gross salary.

If we assume that the legal duration will be imposed on every individual ($H_i = H$), the "solution" for the program (11) is $\overline{cons_i} = w_i H$ et $\overline{l}_i = T - H$. Hence, constrained indirect utility is $\overline{u}_i(w_i H, T-H) = \overline{u}_i\left(\Omega_i \times \frac{1-TCSS_i}{1+TCSE_i-\alpha_i} H, T-H\right)$[21]. Following the implementation of the WTR, an increase in welfare inequality – between two skilled and unskilled workers – will occur if[22]:

$$\frac{\frac{d\overline{u}_j}{dH}}{\frac{d\overline{u}_i}{dH}} > 1 \tag{12}$$

However, for all type i individuals:

$$\frac{d\overline{u}_i}{dH} = \frac{\partial u_i}{\partial cons_i}\left[(1-\gamma_i)\Omega_i \frac{1-TCSS_i}{1+TCSE_i-\alpha_i} + \Omega_i H \frac{\partial \alpha_i}{\partial H} \frac{1-TCSS_i}{(1+TCSE_i-\alpha_i)^2}\right] - \frac{\partial u_i}{\partial l_i} \tag{13}$$

with $\frac{\partial \alpha_i}{\partial H} < 0$ corresponding to reductions in employers' social security contributions supplement (called ACBMS – ACBS) following the transition to the 35-hour work week[23]. As α_i only depends on H, we have $\frac{\partial \alpha_i}{\partial H} = \frac{d\alpha_i}{dH}$. Combining (12) and (13) and assuming that the individuals are in their optimum in the initial legal weekly work duration, one comes up with a relation concerning the ratio of the leisure marginal utilities among both individuals[24] :

$$\frac{\frac{\partial u_j}{\partial l_j}}{\frac{\partial u_i}{\partial l_i}} > r \equiv \frac{\gamma_i - \frac{d\alpha_i \times \left(\frac{dH}{H}\right)^{-1}}{1+TCSE_i-\alpha_i}}{\gamma_j - \frac{d\alpha_j \times \left(\frac{dH}{H}\right)^{-1}}{1+TCSE_j-\alpha_j}} \tag{14}$$

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[21]For convenience, we normalized the price of the consumer good to one.

[22]We assume that the set profile $\{u_k\}_{k=i,j}$ is defined up to an affine transformation, i.e. $\{u_k^*\}_{k=i,j}$ represent the same preferences than $\{u_k\}_{k=i,j}$ if : $u_k^* = a + b u_k^*, b > 0,\ a \in R$ (see C. List $[2001]$ and P. J. Hammond $[1991]$ for a survey on ICU's (interpersonal comparisons of utilities) concerns. Given ICU's limits, we can alternatively consider that workers have the same preferences ($u_i = u, \forall i$) and only differ by income, social security contributions'rates and tax cuts.

[23]We consider here the possibility for repercussions in tax cuts, in the form of net wage increases. Later, cases where the declines in a lowering trend are not echoed will also be shown.

[24]By affecting Lagrange's multipliers λ_i (respectively μ_i) to the constraint of inequality (respective of equality) of the program of consumer of type i, one obtains the following optimality condition: $\frac{\frac{\partial u_i}{\partial l_i}}{\frac{\partial u_i}{\partial cons_i}} = \frac{\lambda_i w_i + \mu_i}{\lambda_i}$ where $\lambda_i = \frac{\partial u_i}{\partial cons_i} > 0$. For unconstrained individuals, we have $\mu_i = 0$, which will be assumed when considering initial legal working time.

This condition is a function of the differential of wage compensation degrees and of a term including the differential of supplemental decreases in employers' social security contributions, with the largest decreases for people with low wages. Therefore, an increase in (welfare) inequality will be all the less likely as the differential of compensation degrees and tax cuts is high, because the value of leisure marginal utility would have to be very large for high salaries compared to that for low salaries.

If we use the parameters'values found in Table 2, the ratio value is 1.6: ceteris paribus, a decline of weekly working time should increase the utility of high salaries by 60% more than that for low salaries, so that inequality in terms of welfare remains unchanged and this in spite of the reduction of the wage differential. In addition, without taking into account the impact of tax cuts on net salaries, r is equal to the ratio of wage compensation degrees and has a value of 1.27 (that is $\frac{0.95}{0.75}$). The "borderline ratio" is probably part of $[1.3;1.6]$ and will therefore take realistic values. Consequently, the results obtained in section 3 can be qualified thus: if the implementation of the 35-hour work week should result in a decrease in wage disparities, one could expect a rise in welfare inequality.

