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Wage Resilience in France since the Great Recession

Abstract

From 2009 onwards, the slowdown in French real wages was less acute than that in labour productivity, which pulled French firms' margin rate down. This article deals with this recent disconnection and surveys two potential explanatory hypotheses: labour force composition effects and downward nominal wage rigidities. The first assumption is related to the impact on the average wage of increasing job losses, especially when they are concentrated on lower-paid workers. Labour force structure evolution does contribute to wage resilience, but with little difference between 2009 and the period before, in which we observe a long run increasing trend of the working population toward a higher qualification. The downward nominal wage rigidities assumption is bounded by the empirical evidence of a significant amount of wage drops, while wage freezes are rare. Furthermore, in 2009, wages decreased faster as the firm's activity dropped than they increased as the firm's situation improved. However, the estimation, done at the wage earner level, shows the low response of wages to a (positive or negative) activity shock, especially for lower wage earners and large firms. The elasticity of wages with respect to a negative shock, though increasing in 2009, remains low in absolute terms. This wage inertia would facilitate the recovery of the firms' margin rate in times of strong economic upturn.

Keywords: Wages, Rigidity, Labour force structure, Cointegration

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La résistance des salaires depuis la grande récession s'explique-t-elle par des rigidités à la baisse ?

Résumé

À partir de 2009, le ralentissement des salaires réels en France a été moins prononcé que celui de la productivité des salariés, ce qui a tiré le taux de marge des entreprises françaises à la baisse. Comment expliquer cette déconnexion ? Deux facteurs sont étudiés. Le premier porte sur le changement de structure de la population salariée consécutif à une perte d'emploi plus concentrée sur les bas salaires. Ce facteur contribue bien à la résilience des salaires mais semble marginal pour expliquer cette déconnexion entre salaire et productivité. De fait, il contribuait aussi sur la période pré-crise en raison de la hausse de la qualification de la population active. Le deuxième facteur examine l'existence de rigidités nominales à la baisse des salaires. D'abord, une proportion significative des salaires a diminué et les gels de salaire ont concerné une très faible proportion de salariés. Ensuite, en 2009, les salaires ont plus baissé quand l'activité de l'entreprise a diminué qu'ils n'ont augmenté quand celle-ci a progressé. Pour autant, l'estimation économétrique effectuée au niveau des salariés montre la faiblesse de la réponse des salaires à un choc d'activité de l'entreprise du salarié, qu'il soit positif ou négatif, et ce particulièrement pour certaines catégories de personnes dont les bas-salaires, et pour les grandes entreprises. Bien qu'en nette augmentation, la réponse des salaires au choc d'activité négatif en 2009 reste ainsi faible en niveau et dans l'absolu. Celle-ci n'a donc pas permis de maintenir le partage de la valeur ajoutée au niveau d'avant-crise. En miroir, cette inertie des salaires pourrait permettre le rétablissement du taux de marge des entreprises en période de forte reprise.

Mots-clés : Salaires, Rigidités, Structure de la population active occupée, Cointégration

Classification JEL : C22, J21, J30, J31

Sommaire

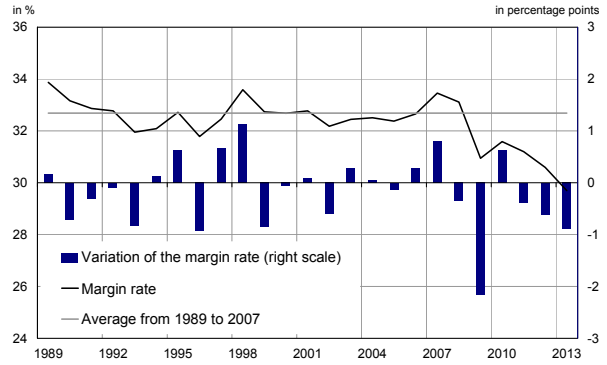
Introduction: during the crisis, wages have only slowed down, despite the fall in productivity

From the end of the 1980s to the 2009 Great Recession, the margin rate of non-financial companies remained remarkably stable in France, between 32% and 34% of value added. Since then, it has fallen almost continuously to a trough of 29.7% in 2013, almost 4 points below its 2007 peak (figure 1a). This drop was essentially the result of real wage[1] resilience over a period of falling productivity.

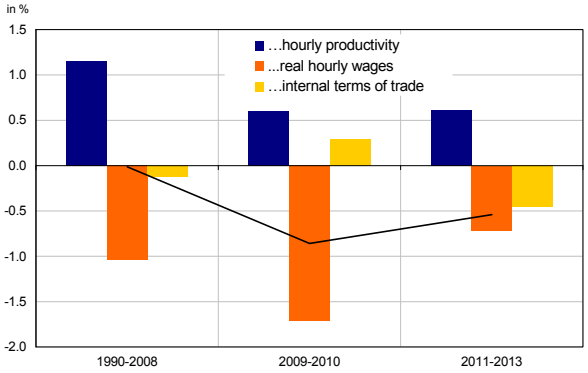
Three sub-periods show up (figure 1b). Between 1990 and 2008, real wages and productivity grew at the same rate, which resulted in the stability of the margin rate. In 2009-2010, the fall in inflation was only partly passed on to nominal wages, which resulted in real wages acceleration despite the deterioration in the labour market, while productivity gains were slowing down very sharply. The margin rate fell significantly, internal terms of trade[2] limiting this fall only slightly. In 2011-2013, real wages slowed down distinctly and their growth was close to that in productivity. Terms of trade had a negative effect this time, causing the margin rate to fall again.

1.- Margin rate of non-financial companies in France

a. Level and variation of the margin rate



b. Contribution to the variation of the margin rate of…



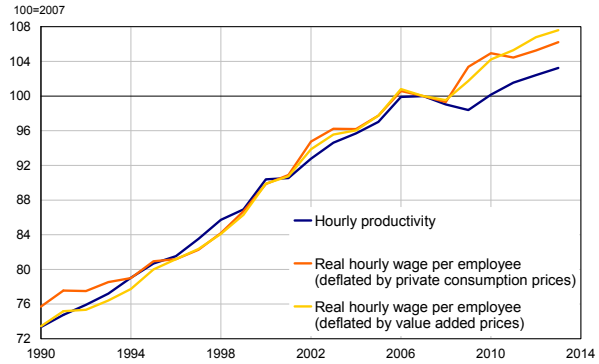
Note: Margin rate at factor costs (Value added minus taxes and subsidies on production). A negative contribution of real hourly wages means that they have grown.
Source: Insee, National Accounts.

While real wages and hourly productivity followed similar trends from 1990 to 2008,[3] the 2009 decline in productivity was not followed by wages. The modest upturn in 2010-2011 and relative stabilisation of activity in 2012-2013 did not bring convergence between these two variables (figure 2a). 2009 was also particular in two ways: for the first time since 1990, inflation was close to zero and hourly productivity had been strictly negative for two years (figure 2b). On account of the time taken by any adjustments, these shocks may have had an effect in 2009 as well as being taken into account by firms and workers for their 2010 wage negotiations.

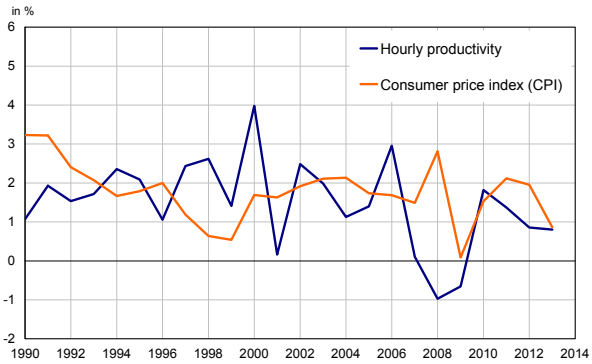
[1] Deflated by consumer prices.
[2] The growth in sale prices (in prices of value added, to be more precise) was less than that in the consumer prices on which employees base themselves in wage negotiations to maintain their purchasing power.
[3] It is noteworthy that before 1990, this relation was not so well verified (see for instance the Insee report, 2009)

2.- Wage, productivity and inflation in France

a. Wage and productivity



b. Productivity growth and inflation



Source: Insee, National Accounts.

The purpose of this article is to investigate this lasting disconnection between productivity and wages. Could it result from a long lag between change in the productivity trend and wages? Did the ongoing adjustments on the labour market affect the average wage growth? Are there any downward nominal wage rigidities in France whose effect could have held back the adjustment to disinflation and productivity shocks?

In section 1, we develop a macroeconomic model of wage, in order to quantify the disconnection. Amongst other things, we find that the spontaneous indexing of wages on productivity is slow. However, in 2009 and above all in 2010, even taking account of this delayed adjustment, the disconnection remains, with a wage growth greater than expected according to its main economic determinants. Two main explanations are often met in the literature and studied in the next two sections of the paper.

In section 2, we study the assumption that the 2009-2010 disconnection could come from changes in the labour force structure. Indeed, the average wage calculation aggregates very contrasted population groups, especially in terms of income levels and vulnerability to activity shocks. It is therefore slightly sensitive to adjustments in payroll linked to employment flows. We find, through an Oaxaca decomposition, that the structure effect weights for 0.7 points each year on average wage growth, but also that this contribution was of 0.4 points prior to the Great Recession. The effect of labour force structure changes therefore seems not strong enough to explain the disconnection.

In section 3, we investigate the mechanisms of wage settings, focusing on labour force stocks rather than flows. We emphasize the impact of downward nominal wage rigidities on the average wage, which should be a more binding constraint during recessions and could thus account for the disconnection. We measure downward nominal wage rigidities according to two different meanings: a restrictive one, which states that rigidities result in a very low frequency of wage cuts, whereas the extensive one defines rigidity as an asymmetry in the response of wage to an activity shock, the adjustment being less pronounced to a negative change than to a positive one. We find that there are no downward nominal wage rigidities in the first meaning. However, a microeconometric analysis highlights the existence of an asymmetry as defined by the second meaning. In 2009, this asymmetry is nevertheless reversed: this particular year, firms that suffered a negative activity shock adjusted wages downwards and these falls were greater in scale than the rises granted by firms whose activity improved. Downward nominal wage rigidities therefore can not explain the particular 2009-2010 disconnection between wage and productivity.

We also find through the microeconometric estimation that the sensitivity of wages to firms' activity is very weak: a 10% shock on activity results in a change inferior to 1% in wages after one year. This could illustrate a more global rigidity of wage in regards to activity at a microeconomic level, which would not be asymmetrical but could yet explain the recent disconnection between wages and productivity highlighted at a macroeconomic level.

I - Section 1: macroeconomic modelling corroborates the disconnection between wage and productivity in the aftermath of the crisis

As shown previously, the trends in real wages and hourly productivity were similar from 1990 to 2008 but disconnected in 2009: on this particular year of the Great Recession, the drop in productivity was not followed by wages, and there was no convergence, even since the upturn of 2010-2011 and the two next years. We try in this section to establish a relationship between wages and their main determinants, which is possible through a macroeconometric modelling, using French national accounts.

I.1 Model

We choose to model gross wages in the non-agricultural market sectors on a full-time-equivalents basis (noted W hereafter, and WSG for the super-gross wage) for several reasons. First of all, this contains all the compensation of employees, including bonuses and overtime. Next, it excludes wages in non-market sectors, which are less cyclical and provide less information on what extent the shock can hit the economy. Finally, the wage in full-time-equivalents corrects a part of the structural change in working time, due to the growth in part-time work over the period, and short-term variations due to the use of flexibility mechanisms like part-time activity.

