Hirings and Firings: Does firm size matter ?

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Abstract

In this paper, we estimate a dynamic model of labor demand that incorporates quadratic hiring and firing costs depending upon firm size.

Our data consists of a panel of 1,000 French firms for which we observe the number of workers entries and exits by type of contract and by reason of exit: hirings on a short-term contract, hirings on an indefinite-term contract, layoffs, voluntary quits and ends of fixed-term contract. Our statistical analysis highlights the importance of hiring and firing flows in the dynamic of labor demand. It also shows the importance of taking firm size into account. Indeed, flows depend on firm size : the larger a firm is, the higher hirings and firings are and the smaller the hiring and firing rates are.

The solution of our dynamic program results in a system of Euler equations, which are estimated by GMM. Our estimates suggest that (i) hiring a worker on an indefinite-term contract is less costly than firing him; (ii) hiring a worker on a short-term contract is also less costly than ending his contract; (iii) it is less costly to adjust the number of workers under short-term contract than to adjust the number of workers under indefinite-term contract; (iv) those three results are true whatever the size of the firm may be; moreover (v) the marginal cost of hiring or firing one more employee is less important in the large firms than in the small ones.

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1 Introduction

Since the seminal work of Oi (1962), labor is not any longer treated as a fully flexible factor. Much of the debates on the persistent unemployment in the European Union rely mostly on the rigidity of labor demand. Such rigidity would be mainly due to the existence of large adjustment costs, which generate sluggishness in adjustment of employees and firms in a changing economic environment. As a matter of fact, high firing costs imply that firms will lower their hirings during periods of expansion in order to avoid firing costs in case of recession. Nevertheless, short-term contracts, which are flexible labour contracts, make adjustment (in term of employed workers) easier given a specific economic surrounding. In other words, the legal framework affects the worker flows too.

For decades, most of the literature studied the net variation of employment to describe the dynamic labor demand. Recently, in the 90's, most studies emphasize that it is not sufficient and that we have to focus on job and worker flows (see Davis, Haltiwanger and Schuh (1996) and Abowd, Corbel and Kramarz (1999)). Dynamic labor demand results from simultaneous creation and destruction of jobs as well as simultaneous worker entries and exits.

Moreover, the econometric debates on employment flows became recently animated. The empirical studies seem to show differences according to the countries. For example, Bentolila and Saint-Paul (1992), using a panel of Spanish firms, show that the introduction of flexible labor contracts has increased the cyclical sensitivity of labor demand. As for Schiantarelli and Sembenelli (1993), using a panel of U.K companies, they show that hiring costs are greater than firing costs. On the contrary, using a panel of French firms, Goux, Maurin and Pauchet (2001) show that firing costs are greater than hiring costs (for indefinite-term contracts). Nevertheless, no one of those papers test the relationship between worker flows and firm size. More precisely, it seems that no work has been done to estimate adjustment costs by type of contract and by size of firm.

However, this subject gives rise to a lot of questions. We know that, *on average*, hiring a permanent worker is relatively more costly than hiring a temporary one (see Goux, Maurin and Pauchet (2001)). We also know that, for indefinite-term contracts, adjustment costs are asymmetric. But, are labour adjustment costs different for large and small firms? What is the link between the labor adjustment technology and the firm size? Could it explain adjustment costs differences? What is the role of the French labour law ? Would the effect of a policy changing the relative cost of permanent workers be the same in large and small firms?

In France, we focus today our attention on those questions. Recently, the French gouvernment has proposed to increase firing costs, especially for very large firms. First, legal severance payments would be increased for all firms, from 10 to 20% of the worker's reference wage by year of seniority. Second, in case of firings by firms with more than 1,000 workers, all workers would be entitled to a retraining period and maintained in the firm during this period. Moreover, those large firms would be obliged to contribute to the labor pool re-industrialization, by a contribution to the costs.