When next considering job creation, we adopt a utility function $U_i(CONS_i, LE_i) = U_i(N_i cons_i, N_i l_i)$ for every group i with the same properties as for the individual function. The program of every group carrying on $CONS_i$ and LE_i is equivalent to the choice by this group of optimal $cons_i$ and l_i for a representative individual belonging to group i; the "solutions" for every group are then $\overline{CONS_i} = N_i \overline{cons_i}$ and $\overline{LE_i} = N_i \bar{l}_i$. By keeping the same criterion (12), but this time based on the "indirect" utilities of the two groups, one obtains:

$$\frac{\frac{\partial \bar{U}_j}{\partial LE_j}}{\frac{\partial \bar{U}_i}{\partial LE_i}} > R \equiv \frac{N_i}{N_j} \frac{\gamma_i - \frac{d\alpha_i \times \left(\frac{dH}{H}\right)^{-1}}{1+TCSE_i-\alpha_i} - \eta_H^{N_i} \frac{T}{H}}{\gamma_j - \frac{d\alpha_j \times \left(\frac{dH}{H}\right)^{-1}}{1+TCSE_j-\alpha_j} - \eta_H^{N_j} \frac{T}{H}} \tag{15}$$

where one finds, by intuition, a term which at once takes into account the differential in number of workers $\left(\frac{N_i}{N_j}\right)$ before WTR and the relative variation of the workers in every category (weighted by the opposite of the ex-ante portion of working time in the total time available, that is $\eta_H^{N_i} \frac{T}{H}$).

A calculation of R shows that its value runs from 1.4 and 1.61 according to the given scenario: in particular, an increase in inequality (small values for R) is more likely to occur if hourly productivity gains are small, reorganizations are strong and possibilities of substitution between both categories of workers are weak, thus WTR is favorable to more skilled workers[25].

Finally, the 35-hour work week increases welfare inequality. This last result would certainly be strengthened if one took into account the intensification in working pace, presumably more unfavorable to the unskilled[26] than to the skilled. The consideration of a uniform financing of tax cuts should not modify this conclusion either.

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[25]In the case (usually found in the literature) where $\sigma_j^i = 1$. If we position on the whole range of values for σ_j^i, we obtain: $R \in [1.29;1.84]$, these two "borders" corresponding to the extreme hypothesis $\sigma_j^i = 2$. On the other hand, for values of $\sigma_j^i < 1$, R is closer to one.

[26]By considering, for example, a function such that $u_i = u_i\left(c_i, l_i, \frac{e_i(H)}{H}\right)$ with $\frac{\partial u_i}{\partial \frac{e_i(H)}{H}} < 0$.

5. Conclusion

In this study, our objective was to analyze the impact on inequality of the implementation of a 35-hour work week in France. Indeed, the device to reduce unemployment ran the risk of modifying the wage income distribution within the active working population in three ways: the creation/ destruction of jobs, in favor or not of skilled employees; the degree of wage compensation, higher for the most weakly paid individuals; the new initiative of lowering employer's social security contributions for low to average salaries. To study the impact of these mechanisms on employment and wages, we have considered the reference framework of the neo-classical theory on labor demand with imperfect competition on the goods market. In addition to the traditional determinants of the success of WTR in terms of job creation, our model shows which factors increase employment disparities: specifically, the more productivity gains are great, the more the 35-hour work week will benefit unskilled workers and so contribute to increasing wage inequality; the opposite is true when considering the effects of reorganizing production processes that are more advantageous for the most highly-skilled.

Numerical simulations show that the differential of labor cost decline (in favor of the unskilled) implied by the lowering of an employer's social security contributions allows the differential linked to the increase in hourly pay to be compensated for (not favoring the unskilled). Finally, the 35-hour work week results in job creation at the level of 15 in 50% of the "rule of three", either of the order of 1.5 in 5% of the initial concerned workers, or from 105,000 to 350,000. In all cases, there is also a resulting decline in working hours (since WTR always creates fewer jobs in comparison with the "rule of 3"). In addition, the calculation of Theil and Gini indexes before and after the 35-hour work week shows that the disparities in terms of distribution of the salary mass (except for social contributions) would decrease for all values of parameters. If they create jobs while lowering the disparities among those who have a job, the 35-hour work week reduces inequality within the labor force. A uniform financing of all factors involved in production divides the effects of WTR on employment in two and always causes a decline of wage disparities among those who have a job as it does within the whole working population. Taxation concentrated on the capital or on skilled workers leads to more job creation and to a larger decline in disparities, whereas financing concentrated on unskilled workers/ low salaries leads to inverse effects. However, leisure marginal utility of skilled workers / people earning high wages is, presumably larger than that of less skilled workers. Moreover, an intensification in the work pace should doubtless be less favorable for less skilled employees. Simulating a leisure marginal utility ratio compatible with unchanged welfare inequality leads to a relatively weak value for this ratio (belonging to [1.2;1.6]), which suggests an increase in welfare inequality among all employees, as well as within the whole working population.