We estimate wages with their traditional determinants, that are inflation (CPI); the unemployment rate (U, as defined by the ILO), reflecting the bargaining power of workers and the degree of labour market tension; labour productivity[4] (Π), tracing the trends in productivity and some cycle effects (in conjunction with the unemployment rate); internal terms of trade (ToT), defined as the ratio between the household consumption deflator and the value added of the non-agricultural market sectors deflator; the employer social contribution rate (ESC); the minimum wage stimulus (CP for *coup de pouce*), to take into account not only the accounting effect but also its spillover effect. The introduction of a dummy variable in Q3 1982 (*d82q3*) reflects a period of temporary deindexing, while a step since Q2 1983 (*sup83q2*) allows for a documented change in the wage formation process.

Finally, the modelling includes an error-correction term (Wage Setting type); in the long-term relationship, wages are indexed on prices, whereas the indexation on the productivity is not unitary. A rise of one percentage point in the unemployment rate reduces wages over the long term by 0.7% while a one-point increase in productivity improves wages by 0.46%. The estimation, performed in one step, confirms the existence of a cointegration relationship, the error-correction term being significant at a level of 10% (cf. tables given in Banerjee, Dolado and Mestre, 1998).

I.2 Results

The results of the equation estimated over the period 1980Q1 – 2008Q4 are as follows, with an adjusted R² of 94.8% and a DW of 2.17:

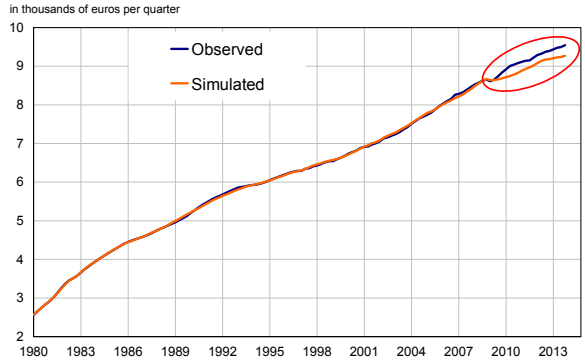
$$
\begin{aligned}
\Delta \ln W \;=\;& \underset{(4.0)}{0.50} - \underset{(-4.1)}{0.009} \times d82q3 - \underset{(-4.0)}{0.005} \times \sup 83q2 + \underset{(4.0)}{0.26} \times \Delta \ln W_{-1} + \underset{(6.5)}{0.30} \times \Delta_2 \ln CPI + \underset{(4.0)}{0.12} \times \left(\Delta \ln \Pi + \Delta \ln \Pi_{-5}\right) \\
& - \underset{(-2.7)}{0.3\%} \times \left(\Delta U - \Delta U_{-1}\right) - \underset{(-3.2)}{0.17} \times \Delta \ln ToT + \underset{(2.2)}{0.06} \times \Delta \ln CP - \underset{(-2.4)}{0.13} \times \Delta \ln(1 + ESC) + \underset{(2.5)}{0.12} \times \Delta_2 \ln(1 + ESC)_{-3} \\
& - \underset{(-3.8)}{0.09} \times \left[\ln WSG - \left(\ln CPI - \underset{(*)}{0.59} \ln ToT + \underset{(*)}{0.46} \ln \Pi - \underset{(*)}{0.007} U + \underset{(*)}{0.20} \ln CP \right) \right]_{-1}
\end{aligned}
$$

[4] More precisely, in the scope of the non-agricultural market sectors, this is productivity on a full-time-equivalent basis, corresponding to the ratio between value added in volume and full-time-equivalents employment.

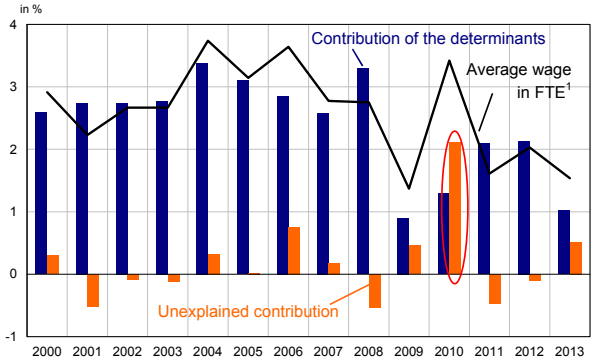
The econometric estimation indicates that spontaneous indexing of wages on productivity is particularly slow. Even once the adjustment has been made, it is not spontaneously unit indexing: all other things being equal, a slowdown in productivity does not necessarily go hand in hand with an equivalent slowdown in wages. The slowdown in productivity was particularly pronounced in 2009, even corrected for the cycle effect.

The dynamic simulation of wages was particularly satisfactory over the estimation period (figure 3). However, in 2009 and above all in 2010, even after accounting for the delayed adjustment of wages to productivity, wages growth remained significantly higher than expected (figure 4). This gap then remained: from 2011 on, real wages growth was again globally in line with its expected value according to the estimation equation, but without catching up. The years 2009-2010 are therefore highly particular.

3.- FTE[1] gross wage observed and simulated



4.- Contribution to wage growth



1. Full-time-equivalents
Field: France, non-agricultural market sector.
Source: Insee, National Quarterly Accounts.

II - Section 2: the slowdown in the average wage has been slightly held back by composition effect of the labour force

Our first hypothesis to explain the disconnection between productivity and wages is based on the idea that firms facing a fall in their activity adjust their payroll not only through wages, but also through their volume of labour, first cutting back on recruitments, then by laying off employees [Abowd *et al.*, 1999]. The resilience of real wage to activity shock, highlighted for instance by Barsky *et al.* (1994) or Hines, *et al.* (2001) points out implicitly an adjustment on employment. Especially, we expect that the lowest-paid workers would be relatively more dismissed, modifying the structure of the labour force and consequently contributing to limit the fall in the average wage.

Ananian et al. (2012) provide empirical evidence about the major drop in employment between Q1 2008 and Q3 2009, which impacted employees differently according to their type of employment agreement. Especially, at the beginning of 2009, workers and clerks were the first concerned by the rise in the separation rate. Verdugo (2013) explains a huge part of the wage resilience during the Great Recession by a composition effect, people belonging to high educated/high experienced groups being less affected by the dismissals.

II.1 Data

In this part of the paper, we use the Insee quarterly Labour Force Survey (LFS). It is available from Q1 2003 to Q4 2012, and is composed of the answers from six cohorts each quarter. Each cohort, defined by the quarter in which the first interview was conducted, is surveyed for five consecutive quarters, the first and last interviews including a questionnaire about wages. The population under study includes private-sector employees aged 15 to 64, excluding the self-employed, farmers, craftspeople, traders and CEO. The wage considered is the net monthly wage including bonuses.

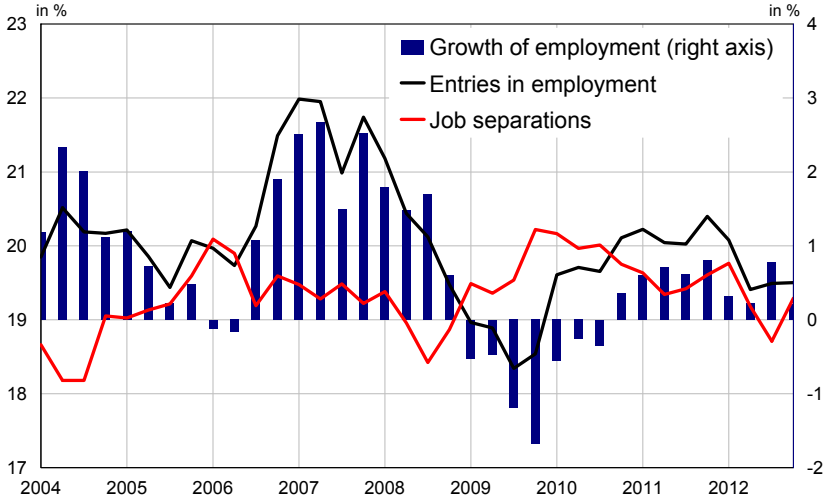
II.2 Descriptive statistics

The Great Recession was no exception to the rule that in France firms whose activity decreases adjust their payroll first by cutting back recruitments, then laying off employees: the contraction in employment was driven initially by a fall in hires in 2008, followed by a rise in job separations at the end of 2008 (figure 5). Shortly after the mid-2009 upturn, the number of people entering employment converged towards that of job separations.

The average wage per capita, computed as the payroll to employment ratio, depends on changes in the labour force structure. During recessions, the rise in unemployment hits more the less qualified, thereby reducing the proportion of low incomes in wage distribution and mechanically causing a rise in the average wage per capita. These composition effects partly mask real variations in wages on the individual basis. To what extent do composition effects impact wage dynamics during the Great Recession?

At the start of 2009, the number of people leaving a job was greater than the number of people finding one. Nonetheless, some categories of employees were less affected by the downturn; employment in these categories even increased. This was the case for the most qualified people with at least high-school education and for managers (figure 6). Conversely, employment among the least qualified and among blue-collar workers fell sharply in 2009 and 2010.

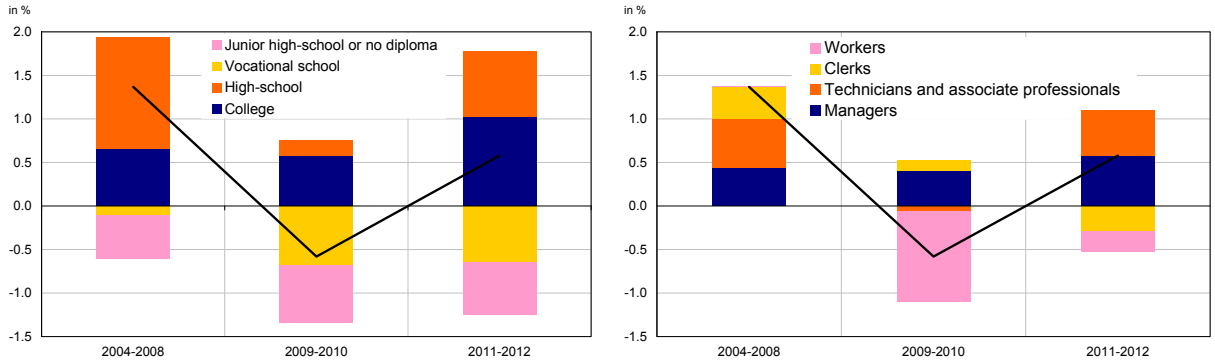
5.- Contribution to the growth of private payroll employment of entries and separations



Field: Metropolitan France, private sector workers from 15 to 64 years old.
Note: cumulation on 4 quarters. Enterings and job leavings in percentage of the employment in the last quarter.
Source: Insee, LFS, author's calculations.

6.- Contributions to employment growth by…

a. …educational level **b. …socio-economic position**



Field: Metropolitan France, private sector workers from 15 to 64 years old.
Note: over the period 2004-2008, private salaried employment under 15 to 64 years (excluding self-employed, etc..) rose 1.3% on average per year. College graduates contributed by 0.7 points to this growth while vocational school attendants weighed up to 0.1.
Source: Insee, LFS.

II.3 Model: decomposition of average wage growth using the Oaxaca method

To measure the consequences of these changes in the labour force structure on the average wage of the sample, we use the Oaxaca decomposition procedure (1973). The underlying idea of such a decomposition is, on the basis of a reference year, to compare the variation in the observed annual wage and in a counterfactual scenario based on a constant structure of the labour force. The structure of the labour force is indeed subject to long-term trends and short-term shocks between which a distinction has to be made.

This decomposition, which was initially developed to explain differences in wages between different groups (gender or ethnic groups in the United States...) can be adapted to the decomposition of variations in wages over time. To do so, an estimation was made of the logarithm of the wage of individual i (w^i) using the usual determinants ($X^{i,k}$), which are gender, age, socio-economic position and educational level:

$$w_i = \beta_0 + \sum_k \beta_k X_{i,k} + \varepsilon_i$$

The estimation was conducted separately for each year. The difference between two years A1 and A2 expresses the growth rate of the average wage as the sum of a composition effect and a wage effect:

$$\overline{w}_{A2} - \overline{w}_{A1} = \underbrace{\hat{\beta}_{0,A2} - \hat{\beta}_{0,A1} + \sum_k \overline{X}_{A1,k}\left(\hat{\beta}_{A2,k} - \hat{\beta}_{A1,k}\right)}_{wage\ \ effect} + \underbrace{\sum_k \hat{\beta}_{A2,k}\left(\overline{X}_{A2,k} - \overline{X}_{A1,k}\right)}_{composition\ \ effect}$$

Then the contribution, through the composition effect, of each characteristic to the average wage growth is easily computed, taking the average proportion of each group and multiplying it by the corresponding estimated parameter. That way, we compute a composition effect for each category.