To answer those questions, we set up a dynamic labor demand model where adjustment costs are functions of workers flows (and not of the net employment variation), and where the level of flows depends on the firm size.

Our paper is organized as follows. Section 2 presents the theoretical model : in a first step we define the concepts we used (definitions of worker flows and of labor adjustment costs); in a second step, we propose a dynamic model which takes account of the link between hiring and firing costs and firm size. Section 3 presents the data and the econometric method. Section 4 reports econometric results and the last section concludes.

2 The theoretical model

Workers flows have a central position into several modern theories of the labor market. For example, one of the main explanation in efficient wage theory, is to assume that a firm face important costs when some of its employees quit their jobs. Moreover, hiring new workers to replace them implies training and recruiting costs. In such a case, firms are likely to increase wages in order to lower the voluntary exit flows (Salop (1979)).

The magnitude of flows reflects the importance of reallocations in the labor market. A large number of workers, for a given period of time, will leave their job and may experience a period of unemployment. Therefore, the matching process leads to frictional unemployment (Pissarides (1990)).

Similarly, insiders (workers) and outsiders (workers) confrontation involves the notions of entry flows, firings and consequently adjustment costs. Lindbeck and Snower (1988) prove that even if workers share similar skills, insiders and outsiders are not perfectly substitutable. Therefore, "the resulting labor turnover costs create economic rent which the insiders tap in wage setting and, as a result, involuntary unemployment may arise".

Generally, the vast majority of theories that takes account for dynamics relies either on net change in employment or in flows. In this article, we will focus on the impact of workers flows on labor demand. We will exhibit an impact of the legal system associated with fixed-term contracts and indefinite-term contracts on the value of adjustment costs and on the speed of adjustment.

2.1 Usual Definitions

Flows on the labor market may concern jobs or workers. Oue study is about worker flows but it is necessary to first distinguish job turnover from worker flows. Let us introduce some definitions. The net employment change is described by the following relationship:

$$\Delta L_t \equiv \sum_i (L_{i,t} - L_{i,t-1}),$$

where $L_{i,t}$ denotes the number of workers at time t in firm i. Moreover, to take worker flows into account, we define the change in the number of employees as:

$$\Delta L_t \equiv \sum_i (H_{i,t} - F_{i,t}),$$

where $H_{i,t}$ and $F_{i,t}$ denote respectively the sum of worker entries and the sum of exits at time t in firm i.

It is also possible to measure this variation with the job creation indicator (JC) and the job destruction indicator (JD):

$$\Delta L_t \equiv JC_t - JD_t, \quad with \quad \begin{cases} JC_t \equiv \sum_i^{\Delta^+} (L_{i,t} - L_{i,t-1}) \\ JD_t \equiv \sum_i^{\Delta^-} |(L_{i,t} - L_{i,t-1})| \end{cases},$$

where Δ^+ denotes the subset of firms with a positive change in the labor force between $t-1$ and t ($L_{i,t} - L_{i,t-1} > 0, \forall i$), and Δ^- corresponds to firms which contract the number of employees ($L_{i,t} - L_{i,t-1} < 0$).

To have more information about flows on the labor market, we can use other definitions. First, to compute how many jobs have been created or destructed between $t-1$ and t, we define the gross job reallocation indicator or job turnover (JT_t) indicator:

$$JT_t \equiv JC_t + JD_t.$$

Now, if we consider employees, we can define the labor turnover (LT_t) as:

$$LT_t \equiv H_t + F_t.$$

where H_t ($H_t = \sum_i H_{i,t}$) denotes the sum of workers entries in all firms and F_t ($F_t = \sum_i F_{i,t}$) the sum of exits.