However, this framework has both its theoretical and empirical limits. First of all, the reduced equation used for the simulation is based on two debatable hypotheses. To begin, it assumes that the functions of efficiency are the same for all individuals: a decline in the weekly duration of the work would have the same effect on the work efficiency of all employees, although their tasks differ. Subsequently, the working time is supposedly identical from one category of worker to another, which is not empirically verified. Besides, this approach does neither take into account individual nor household labor supply, which was thought to be infinitely elastic both in the hourly wage rate and in the time of weekly work, while a decline of the weekly duration of work leads instead to an intensification in work. Finally, the accumulation of physical and human capital, as well as an open economy were not considered.

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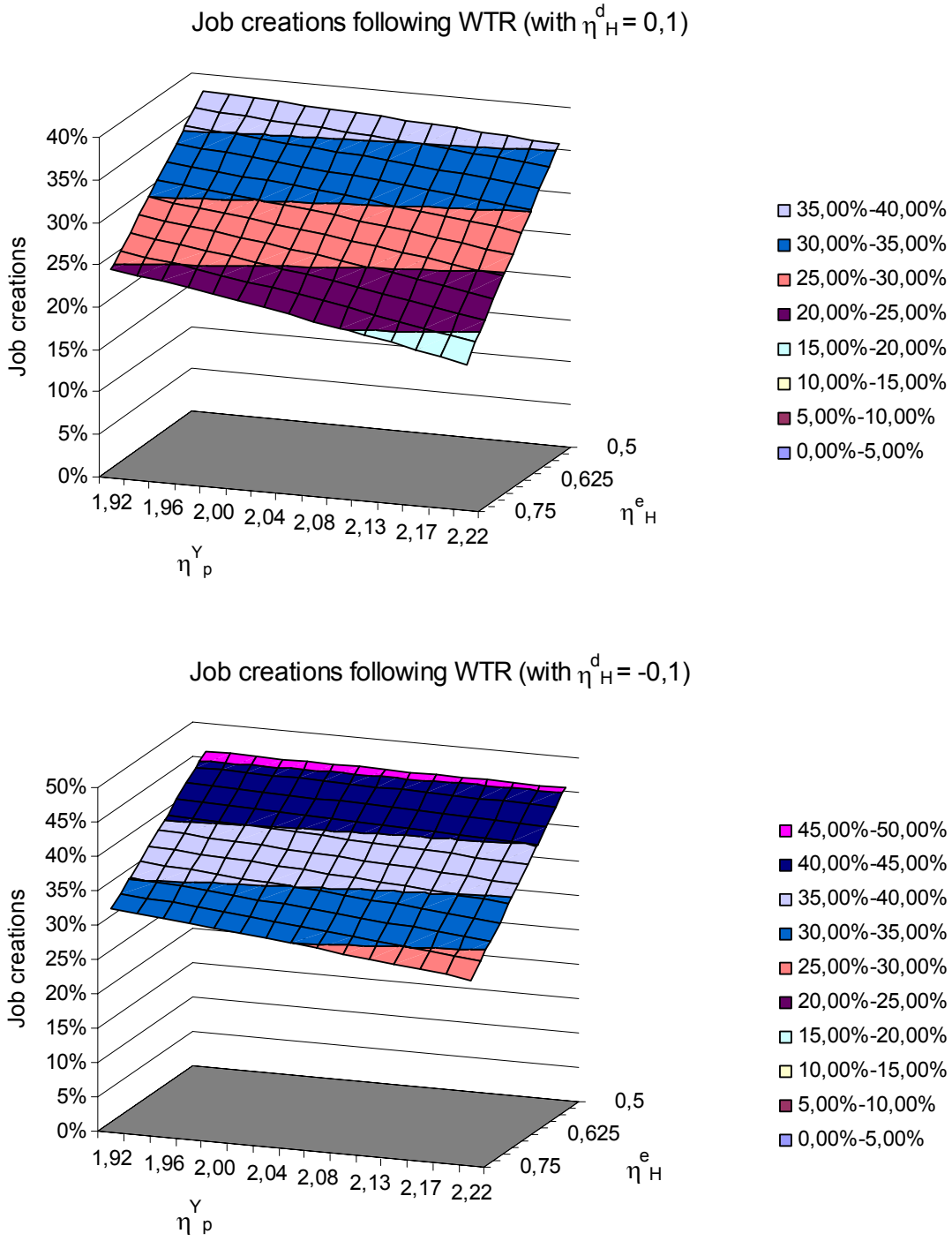
Appendix : Notations