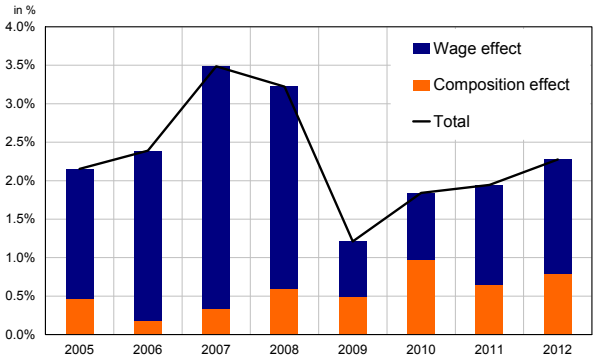
II.4 Results: the changes in the labour force structure limited the slowdown in wages

Over 2004-2012, a first observation is required: changes in the labour force composition contributed to the rise in average wage each year both before and after the crisis, due to the trend rise in the level of qualification of the labour force (figure 7). Between 2005 and 2008, this effect contributed 0.4 points to annual growth in wages on average. For instance, if the structure of the labour force in 2005 had been the same as in 2004, the average wage would have grown by 1.7% instead of 2.2%.

Starting from 2009, the analysis leads to two important conclusions. First of all, it shows that composition effects are a little higher: each year from 2009 onwards, these effects exceeded 0.5 points, with a maximum of 1 point in 2010 in particular (figure 7). Next, the analysis confirmed the slowdown in the average wage per capita for an unchanged structure (average annual growth of 1.1% in 2009-2012 against 2.4% between 2005 and 2008). All in all, the growth in average wage over the period 2009-2010 came to 1.5% according to the LFS, of which 0.7 points from composition effects.

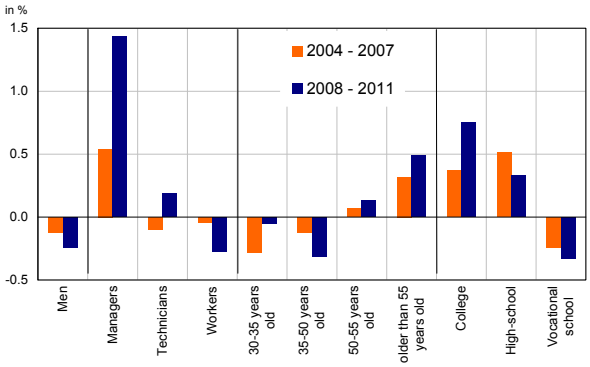
A more advanced estimation of the Oaxaca decomposition allows to compute the contribution of various individual characteristics to the composition effect. The result of such an estimation, over the 2004-2007 and 2008-2011 periods, highlights that the composition effects we measured are explained by a stronger rise during the Great Recession in the proportion of managers, the higher-educated and seniors (figure 8).

7.- Annual growth of average wage per capita and contribution of the composition effect



Note: Between 2004 and 2005, the average wage increased by 2.2% with 0.5 points from the composition effect. In 2010, the modification of the private employment structure contributed 1 percentage point to the average wage growth.

8.- Contributions of characteristics to wage growth



Note: between 2004 and 2007, for every 1 point of growth in the average wage over the three years due to the change in the structure of the active population in employment, half came from the rise in the proportion of managers.

Field: Metropolitan France, private sector workers from 15 to 64 years old, excluding self-employed people, farmers, craftspeople, merchants and CEO.

Source: Insee, LFS.

II.5 Conclusion

The contribution of the composition effect to wage growth between 2008 and 2011 was close to that of Verdugo (2013), but our analysis shows that half of this effect was structural: it was linked to a long-term trend and therefore cannot explain the resilience of wages since 2009.[5] In addition, this rise in the labour force education is also likely to have buoyed up average productivity. Finally, while it does show the sort of composition effect that is usually observed when labour markets deteriorate, this effect is already taken into account in the econometric model through the impact of unemployment on wages.[6] All in all, the effect of the labour force composition can only explain a marginal part of the unexpected resilience of real wages in recent years.

[5] On the basis of a decomposition of the wage distribution in France in groups formed by combining age and qualification levels, Verdugo (2013) explained the whole of the rise in the real average wage by composition effects (rise in the average real wage of 2% overall over 3 years between 2008 and 2011 against -0.8% based on a constant composition of the labour force). Verdugo (2013) also reasoned in real wage terms and seems to explain the correction in prices only by the wage effect. Other differences, of less importance, are also present: the scope of the analysis and wage variable used were not exactly the same, nor was the structure decomposition method.

[6] It should be noted that the macroeconomic specification was estimated in a period during which France did not experience any recessionary periods on such a scale. The behaviour of companies towards their workforce may therefore have been particular in recent years.

III - Section 3: downward nominal wage rigidities, another possible explanation of wage resilience

Another possible explanation of wage resilience over the period of the Great Recession relies on wage rigidities, notably downward nominal wage rigidities. 2009 being also a year of very low inflation, the average effect of such rigidities should be stronger than usual (Holden, 2004) even if Elsby (2006) provides evidence of a weak macroeconomic impact in presence of downward nominal wage rigidities due to wage increases compression. This section focuses on this explanatory factor, seeking first to specify what is meant by wage rigidities.

Economic theory defines wage rigidities as the result of mechanisms implying that wages change less than they should, whether upwards or downwards. The difficulty therefore consists in determining counterfactual variations in wages, which would have been observed in the absence of any rigidity. Two hypotheses are generally applied to these variations: they must be equal to the sum of inflation and the variation in labour productivity and their distribution must be symmetrical (Card and Hyslop, 1996). It should be noted that these two hypotheses are independent of each other: the distribution of wage variations may be perfectly symmetrical around its median, while resulting in an average value below the sum of inflation and the productivity growth. When the symmetry hypothesis is not met, we speak more specifically of downward or upward wage rigidities, depending on the type of asymmetry. Here, we are seeking to identify more particularly downward nominal wage rigidity.

Possible origins of downward nominal wage rigidities may be many and have been abundantly illustrated in the literature: regulations, the existence of a minimum wage or the risk of discouraging employees and of reducing their productivity.[7] One broad category of explanations is based on behavioural models and on the idea that wage policy ensues from negotiations between an employer and employees, the result of which depends on the financial situation of the firm, the overall situation of the employees and even of the wage level in the whole economy.[8]

Whatever the origin of these nominal wage rigidities, a distinction can be made between two definitions. The first and most restrictive one takes downward rigidities as situations in which, for a large number of firms, wages cannot be reduced and therefore do not change at all. In this situation, the distribution of variations in wages should be characterized by a concentration around zero and by an asymmetry with a deficit of negative variations (figure 9). The second, broader definition characterizes downward nominal wage rigidities as the situation in which responses to activity shocks are asymmetrical: the drop in wages is less intense when the shock is negative. In both cases, a poor economic outlook is thought to reinforce the average effect of such rigidities on wages.

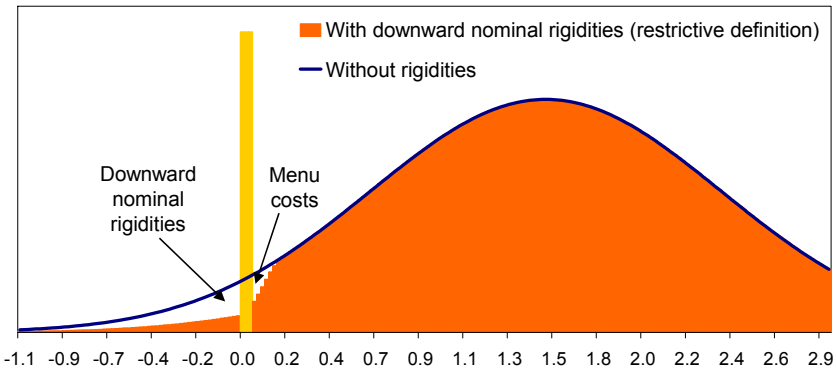
The presence of downward nominal wage rigidities has been deeply studied in the literature. Evidence of such rigidities has been brought at an international level, as shown by Kramarz (1991). Recently, Daly *et al*. (2012), analysing American data, observed thus a large proportion of wages that were constant from one year to the next and therefore concluded in the existence of downward nominal wage rigidities. Moreover, they showed that this proportion of rigid wages increased during recessions. In France, Heckel and al. (2008), using a survey on working conditions, underline that wages are more rigid downwards than prices. Biscourp *et al*. (2003) found that there were no downward rigidities in France at the end of the 1990s according to our first definition, but that a lesser adjustment in wages was indeed observed as a consequence of negative activity shocks, which corresponds to our second definition. In the meantime, international comparisons, such as Dickens *et al.* (2006)

[7] According to efficiency wage theory, due to information asymmetry between employee and employer, it may be in the interest of an employer to set a wage that is higher than the equilibrium level in order to encourage employees to be more efficient.

[8] See Askenazy *et al*. (2013) for an overview of the possible origins of wage rigidities.

or Holden and Wulfsberg (2007) show that France is one of the countries where downward rigidities are the weakest.

9.- Theoretical nominal distribution of changes in wage with and without rigidities



Note: The existence of nominal downward rigidities (orange histogram) is characterised by a concentration in zero (yellow) and a deficit of negative evolution of wages compared to the theoretical distribution without rigidities (blue curve). This figure also pictures the menu costs with a little deficit of positive evolution.

III.1 Data

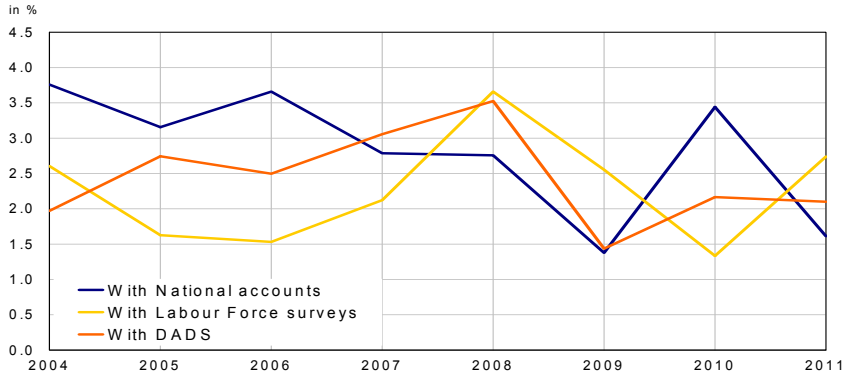
Additionally to the Insee LFS used in the previous section, we will use from now on the Annual Declaration of Social Data (DADS). The DADS source provides precise information about wages, hours worked and employment. The DADS panel is used for the econometric estimations as it offers the advantage of allowing continuous observation of wages.

We match the DADS data with tax returns (Ficus and Ésane databases), using the firm identification system over the period 2003-2011; the matching is of good quality, reaching 87% of the workers in the DADS. The tax returns provide financial and business data. These data allow us to extract the value added and revenue variables, but also the business sector. The field of the study is restricted to full-time private-sector employees. Our study focuses on the net annual wages growth. For this purpose we observe only the job stayers who remained in the same firm two consecutive years, and who worked there for the whole year, in order to guarantee comparability of wages as measured annually. The wage variable studied is a net one, *i.e.* after deduction of social security, pension and supplementary contributions. As for employee savings, these do not include incentives but do include profit-sharing when it is not invested in a firm savings plan.

For the LFS, in order to obtain variations in the net nominal wage, we match the individual responses from the same cohort at a 15 months interval (see Data in section 2). In the purpose of matching individuals at a 15 months interval, 35 re-weighted bases are created, each one covering a period running from quarter q of year n to quarter q+1 of year n+1. The population under scrutiny includes private-sector employees aged 15 to 64, excluding the self-employed, farmers, craftspeople, traders and CEO. In this section, we restrict to individuals who stated that they had more than 15 months' seniority in their firm, thereby guaranteeing that only people who had not changed firm over the period of interest were surveyed. The wage is the net monthly wage adjusted for nonresponses, including bonuses.

The wage measures provided by these two datasets are not strictly equivalent. We compare the average wage growth measured with DADS, LFS and National Accounts (figure 10). The results differ between the three sources, with differences that can sometimes reach two percentage points. The main reason of these variations is the way headcount is assessed: for the National Accounts, the average wage per head is defined as the ratio of gross payroll to average headcount over the year; for the DADS and the LFS, wage income corresponds to the ratio of payroll to total employees over the period, i.e. all individuals who have worked in the period, even only for one hour. Moreover, for the National Accounts, the wage is gross, while for DADS and the LFS it is net of the employee's social contributions and employee savings are only included in the National Accounts.

10.- Average wage growth

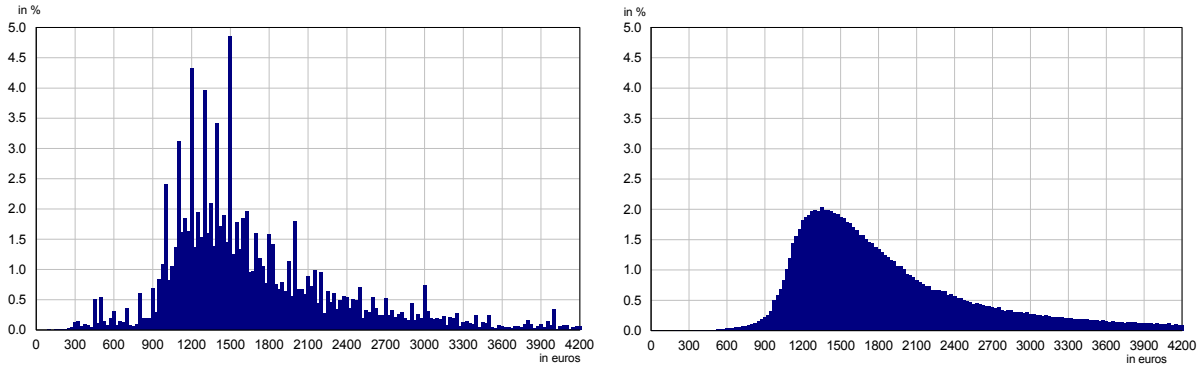


Field: full-time equivalent average gross wage in non-agricultural market sectors for the national accounts; full-time net average wage of employees working in the private sector for the LFS; full-time equivalent net average wage of employees working in the private market non-agricultural sector for DADS.
Sources: Insee, National accounts, LFS, DADS.

Despite these differences, wage distributions are globally similar in both the DADS and the LFS (figure 11). However, the wage distribution in the LFS shows peaks every hundred euros that are absent from the wage distribution in the DADS. While the DADS contain administrative data that are subject to audits, the LFS is declarative in nature. One of the consequences is a tendency among respondents in the survey to round off the wage values they declare.

11.- Distribution of the net monthly wage in 2007

a. In the LFS **b. In the DADS**

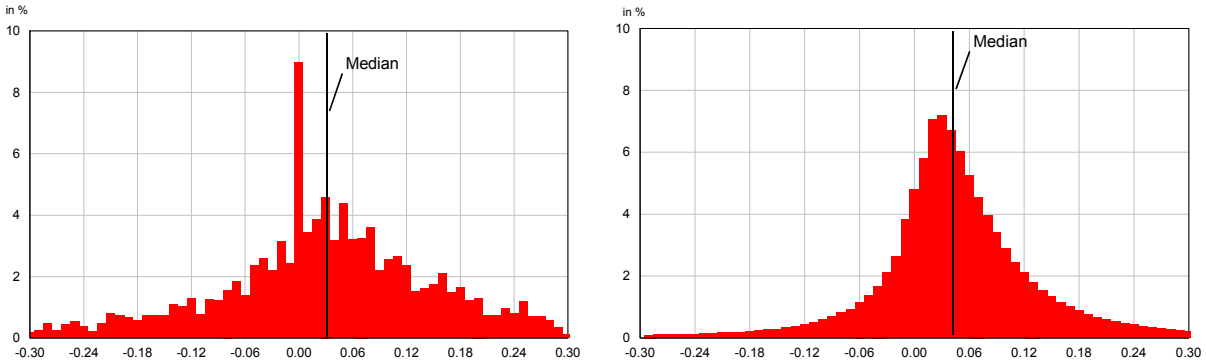


Field: France, full-time employees from the private sector working in the same firm two consecutive years for DADS; full-time private sector workers, from 15 to 64 years old, excluding self-employed people, farmers, craftspeople, merchants and CEO, and working in the same firm since at least 15 months for LFS.
Sources: Insee, LFS, DADS.

Among other things, this rounding off behaviour affects measurement of wages growth in the LFS: if the variation is less than one hundred euros, it is possible that the respondent may declare the same rounded off figure twice, in which case the measured variation will be zero. A large proportion of the wages growth is therefore zero in the LFS (figure 12), while this is not the case of the DADS: the phenomenon observed in the LFS does not necessarily shows the existence of downward nominal wage rigidities in the more restrictive meaning.

12.- Distribution of the wage growth in 2008

a. In the LFS **b. In the DADS**



Field: France, full-time employees from the private sector working in the same firm two consecutive years for DADS; full-time private sector workers, from 15 to 64 years old, excluding self-employed people, farmers, craftspeople, merchants and CEO, and working in the same firm since at least 15 months for LFS.
Note: histogram of the wage variations by increments of 1%.
Sources: Insee, LFS, DADS.

In light of this comparison, we will favour the use of the DADS, which give a more precise measure of the wage and its evolution. LFS will still be useful, for it presents many precisions about the working conditions of the employees, not included in the DADS.

III.2 Descriptive statistics: In the more restrictive meaning of the term, there were no downward nominal wage rigidities

In order to conduct a more in-depth analysis of downward rigidities in the restrictive meaning of the term, we looked at the proportion of employees who experienced no or little variation in their wage in a given period and we analysed its change over time. It confirmed the absence of wage rigidities in the restrictive meaning of the term: like Biscourp *et al.* (2003) before 2000, we observed that over the period 2003-2010, the proportion of near-zero growth was very low (figure 13), with each year less than 1% of employees having a strictly stable wage and around 6% of wages showing growth of less than 0.5% in absolute value. The proportion of drops in wage is always higher than 20% and identical irrespective of firm size. For example, in 2008 the proportion of wages that dropped was 22% in enterprises with less than 20 employees, and 21% in those with more than 250 employees. 2009 and 2010 reveal the largest proportion of negative wage variations, close to one-third, which indicates wage sensitivity to the economic situation of the firms.[9]

13.- Distribution of wage changes between 2003 and 2011 (in %)

	Near-zero growth (|rate| < 0.5 %)	Negative evolution (rate < 0 %)	Strong decrease (rate < -5 %)
2003	7	28	11
2004	7	26	11
2005	6	23	9
2006	6	26	11
2007	6	22	9
2008	5	21	10
2009	7	33	15
2010	7	30	13
2011	6	26	11

Field: France, full-time employees from the private sector working in the same firm two consecutive years.
Note: in 2010, 7% of employees have had a near-zero growth of their wage, 30% a negative evolution and 13% a strong decrease.
Source: Insee, DADS.

[9] Information about the variable part of wages is not available in DADS. The decreases observed very likely reflect adjustments to this variable part, which can take many forms (bonuses, 13th month, employee savings, etc.).

The distribution of wage growth is quite homogeneous on the observed individuals over the 2003-2011 period (figure 14). The largest differences can be observed according to the age and the wage level. Lower-paid workers are less subject to a reduction of their wage than higher-paid worker. This finding can be seen either as a minimum wage effect or as a result of the greater variable part of higher-paid employees' compensations. The first reason is related to an inability to cut wages near to the minimum wage threshold, whereas the second one arises from the French labour law. Indeed, when an employer decides to adjust wages downward, it is possible for him to reduce the variable component of the wage whereas it is very difficult for its fixed part because it implies to modify the employment agreement. As this variable part grows with the wage level, it is not surprising that higher paid workers are the first concerned by wage cuts. The youngest also experience less decreases in their wage than the seniors do. Given that youngest have lower wage, this can be related to the previous mechanism.

14.- Distribution of wage evolutions between 2003 and 2011 by characteristics of firms and individuals

	Near-zero growth		Negative evolution		Strong decrease	
	Mean	*Std Error*	Mean	*Std Error*	Mean	*Std Error*
All individuals	6.1	*0.8*	26.1	*3.7*	10.7	*1.7*
Sector						
Manufacturing Industry	5.8	*0.7*	25.5	*4.7*	10.2	*2.5*
Construction	4.9	*0.7*	27.7	*4.9*	12.4	*2.2*
Trade	6.6	*0.9*	26.3	*3.4*	10.6	*1.5*
Services	6.5	*0.8*	25.9	*3.1*	11.0	*1.2*
Firm headcount						
Less than 20 employees	8.0	*1.1*	27.6	*4.0*	11.5	*1.8*
20 to 50 employees	6.2	*0.9*	26.4	*4.7*	10.8	*2.3*
50 to 500 employees	5.6	*0.7*	25.7	*3.8*	10.6	*1.8*
More than 500 employees	5.4	*0.6*	25.3	*3.5*	10.3	*1.5*
Firm status						
In a group	5.6	*0.7*	25.7	*3.7*	10.5	*1.7*
Independent	7.2	*1.1*	26.9	*3.9*	11.2	*1.8*
Wage level						
First quartile	5.0	*0.7*	20.7	*2.8*	8.5	*1.1*
Medium quartiles	6.3	*0.8*	27.2	*4.2*	10.7	*2.0*
Last quartile	7.0	*0.8*	29.7	*4.0*	13.0	*2.1*
Gender						
Men	6.2	*0.8*	26.4	*4.1*	10.5	*2.0*
Women	6.0	*0.8*	25.4	*2.9*	11.3	*1.1*
Age						
Less than 30 years old	3.8	*0.6*	21.0	*3.1*	9.9	*1.4*
30 to 39 years old	5.3	*0.7*	25.1	*3.6*	10.9	*1.7*
40 to 49 years old	6.7	*0.8*	26.5	*4.0*	10.1	*1.8*
More than 50 years old	7.7	*0.9*	29.4	*4.0*	11.7	*1.8*

Field: France, full-time employees from the private sector working in the same firm two consecutive years.
Note: on the 2003-2011 period, an average of 6.1% of employees have experience a near-zero growth of their wage, with an inter-year standard error of 0.8.
Source: Insee, DADS.

III.3 A significant proportion of wages drop each year without necessarily any change in working conditions

Wages are not downward rigid in the most restrictive sense of the term. However, it is worth analysing whether wage drops are linked to changes in employees working conditions (drop in the number of hours normally worked, end of night-shift work or Sunday working, etc.). In that case we could not say there were no rigidities.

The LFS contains a rich array of variables on working conditions whereas DADS data do not, and they can be used to test this hypothesis (figure 15). In the course of the 2000s, including the years of recession or sluggish growth, less than 15% of wage decreases can be related to a change in working conditions. More specifically, just 6% of employees reporting a wage decrease had their working hours reduced. It therefore appears that a large share of wage drops came without a change in working conditions, and was probably due to a reduction in the variable part of compensation.