- n categories of workers;
- N_i $\left(\forall i = 1,...,n\right) \equiv$ number of workers i employed by the representative company;
- $H \equiv$ weekly working time: $H = H_i = T$ $\left(\forall i = 1,...,n\right)$, where T represents the legal weekly working time (hours a week);
- $L_i \equiv N_i e_i\left(H\right)$ is labor (efficient units). The individual efficiency function e_i is supposed to be increasing in H, constant among workers and concave at least from a certain threshold (so that $\frac{e_i(H)}{H}$ be a decreasing function of H); we also assume that: $e_i = e,\ \forall i \in \left[1,n\right]$.
- $K \equiv \tilde{K}d\left(H\right),\ \tilde{K} \equiv$ demand of the company for real capital stock; $d\left(H\right) \equiv$ duration of utilization of equipment (increasing in H);
- $F\left(K, L_1,...,L_n\right) \equiv$ production function of a company (F is increasing, concave and homogeneous of degree θ);
- $C\left(W_1,...,W_n, r, Y\right)$ is the company's function of cost and we note:
  - W_i is the efficient labor cost for individuals of type i;
  - r unitary cost of physical capital;
- $\Omega_i \equiv$ hourly cost of labor (*before WTR*) for a worker belonging to category i;
- $\gamma_i \equiv$ degree of wage compensation for i: $\gamma_i \in \left[0,1\right]$;
- $\beta_i \equiv$ lowering employer's social security contributions, in percentage of Ω_i;
- $\Omega_{i1} \equiv$ the *ex-post* labor cost: $\Omega_{i1} \equiv \Omega_i\left(1 - \gamma_i\left(\frac{dH}{H}\right)^{-1} - \beta_i\right)$;
- $\eta^{\iota}_{\tilde{n}} \equiv$ elasticity of ι to $\tilde{n}$; so we have: $\eta^{\Omega_i}_{H} = -\gamma_i$ is the elasticity of Ω_i to H;
- $\sigma^{i}_{j} \equiv$ partial substitution elasticity of production factor i to factor j;
- $s^j \equiv$ share of labor cost j in total production cost;
- $\upsilon \equiv \frac{1}{1+\eta^P_Y} \equiv$ one plus the mark up rate ($\eta^P_Y = \frac{1}{\eta^Y_P}$ where η^Y_P represents the demand to price elasticity); $\upsilon \geq 1$ if $\left|\eta^P_Y\right| < 1$.
- $u_i\left(cons_i, l_i\right)$ (respectively $U_i\left(CONS_i, LE_i\right)$) is the utility function of one worker of type i (respective to group i); we assume it to be concave and to be increasing in its two arguments, the demand for goods of type i individuals (respectively of group i – $CONS_i = N_i cons_i$) and the demand of leisure of type i individuals (respective of group i – $LE_i = N_i l_i$);
- $TCSS_i$ (respectively $TCSE_i$) represents the rate of national insurance contributions on wages (respective to an employer's social security contributions, excluding decreases) in percentage of the *ex-ante* gross wage;
- $w_i \equiv \frac{\Omega_i}{P}\frac{1-TCSS_i}{1+TCSE_i-\alpha_i}$ is the *ex-ante* net wage of a type i worker, α_i is the rate of an employer's social security contributions as lowered before WTR.

Figure 1. Variations in the number of aggregate jobs following WTR, with regard to the values of η_H^e, η_H^d and η_P^Y (considered in absolute value).