15.- Loss of wages and modifications of working conditions (in %)

	2005-2008	2009-2012
Proportion of employees whose nominal wage has decreased	**33.2**	**37.7**
among whom : working hours per week has decreased	*5.7*	*5.8*
do not work anymore (or less) on Saturday	*2.7*	*2.5*
do not work anymore (or less) on Sunday	*1.6*	*1.8*
do not work anymore (or less) during the night	*1.5*	*1.3*
increase of the number of "RTT" days that the employee is entitled to	*3.6*	*2.4*
increase of the number of days' leave that the employee is entitled to	*2.6*	*2.1*
job change compared to the last survey	*0.6*	*0.4*
workplace change compared to the last survey	*0.2*	*0.5*
profession change	*2.8*	*4.2*
at least one of these changes	***14.2***	***13.1***

Field: Metropolitan France, full-time private sector employees, from 15 to 64 years old, with fixed-term contracts or permanent contracts, and declaring working in the same firm since at least 15 months.
Note: on average, between 2005 and 2008, 33.2% of employees have had a pay cut. Of those, a decline in seven is justified by at least one changing working conditions.
Source: Insee, LFS.

III.4 Model

In this part we look at the broader definition of rigidities: there is downward nominal wage rigidity when wages react relatively less to a negative shock than to a positive shock on firm's activity. Thanks to the DADS/tax returns matching, we are able to measure changes in both the employee wage and the activity of the firm in which he/she is employed. Thus we can estimate an elasticity of wage with respect to activity shocks. By distinguishing in the estimation the cases when the activity increases or decreases, and then measuring the asymmetry of the wage sensitivity we are able to determine if there are any downward rigidities.

Our estimations of wage variations for individuals who were employed in the same firm for two years running use the methodology developed by Biscourp and Fourcade (2003). More specifically, we study the asymmetry in the response of wage growth to an activity shock using the following model:

$$\Delta \ln(w_{ijt}) = (\alpha^{+} 1_{\Delta \ln(ca_{jt})>0} + \alpha^{-} 1_{\Delta \ln(ca_{jt})<0}).\Delta \ln(ca_{jt}) + \delta x_{ijt} + \eta 1_t + \varepsilon_{ijt} \quad \textbf{(1)}$$

where:

- i represents the employee, j the enterprise and t the year;
- w represents the net annual wage;
- ca represents the firm's total turnover;
- x represents a set of covariables, namely: variation in the number of hours worked, gender, socio economic position, age, firm size, unemployment rate in the employment area in which the enterprise is located, sectoral dummies according to NAF rev. 2;
- 1_t year dummies;
- ε_{ijt} represents the residual of the equation.

The wage rigidities hypothesis involves testing for the difference between the two parameters α^{+} and α^{-}, which respectively capture the effect of a positive or negative shock for the firm on wage variation. The case where α^{+} is significantly greater than α^{-} corresponds to downward nominal wage rigidities. The estimates by Biscourp and Fourcade (2003) covering the period 1994-2000 lead to such a situation, with a significant gap between these two parameters.

However, unlike Biscourp and Fourcade (2003) whose estimation covered a stable period of time, we expect the year 2009, and possibly 2010, to be outliers, considering the disconnection between productivity and wage observed for these particular two years.

Instead of estimating α^+ and α^- for the whole period, we want to estimate them each year. In this purpose, we cross-reference both coefficients with a year dummy, leading to the model (2):

$$\Delta \ln(w_{ijt}) = (\alpha^+ 1_{\Delta \ln(ca_{jt})>0} + \alpha^- 1_{\Delta \ln(ca_{jt})<0}).1_t.\Delta \ln(ca_{jt}) + \delta x_{ijt} + \eta 1_t + \varepsilon_{ijt} \quad \textbf{(2)}$$

It is also noteworthy that this model can be understood in a behavioural dimension, with the idea that wage setting is the result of a bargaining between employee and employer, depending on the overall situation of the employees in the firm, the state of the economy as a whole and of course the financial situation of the firm. This reading of the model and the focus on the year 2009, which was mainly marked by a demand shock [Cabannes *et al.*, 2013], justify the choice of this method which does not take account of any supply shocks.

The DADS provides individual panel data, which can be used to improve the estimates. So, we take into account the unobserved heterogeneity of individuals, which might skew the results, by estimating a fixed individual effects model ("Within" method). We should also note that the presence of a simultaneity bias between wage and turnover variations is always possible, but this bias has no reason to affect the relation upwards more than downwards [Biscourp and Fourcade, 2003]. This point is discussed in the robustness tests section. The estimated model is therefore as follows:

$$\Delta \ln(w_{ijt}) = (\alpha^+ 1_{\Delta \ln(ca_{jt})>0} + \alpha^- 1_{\Delta \ln(ca_{jt})<0}).1_t.\Delta \ln(ca_{jt}) + \delta x_{ijt} + \eta 1_t + e_i + \varepsilon_{ijt} \quad \textbf{(3)}$$

where e_i represents the individual fixed effects.

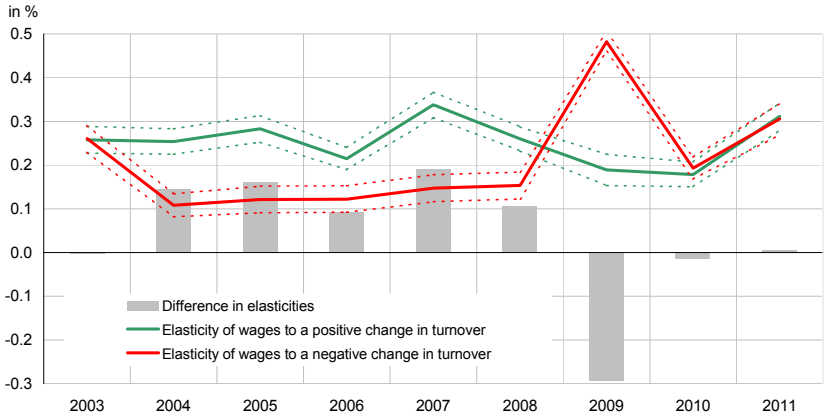
Finally, as it will be shown below, we test some specifications of the model, in order to check robustness and to clarify the underlying economic phenomena we observe, among which:

- the introduction of time-lagged variables of the variation in activity of firms, in order to take account of a delayed wage adjustment;
- the use of other economic cycle variables instead of turnover: value added and productivity;
- estimation on subsets of the data, according to characteristics of the individuals or the firms.

III.5 Results: During the recession, wages were adjusted both upwards and downwards depending on the activity shock specific to each firm

Without the cross-referencing of these coefficients with year dummies, the estimation shows a small but significant and positive gap between α^+ and α^- over the 2003-2011 period (α^+ is 0.025 and α^- is 0.023). In model (3), the estimation of coefficients α^+ and α^- shows that year 2009 is an outlier (figure 16). For every other year, the difference between α^+ and α^- is either positive or not significant, but in 2009, it is strongly negative (see Appendix 1 for the complete results of the estimation).

16.- Variation in wages following a positive or negative shock of 10% of turnover



Field: France, full-time employees from the private sector working in the same firm two consecutive years.
Note: in 2004, firms that have experienced a decrease (respectively an increase) of 10% of their turnover dropped wages by 0.11% (respectively increased wages by 0.25%), all else being equal. Coefficients α^+ (green) and α^- (red) were obtained by the model (3) estimation on the DADS panel from 2003 to 2011. The dashed lines represent the 95% confidence interval. Estimation on 3 771 135 observations (419 015 in average per year).
Sources: Insee, DADS, Ficus, Ésane.

Three main conclusions emerge from this first estimation:

- First, the response of wages to a specific activity shock is always very low: a 10% activity shock for a firm is passed on at a level of 0.3% to its employees' wages in the same year. This low response from wages to an activity shock was already present in Biscourp and Fourcade (2003);

- Next, in periods of medium or strong GDP growth, the increase in wages when the firm's activity grows is significantly larger than the decrease when activity falls. There is therefore an asymmetry in favour of a reaction to a positive shock which characterizes relatively stronger downward nominal wage rigidities;

- However, during periods of weak GDP growth the asymmetry disappears and is even reversed in 2009, year of the Great Recession: that year the wage dropped significantly faster when the firm experienced a negative activity shock than it increased when the firm experienced a positive activity shock. Similarly, the asymmetry in the response of wages to an activity shock disappeared in 2003, year of weak GDP growth, as well as in 2010-2011, years that followed the Great Recession.

In light of these conclusions, it seems that downward nominal wage rigidities exist in France over periods of economic stability, but they fail to explain the disconnection we observe between productivity and wages in 2009.

III.6 Robustness tests

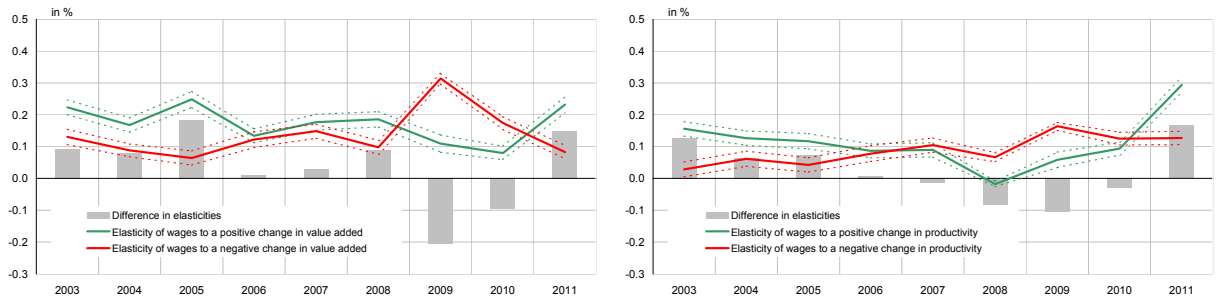
Although model (3) takes account of the unobserved heterogeneity, there is still a potential bias in our estimation, due to a possible simultaneity within contemporary shocks. Our estimations are valid only under the hypothesis that observed activity shocks for the firms are exogenous to individual wage shocks. That might not be true, particularly in the light of the efficiency wage theory. Such an endogeneity bias could be controlled using instrumental variables, but the sources do not offer many appropriate instruments. We can not either use lagged values of the covariables, because we cross-reference the firm shocks with year dummies. The solution we chose is to use the most exogenous available activity proxy, which is turnover. Tax returns yet provide two other variables that could be used in our model: value added and productivity, the second one being measured as the ratio of value added to average headcount of the firm. In order to test the robustness of the choice of

turnover instead of these two variables, we estimate model (3) using them as explanatories (figure 17).

The α^+ and α^- coefficients obtained with the estimations on the value added and on the turnover are rather similar: the wage response to a value added positive shock is a little weaker than the response to a turnover positive shock, but in both cases the rigidity goes downward in years of strong or medium growth, and upward in 2009.

With the productivity model, both responses to positive and negative shocks are weaker, and the difference between α^+ and α^- is often not statistically significant. The reversal of the rigidities begins in 2008 rather than in 2009, mainly because of a very weak wage elasticity to a positive change in productivity this year.

17.- Variation in wages following a positive or negative shock of 10% of…



Field: France, full-time employees from the private sector working in the same firm two consecutive years.
Note: in 2004, firms that have experienced a decrease (respectively an increase) of 10% of their value added dropped wages by 0.09% (respectively increased wages by 0.17%), all else being equal. Coefficients α^+ (green) and α^- (red) were obtained by the model (3) estimation on the DADS panel from 2003 to 2011. The dashed lines represent the 95% confidence interval. Estimation on 3 771 135 observations (419 015 in average per year).
Sources: Insee, DADS, Ficus, Ésane.

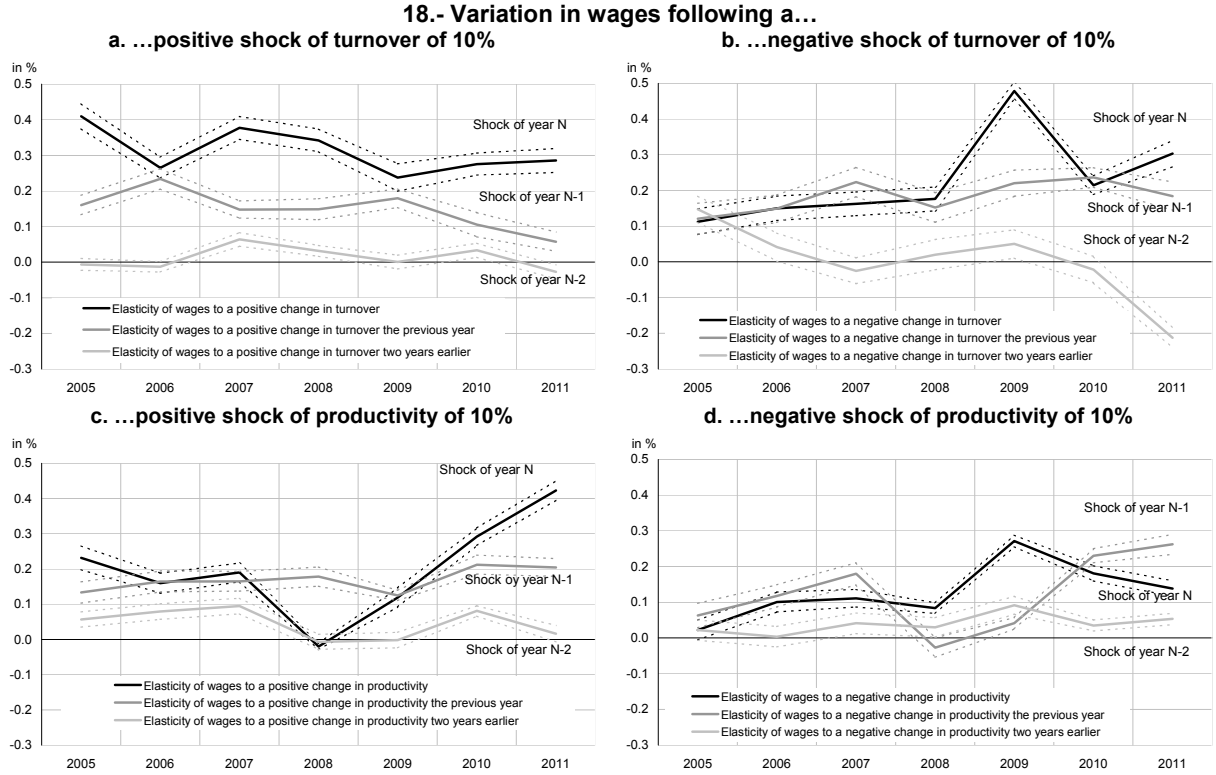
In the rest of this section, we will present for each estimation the results obtained using both turnover and productivity, to control their robustness. In a purpose of parsimony though, we will not present the results obtained with value added, that appear to be for each estimation very close of the turnover ones.

The effect of activity shocks is significant on the current year and the year after, and decreases strongly two years after.

The model links wage growth to variations in turnover in the same year. However, part of wage bargainings takes place each year based on previous year's results. The macroeconomic modelling (Section I) also shows that there is a diffusion effect of productivity shocks in the following years. To take account of this potential delayed effect, we add to the model (3) time-lagged variables of the activity shocks. From now on, the change in wages is explained not only by contemporary changes in the activity of the firm, but also by variations in the activity of the two previous years. Others covariables are not modified.

First of all, we notice that the shape of the results is not modified for the contemporary shocks (figure 18a-d). The value of the coefficient is of the same order of magnitude. The effect of the previous year's activity shocks on wage growth is also of the same order of magnitude, but the difference between the elasticity to a positive or negative shock is reduced compared to the contemporary shocks. The values of the coefficients are rather stable over the time, except for the year 2008 in the productivity model. Finally, activity shocks happening two years earlier have little effect on wage evolution, with almost no difference between positive and negative shocks.

18.- Variation in wages following a…



Field: France, full-time employees from the private sector working in the same firm two consecutive years.
Note: firms that experienced an increase of 10% of their turnover in 2005 have increased wages by 0.41% in 2005, 0.23% in 2006 and 0.06% in 2007, all else being equal. Estimation on 3 771 135 observations (419 015 in average per year).
Sources: Insee, DADS, Ficus, Ésane.

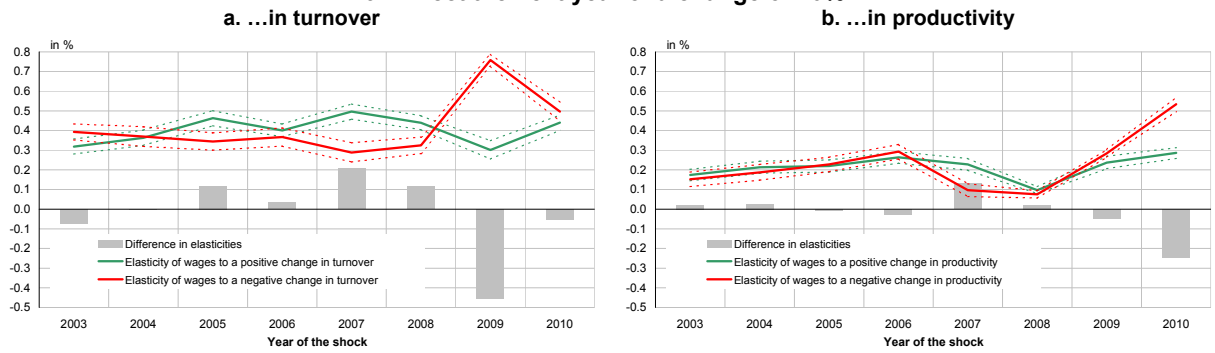
In light of these results, it seems that the hypothesis of a delayed effect of the activity shocks is especially relevant for the first year, for it disappears almost entirely from the second year. That is why we will rather estimate the effect of a change in activity on the next year, rather than only on the current year. There is a way to estimate the cumulative effect by adjusting model (3). Instead of estimating the effect of a shock on a yearly wage growth, we compute a two-year evolution of the wage, and use as covariables the two activity shocks the firm has experienced between these two years. The new model is:

$$\begin{aligned}\ln(w_{ijt}) - \ln(w_{ijt-2}) \quad = \quad & (\alpha_t^+ 1_{\Delta\ln(ca_{jt})>0} + \alpha_t^- 1_{\Delta\ln(ca_{jt})<0}).1_t \,.\, \Delta\ln(ca_{jt}) \\ & +(\beta_t^+ 1_{\Delta\ln(ca_{jt-1})>0} + \beta_t^- 1_{\Delta\ln(ca_{jt-1})<0}).1_{t-1} \,.\, \Delta\ln(ca_{jt-1}) \\ & +(\delta_1 + \delta_2 L).x_{ijt} + \eta.1_t + e_i + \varepsilon_{ijt}\end{aligned} \qquad \textbf{(4)}$$

The α coefficients estimate the effect of the current activity shock on the two-years wage evolution, and the β coefficients are the one we are more precisely interested in: the one-year diffusion effect of the activity shock on wage. We also use a subset of time-lagged covariables, namely variation in the number of hours worked and socio-economic position ($\delta_2 L$ term).

First of all, we observe that after one year, the asymmetry between the response to positive or negative shocks is weaker than its current year value (figure 19b compared to figure 17b). Considering productivity, there are hardly any rigidities on the entire 2003-2010 period. The estimate from model (4) on turnover yet still confirms the reversal of the rigidity for 2009 shocks, whereas its estimation on productivity shows this reversal for 2010 shocks. This result confirms that these two years are outliers regarding the relation between economic activity and wage. That said, this microeconometric modelling shows that, although downward nominal wage rigidities do exist over economically stable periods, they do not constitute a valid explanation to the 2009 and 2010 disconnection revealed by the macroeconomic simulation.

19.- Effect the next year of a change of 10%…



Field: France, full-time employees from the private sector working in the same firm two consecutive years.
Note: firms that have experienced a decrease (respectively an increase) of 10% of their turnover in 2004 dropped wages by 0.37% (respectively increased wages by 0.36%) in 2005, all else being equal.
Coefficients β+ (green) and β- (red) were obtained by the model (4) estimation on the DADS panel data from 2003 to 2011. The dashed lines represent the 95% confidence interval. Estimation on 2 712 774 observations (339 097 in average per year).
Sources: Insee, DADS, Ficus, Ésane.

Wage adjustments are smaller for lower-paid employees and for large firms

Previous results have highlighted that in economically stable periods, there are some downward rigidities impacting French wages. In this part, we will investigate the strength of these rigidities on various subsets of firms or employees.

In that purpose, we estimate model (4) on turnover and productivity, with an extra simplification: since we noticed that 2009 is the main year of interest, we no longer cross-reference the α and β coefficients with all years, but with 2009 on the one hand and a cluster of all other years on the other hand. The idea is to make a distinction between "normal" rigidities and "special" ones that we observe in 2009. Table 20 shows the estimates of the β coefficients for those two periods and for the various subsets of the population we study.

Firstly, for all subsets, we observe a negative difference between β^+ and β^- for shocks occurring in 2009. For other years, the difference ("Diff" column) is either slightly positive or not significant, due to the estimation of a delayed effect which attenuates the rigidity, as depicted on figure 19. There seems to be little difference between the subsets of the population in regard of the criterion of the sign or the amplitude of the difference between the β^+ and β^-. On the contrary, the value of these two coefficients varies strongly between subsets ("Coeff" column), underlining differences in the sensitivity to activity shocks, on which we will focus here.

Except for the construction sector, which shows a slightly stronger response to negative shocks than the other ones, the activity sector does not seem to be a relevant criterion regarding wage rigidities. On the contrary, wage rigidities change strongly according to firm size: values of the β coefficients are much higher for small firms and decrease as the size of the firm increases. With the behavioural interpretation of the model in mind, it seems that for small firms, activity weighs more in the bargaining outcome, maybe because of a smaller leeway in wage setting. It could also be seen as the consequence of an "implicit contract" between larger firms and their employees: in such firms, wage evolution is smoother but less sensitive to business cycles (*see* Azariadis, 1975 and Azariadis and Stiglitz, 1983).

The sensitivity of wages to activity is also weaker for lower-paid workers, and increases with the wage level. This result can be seen as an effect of the minimum wage: the first quartile includes wages close to the minimum wage and whose evolution is not decided only by local bargaining in the firm, but also by a national policy. It is thus not abnormal to observe a weaker relation between firm's activity and wage setting for this level of wage. On the contrary, for higher wage levels, wage evolution will not only be affected by minimum wage policy, but will also be more adaptable, due to a growing weight of the variable part of the wage (premia, employee savings).

Men's wages are also more sensitive to activity shocks than women's. One of the consequences is that the wage rigidity disappears for women. As for the age, it seems to have no clear influence on the elasticity of wages with respect to activity shocks.