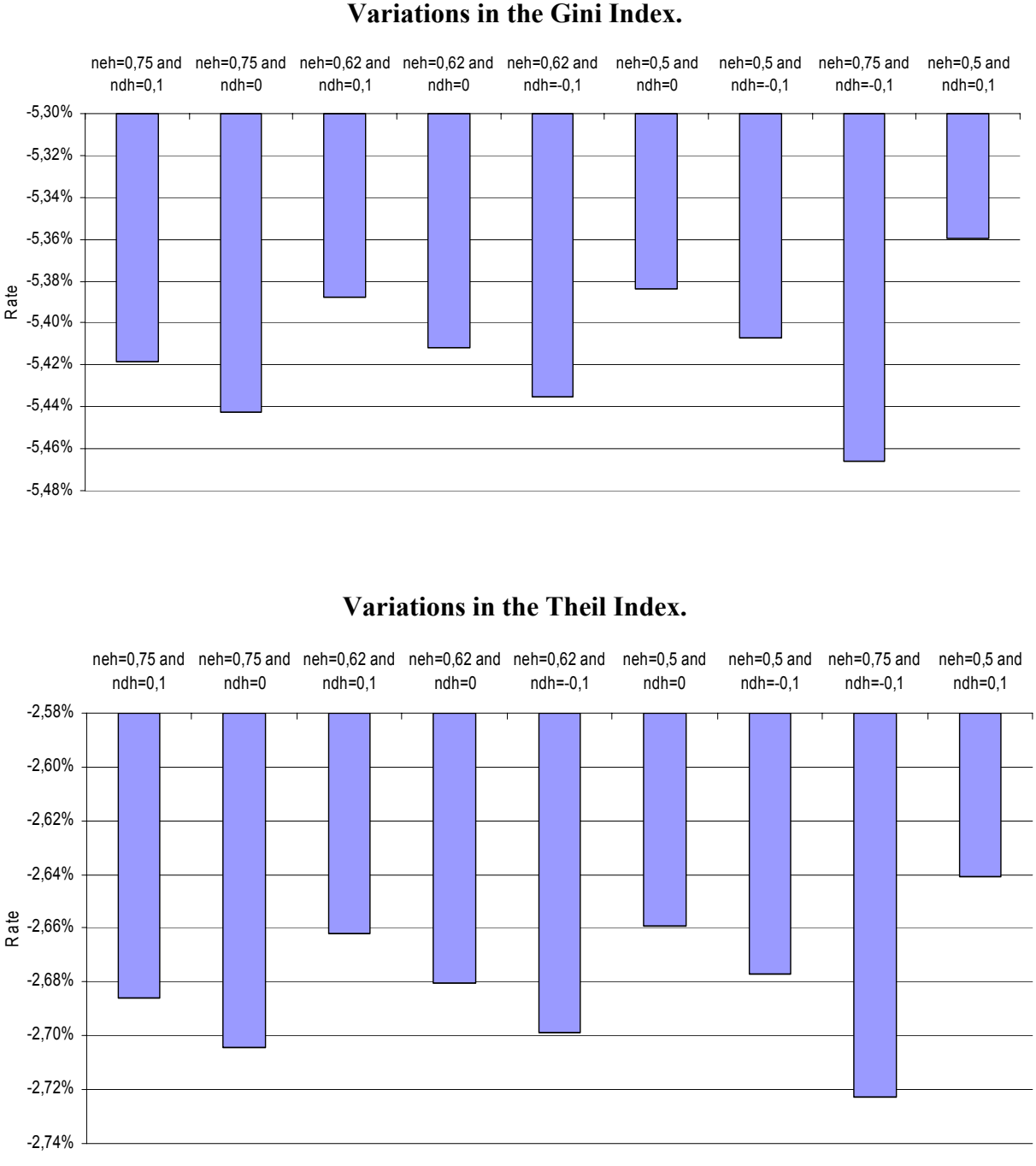
Note: Job creation is expressed in percentage of the "rule of 3" (assumptions : $\sigma_j^i = 1$ and $\sigma_k^j = 0.5$).

Sources: Authors' calculations based on DADS and on equation (8).

<u>Figure 1bis</u>. Consequences of a variation in σ_j^i on aggregate job creation following the implementation of WTR policy (η_P^Y is taken in absolute value and $\sigma_k^j = 0.5$).

Notes: Job creation is expressed in percentage of the "rule of 3".
Sources: Authors' calculations based on DADS and on equation (8).

<u>Figure 2</u>. Effects of the reduced working week on inequality in terms of distribution of the salary mass (except for social contributions) within the working population.



Notes: X-axis: situation (values of η_H^d and of η_H^e). Y-axis: growth rate of the index (in percentage of the index value calculated before WTR).
Sources: Results of an evaluation of the Aubry device thanks to simulations carried out on equation (8) and authors' calculations based on DADS.

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