20.- Effect the next year of a change of 10% in turnover/productivity, by characteristics

		Turnover shocks						Productivity shocks					
		Other than 2009			2009			Other than 2009			2009		
	Sign of the shock	Coeff	Sign.	Diff.	Coeff	Sign.	Diff.	Coeff	Sign.	Diff.	Coeff	Sign.	Diff.
All individuals													
	Positive Shock	0.42	***	+0.05	0.27	***	-0.51	0.20	***	+0.04	0.22	***	-0.08
	Negative Shock	0.36	***		0.78	***		0.15	***		0.30	***	
Sector													
Industry	*Positive Shock*	0.41	***	n.s.	0.36	***	-0.64	0.27	***	n.s.	0.14	***	-0.52
	Negative Shock	0.39	***		1.00	***		0.24	***		0.66	***	
Construction	*Positive Shock*	0.36	***	n.s.	0.21	***	-0.49	0.29	***	n.s.	0.26	***	-0.45
	Negative Shock	0.46	***		0.70	***		0.34	***		0.70	***	
Trade	*Positive Shock*	0.39	***	n.s.	0.37	***	-0.28	0.20	***	n.s.	0.17	***	-0.28
	Negative Shock	0.33	***		0.65	***		0.19	***		0.45	***	
Services	*Positive Shock*	0.44	***	+0.10	0.25	***	-0.36	0.12	***	n.s.	0.19	***	n.s.
	Negative Shock	0.34	***		0.61	***		0.17	***		0.13	***	
Firm headcount													
Less than 20 employees	*Positive Shock*	0.79	***	+0.18	0.43	***	-0.52	0.30	***	n.s.	0.19	***	-0.41
	Negative Shock	0.61	***		0.95	***		0.33	***		0.60	***	
20 to 50 employees	*Positive Shock*	0.46	***	+0.09	0.25	***	-0.56	0.24	***	n.s.	0.30	***	-0.23
	Negative Shock	0.37	***		0.81	***		0.30	***		0.54	***	
50 to 500 employees	*Positive Shock*	0.30	***	n.s.	0.30	***	-0.28	0.22	***	+0.06	0.27	***	n.s.
	Negative Shock	0.26	***		0.57	***		0.15	***		0.36	***	
More than 500 employees	*Positive Shock*	0.29	***	+0.07	0.51	***	-0.45	0.10	***	n.s.	0.16	***	n.s.
	Negative Shock	0.22	***		0.96	***		0.08	***		0.24	***	
Firm status													
In a group	*Positive Shock*	0.30	***	n.s.	0.29	***	-0.48	0.15	***	n.s.	0.22	***	-0.07
	Negative Shock	0.27	***		0.78	***		0.16	***		0.29	***	
Independent	*Positive Shock*	0.69	***	+0.14	0.38	***	-0.45	0.32	***	+0.17	0.25	***	-0.16
	Negative Shock	0.55	***		0.84	***		0.15	***		0.40	***	
Wage level													
First quartile	*Positive Shock*	0.17	***	-0.07	0.01		-0.40	0.08	***	n.s.	0.15	***	n.s.
	Negative Shock	0.25	***		0.41	***		0.09	***		0.13	***	
Medium quartiles	*Positive Shock*	0.33	***	n.s.	0.10	***	-0.59	0.17	***	+0.04	0.21	***	-0.06
	Negative Shock	0.33	***		0.68	***		0.14	***		0.27	***	
Last quartile	*Positive Shock*	0.63	***	+0.23	0.55	***	-0.33	0.27	***	+0.06	0.20	***	-0.19
	Negative Shock	0.40	***		0.87	***		0.21	***		0.39	***	
Gender													
Men	*Positive Shock*	0.45	***	+0.06	0.31	***	-0.52	0.24	***	+0.04	0.23	***	-0.15
	Negative Shock	0.40	***		0.83	***		0.19	***		0.38	***	
Women	*Positive Shock*	0.33	***	n.s.	0.19	***	-0.43	0.12	***	n.s.	0.18	***	n.s.
	Negative Shock	0.29	***		0.62	***		0.10	***		0.18	***	
Age													
Less than 30 years old	*Positive Shock*	0.39	***	n.s.	0.07		-0.63	0.16	***	n.s.	0.17	**	n.s.
	Negative Shock	0.32	***		0.71	***		0.16	***		0.24	***	
30 to 39 years old	*Positive Shock*	0.41	***	n.s.	0.41	***	-0.38	0.18	***	n.s.	0.33	***	n.s.
	Negative Shock	0.36	***		0.79	***		0.15	***		0.26	***	
40 to 49 years old	*Positive Shock*	0.41	***	+0.07	0.22	***	-0.53	0.19	***	n.s.	0.19	***	-0.13
	Negative Shock	0.34	***		0.75	***		0.15	***		0.31	***	
More than 50 years old	*Positive Shock*	0.38	***	n.s.	0.26	***	-0.53	0.20	***	+0.05	0.18	***	-0.14
	Negative Shock	0.36	***		0.80	***		0.15	***		0.33	***	

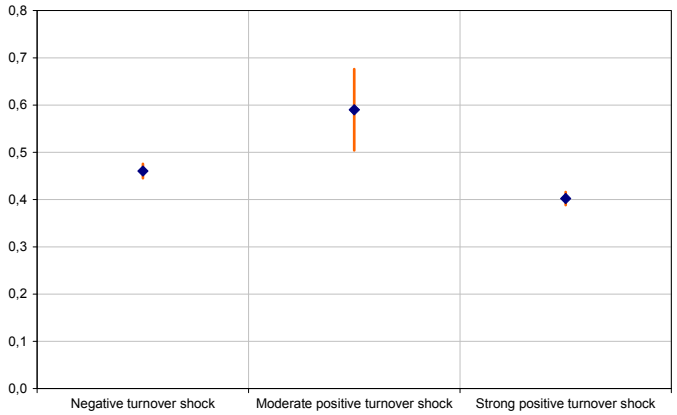
Field: France, full-time employees from the private sector working in the same firm two consecutive years.
Note: Results of the estimation of β coefficients in model (4) with year clusters (2009 on the one side and other years on the other). Estimations done separately on each sub-population. Estimated on all individuals, the effect of a negative (respectively positive) turnover shock of 10% in 2009 results in a drop of the wage of 0.78% in 2010 (respectively an increase of 0.27%). Estimation on 2 712 774 total observations (339 097 in average per year).
***: significant at 1% level ; **: significant at 5% level ; *: significant at 10% level.
n.s.: difference is not significant at 5% level.
Sources: Insee, DADS, Ficus, Ésane.

The elasticity of wages is higher for moderate turnover shocks

In this section, we test the sensitivity of our model to the choice of the threshold. In this light, we split the positive turnover shocks in two groups, according to the intensity of the shock. If this intensity is superior to 8%, we consider the shock as strong, else we consider it moderate. We estimate model (4) using these three cases of turnover shocks instead of only positive or negative.

The estimation of the elasticity on the whole period (figure 21) shows a stronger elasticity to moderate turnover shocks than the one to stronger (negative or positive) turnover shocks, with a significant difference between coefficients. With a year cross-referenced estimation, results are more fragile, notably in 2005 and 2006 where the results are inverse. However, for most years the elasticity stays higher for moderate turnover shocks. On the macroeconomic level, we find a similar result by allowing a non-linear response of wages to productivity shocks: the adjustment is stronger for periods of moderate shock than for periods of intense shock (negative or positive), and the predictive power of the macroeconomic model is strengthened (see Appendix 2).

21.- Effect the next year of a change of 10% in turnover



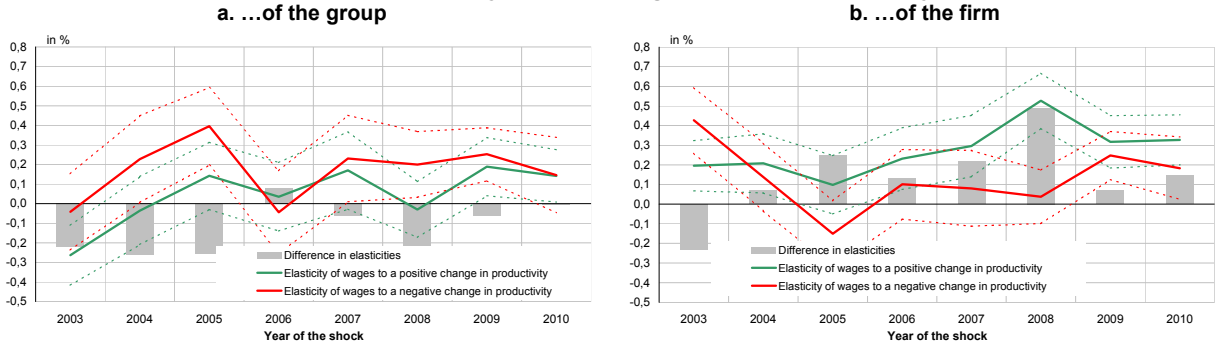
Field: France, full-time employees from the private sector working in the same firm two consecutive years.
Note: Results of the estimation of β coefficients in model (4) without year cross-referencing. The blue point represents the estimation of β . The orange line represents the confidence interval (95%). A negative turnover shock of 10% results in a drop of the wage of 0.46% the year after. Estimation on 2 712 774 total observations (339 097 in average per year).
Sources: Insee, DADS, Ficus, Ésane.

There is no evidence of downward nominal wage rigidities at a group level

The weak reaction of wages to macroeconomic activity shocks in a given year could also be explained by constraints linked to branch agreements on wage formation [Avouyi-Dovi et al., 2013] or to economic performance of the headquarter. Indeed, employees in firms that do not belong to a group also experience a stronger connection between their wages and the firm's activity. Two non-exclusive explanations are possible: on the one hand, the activity of the firm may not be the good proxy for firms that belong to a group, because wage negotiations happen at a higher group level; on the other hand, since independent firms tend to be smaller, this could be an effect of the firms' size. In order to further investigate this question, we compute productivity at a group level[10], using data on group structures in France, and estimate model (4) with shocks on both the firm and the group productivities.

The effect of a group productivity shock on wages is of the same order of magnitude as the effect of a firm productivity shock, that is to say rather low (figure 22a-22b). Nonetheless, the asymmetry is reversed between the two levels: the response of wages is stronger when the shock is positive (resp. negative) at the firm level (resp. the group) level. The introduction of the group-level shocks does not change the effect of the positive firm-level shocks, but attenuates the effect of negative firm-level shocks as if in case of downturn the group substitute itself to the firm to moderate wages. In relation with the downward nominal wage rigidities issue, this insight gives no clear evidence, in part because our sample is reduced and confidence intervals are large.[11]

22.- Effect the next year of a change of 10% in productivity…



Field: France, full-time employees from the private sector working in the same company two consecutive years. Firms belonging to the same group for two consecutive years.
Note: firms that have experienced a decrease (respectively an increase) of 10% of their productivity in 2004 dropped wages by 0.14% (respectively increased wages by 0.21%) in 2005, all else being equal.
Coefficients β+ (green) and β- (red) were obtained by the model (4) estimation on the DADS panel data from 2003 to 2011 with productivity shocks at both firm and group level. The dashed lines represent the 95% confidence interval. Estimation on 392 102 observations (49 013 in average per year).
Sources: Insee, DADS, Ficus, Esane, LiFi.

[10] The evolution of group structures may provoke strong productivity shock at the group level, which should be uncorrelated to the workers' wages. In order to avoid such shocks, we measure the group productivity shocks between two years using only firms that are present in the group in both years, and estimate the model (4) only on such firms. They approximatively represent 75% of the firms that belong to a group on the 2003-2011 period. We also lose some information in the computation of a group level productivity, for we need value added and headcount for every firm of our sample and missing values cause us to withdraw the whole group from the sample. In the end, we estimate our new model on almost 50 000 individual observations per year.

[11] We checked robustness of these results with an estimation of the same model using value added instead of productivity (turnover is not computable at a group level due to within-group trade). Results are inchanged.

Conclusion: The weak response of wages to an activity shock, whether positive or negative, could however indicate some wage inertia

This article shows an asymmetry in wage response depending on the economic environment. A possible explanation for the sensitivity of these rigidities to the cycle could be found in behavioural models. A deterioration of the general economic context and a rise in unemployment affect the result of wage bargaining, strengthening employers' bargaining power. In the opposite economic context, the same transmission channels might explain the asymmetry reversal.

The disconnection between wage and productivity remains unexplained by the two core assumptions of labour force composition effects and downward nominal wage rigidities. The reason lies most likely in the singular nature of 2009 Great Recession. First, the activity shock reached an unprecedented scale since World War II. Then, the near-zero inflation probably damaged individuals' expectations. However, our contribution emphasises a significant result: the low response of wages to a (positive or negative) activity shock, especially for lower wage earners and large firms. The elasticity of wages with respect to a negative shock, though increasing in 2009, remains low in absolute terms. The weakness of this elasticity contributed to modify the share of salaries in GDP in favour of employees and then prevented to get back to pre-crisis levels.

In return, wages inertia would facilitate the recovery of the firms' margin rate in times of strong economic upturn. New estimations allowing an asymmetric response of wages to productivity provide evidence in favour of the weaker wage adjustments in response to high productivity shocks. According to Daly and Hobijn (2014), this type of mechanism has also driven wage evolution in the U.S. if downward nominal wage rigidities result in substantial pent up wage deflation, then wage inflation should remain lower than expected from the tightening of the labour market during the ensuing recovery period.

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Appendix

1- Complete results of the estimation of model (3) on turnover shocks

	Coefficient	Std Error	P-Value
Positive variation of turnover in 2003	0,0258	0,0016	0,0000
Positive variation of turnover in 2004	0,0254	0,0015	0,0000
Positive variation of turnover in 2005	0,0283	0,0015	0,0000
Positive variation of turnover in 2006	0,0214	0,0013	0,0000
Positive variation of turnover in 2007	0,0338	0,0015	0,0000
Positive variation of turnover in 2008	0,0260	0,0014	0,0000
Positive variation of turnover in 2009	0,0189	0,0018	0,0000
Positive variation of turnover in 2010	0,0178	0,0014	0,0000
Positive variation of turnover in 2011	0,0312	0,0016	0,0000
Negative variation of turnover in 2003	0,0260	0,0016	0,0000
Negative variation of turnover in 2004	0,0108	0,0013	0,0000
Negative variation of turnover in 2005	0,0121	0,0015	0,0000
Negative variation of turnover in 2006	0,0122	0,0016	0,0000
Negative variation of turnover in 2007	0,0147	0,0016	0,0000
Negative variation of turnover in 2008	0,0153	0,0016	0,0000
Negative variation of turnover in 2009	0,0482	0,0011	0,0000
Negative variation of turnover in 2010	0,0193	0,0013	0,0000
Negative variation of turnover in 2011	0,0305	0,0018	0,0000
Variation in number of hours worked	0,5337	0,0008	0,0000
Age	0,0003	0,0015	0,8370
Farmer	-0,0251	0,0269	0,3510
Independent	0,0364	0,0011	0,0000
Manager	0,0328	0,0006	0,0000
Technicians and associate professionals	0,0111	0,0004	0,0000
Employee	ref.		
Worker	-0,0033	0,0005	0,0000
Less than 20 employees	-0,0012	0,0005	0,0250
Between 20 and 200 employees	ref.		
Between 200 and 1000 employees	0,0012	0,0005	0,0180
More than 1000 employees	0,0012	0,0006	0,0580
Unemployment rate in the area	0,0000	0,0001	0,7660
Sector of activity	22 dummies		
2003	0,0050	0,0061	0,4160
2004	-0,0018	0,0046	0,7000
2005	0,0032	0,0031	0,2960
2006	-0,0053	0,0016	0,0010
2007	ref.		
2008	0,0032	0,0016	0,0380
2009	-0,0136	0,0031	0,0000
2010	-0,0225	0,0046	0,0000
2011	-0,0177	0,0061	0,0040
Number of obs. 3 771 135 (419 015 in average per year)			
	R^2	**28,94%**	

2- ECM over the 1980 - 2012 period featuring an asymmetry in productivity

In light of the above discussion, we can improve the macroeconomic modelling and see how it could explain the wage dynamics over the recent period. A one step approach is pursued for the estimation of the error correction model.

a- The benchmark modelling fails estimating the 2009 - 2012 period

As shown in Section 1, the macroeconometric model fails to explain the behaviour of the wages in the aftermath of the crisis. Wages are much more dynamic than expected by their usual determinants, particularly in 2010. Then, they seem to take a more usual pattern, leaving rather large the gap between the two.

The answer that consists in extending the estimated period by years 2009-2012 is not fruitful. The resulting estimated model for the extended sample period, running from the beginning of the 80's up to the fourth quarter of 2012 is given by:

$$\begin{aligned}\Delta \ln W \;=\;& \underset{(3.0)}{0.26} - \underset{(-3.7)}{0.008}\times d82q3 - \underset{(-3.5)}{0.004}\times \sup 83q2 + \underset{(4.4)}{0.28}\times \Delta \ln W_{-1} + \underset{(6.2)}{0.30}\times \Delta_2 \ln CPI + \underset{(3.5)}{0.10}\times\left(\Delta \ln \Pi + \Delta \ln \Pi_{-5}\right) \\ & - \underset{(-4.1)}{0.4\%}\times\left(\Delta U - \Delta U_{-1}\right) - \underset{(-3.0)}{0.17}\times \Delta \ln ToT + \underset{(1.8)}{0.05}\times \Delta \ln CP - \underset{(-2.3)}{0.13}\times \Delta \ln(1+ESC) + \underset{(2.4)}{0.12}\times \Delta_2 \ln(1+ESC)_{-3} \\ & - \underset{(-2.7)}{0.04}\times\left[\ln WSG - \left(\ln CPI - \underset{(*)}{1.30}\ln ToT + \underset{(*)}{0.60}\ln \Pi - \underset{(*)}{0.009}\,U + \underset{(*)}{0.20}\ln CP\right)\right]_{-1}\end{aligned}$$

The t-ratios for the estimated coefficients are presented between brackets. Concerning the long run relationship, it is worth mentioning that the coefficient of the error correction term (i.e. the coefficient of the wage level lagged one period) is small (equal to 0.04), which denotes some persistence concerning the evolution of the wage towards its long-run path. Within the single step framework, testing for cointegration can be performed through the significance testing of the error correction term (see Ericsson and Mackinnon, 2002). In practice, this can be realized through the t-ratio of the error correction term coefficient, called the ECM statistic. This t-ratio is used to test the null hypothesis of no cointegration and the critical values can be found in Banerjee et al. (1998). As expected, based on this cointegration test, one would not reject the null hypothesis of no cointegration at usual significance levels. The estimation invalidates the benchmark equation when this one is extended over the 2009 - 2012 period.

b- Improvement of the initial estimation

We add a dummy variable which is equal to 1 from 2009Q1 and 0 before, in order to take into account the special behaviour of the firms since the Great Recession. We also allow for an asymmetric impact of labour productivity on wages. In particular, we split labour productivity in two different variables, depending on the strength of its growth rate. If it is included in a range between 1.0% and 1.9% (annual rate), the productivity growth is moderated (the Dummy variable is equal to 1). If it is not, the productivity growth is particularly low, if lower of 1%, or high if upper of 1.9%:[12]

$$Dummy = \begin{cases} 1 \; if \; 1\% < \Delta_4 \ln \Pi \le 1.9\% \\ 0 \; otherwise \end{cases}$$

[12] These thresholds are endogenously determined to maximize the log-likelihood of the model.

The resulting estimated model is the following:

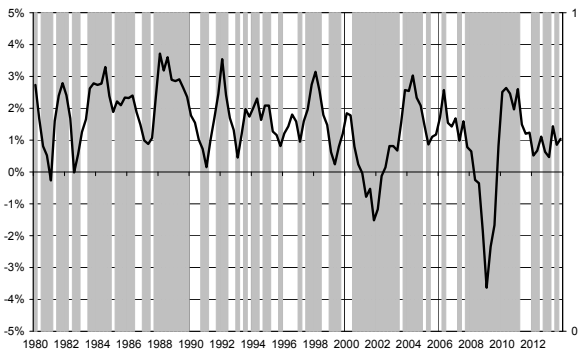
$$
\begin{aligned}
\Delta \ln W \;=\;& \underset{(4.9)}{0.60} - \underset{(-3.3)}{0.007} \times d82q3 - \underset{(-4.0)}{0.004} \times \sup 83q2 + \underset{(3.3)}{0.003} \times \sup 09q1 + \underset{(4.4)}{0.26} \times \Delta \ln W_{-1} \\
& + \underset{(7.2)}{0.32} \times \Delta_2 \ln CPI + \underset{(1.6)}{0.04} \times \Delta \ln CP + \underset{(5.5)}{0.34} \times \Delta \ln \Pi \times Dummy + \underset{(3.2)}{0.14} \times \Delta \ln \Pi \times (1 - Dummy) \\
& - \underset{(-4.1)}{0.4\%} \times (\Delta U - \Delta U_{-1}) - \underset{(-3.3)}{0.17} \times \Delta \ln ToT - \underset{(-3,4)}{0.18} \times \Delta \ln(1 + ESC) + \underset{(2.7)}{0.12} \times \Delta_2 \ln(1 + ESC)_{-3} \\
& - \underset{(-4.7)}{0.11} \times \left[\ln WSG - \left(\ln CPI - \underset{(*)}{0.69} \ln ToT + \underset{(*)}{0.46} \ln \Pi - \underset{(*)}{0.005} U + \underset{(*)}{0.20} \ln CP \right) \right]_{-1}
\end{aligned}
$$

Overall, the results are similar to the precedent ones, with the exception of the non linear effects of labour productivity changes on wages behavior which cannot be disregarded. When productivity growth is moderate the effects are strong and statistically significant. In contrast, when productivity growth is low or high, it has a weak impact on wages in the short run.

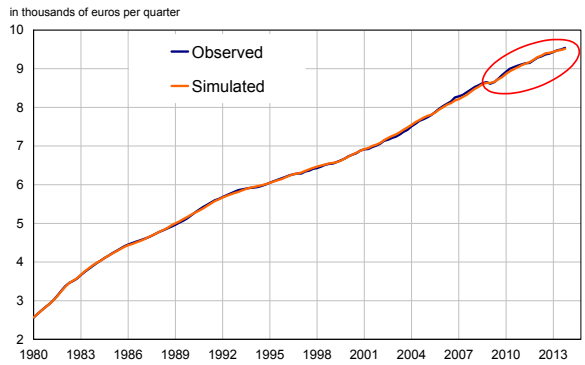
In addition to the strong evidence regarding the significance of the labour productivity variable, one should focus on the interpretation of the results. In particular, in this model one can argue that the hypothesis of cointegration is again accepted as denoted by the fast speed adjustment to the long run equilibrium. The error correction term, equal to 0.11, is now much more statistically significant: we can now reject the hypothesis of no cointegration with a significance level of 5% (the asymptotic critical value is 4.30).

The new dynamic simulation of wages was particularly satisfactory over the whole period and the unexplained contributions are very weak also in the aftermath of the Great Recession (see figures below).

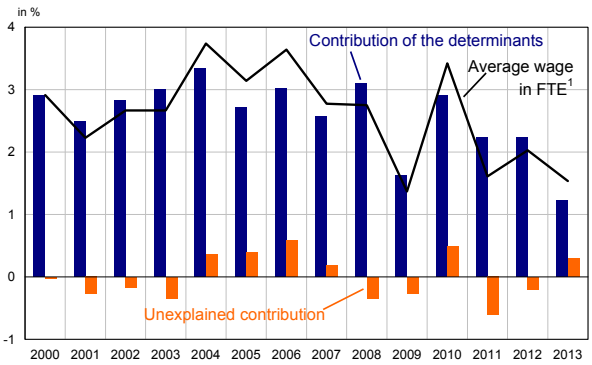
A1.- Productivity growth (y-o-y)[1]



A2.- FTE[2] gross wage observed and simulated



A3.- Contribution to wage growth



1. The grey area represents periods where the productivity growth is particularly low or high.
2. Full-time-equivalents

Field: France, non-agricultural market sector.

Source: Insee, National Quarterly accounts.

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