Those quantities can be ordered as:

$$\Delta L_t \equiv JC_t - JD_t \equiv H_t - F_t,$$
$$\Delta L_t \leq JC_t + JD_t \leq H_t + F_t.$$

When we want to estimate the value of adjustment costs, it is important to distinguish between the net employment change ΔL_t and the gross workers flows $H_t + F_t$. Indeed, when a firm fires for example 10 employees and hires 10 other employees, the net adjustment is equal to zero and no adjustment costs occur, whereas the gross adjustment cost is strictly positive.

The net adjustment cost is:

$$AC(L_t - L_{t-1}),$$

and the gross adjustment cost is:

$$AC(H_t) + AC(F_t).$$

2.2 Adjustment costs : the role of law and firm size

We now turn to the empirical definition of hiring and firing. A survey of the existing literature unearths many definitions: Hamermesh, Hassink and Van Ours (1996), using a survey of Dutch firms, decompose the net change of employment in entries (new hires + rehires + transfers from other plants) and exits (voluntary quits + layoffs + discharges for causes + transfers to other plants). Serrano (1998) in the case of Spain and Abowd, Corbel and Kramarz (1999) in the case of France emphasize the role of contracts in describing workers movements. Indeed, the French law enables firms to hire workers on two types of contracts : the indefinite-term contract (contrat à durée indéterminée) and the fixed-term contract (contrat à durée déterminée).

In France, the maximal duration of a fixed-term contract is 18 months. This contract is renewable once but the sum of the two contracts cannot be more than 18 months. But, there is a supplement wage of about 6%, due at the end of the contract, which it is not payable if the contract is transformed to an indefinite-term contract. A firm cannot fire a worker employed on a fixed-term contract before the end of the contract (except for serious misconduct). Note that for an indefinite-term contract, French law allows severance payments which depend on the worker seniority and a reference wage[1]. To sum up, in any cases, and for any country, hiring and firing definitions greatly depend on institutional and cultural elements. Therefore, flows and their associated adjustment costs are strongly determined by French law. But they are also determined by firms characteristics, especially by firms organization.

Concerning organization, firm size affects job and worker flows. Davis, Haltiwanger and Schuh (1996) find a significant negative link between gross job destruction rates and firm size: "the job destruction rate averages 17.5% of employment per year for firms with fewer than 20 employees, 9.7% for firms with 500-999 employees, and 6.6 percent for firms with 50000 or more employees, ..., (they) show that gross job destruction rates decline sharply with firm and plant size". Our aim is to examine a possible relationship between worker flows and firm size.

As pointed out before, taking firm size into account could lead to a better understanding of the dynamic demand for labour. We do not know if there are differences in adjustment cost structures due to firm size differences. Is it less costly to hire and fire in very large firms, or are smaller firms more flexible? Are findings about "average" adjustment costs (see Goux, Maurin and Pauchet (2001)) always true whatever the size of the firm, that is : is the firing of a worker on a indefinite-term contract more costly than his hiring? Is the adjustment of permanent workers more costly than the adjustment of temporary ones? The answer could help us to make a step towards a better understanding of the labour adjustment costs composition. Indeed, the finding of differences by size of firm would suggest that gaps in labour adjustment technologies play an important role, and the finding that adjustment costs hierarchy is the same whatever the size of firm would mean that French labour law strongly constraints employment adjustment.

Following Blundell, Bond and Meghir (1996) for the investment or Meghir, Ryan and Van Reenen (1996) for the net employment change, we choose to model the adjustment cost with the following equation (see Summers (1981) for details):

$$AC\left(Z_t, X_t\right) = \frac{a_z}{2}\left(\frac{Z_t}{X_t}\right)^2 X_t, \qquad (1)$$

where Z_t denotes the gross flow (in our case the hirings H_t and the firings F_t) of the stock variable X_t (in our case the stock of employment L_t) and a_z, the coefficient of adjustment cost for the flow Z_t. With this function we introduce the fact that the plants' size has an importance in the determination of the dynamic behavior of the firms (see Hamermesh (1995)). Indeed, the

[1] A worker with more than 2 years of seniority receives 10% of a reference wage by year of seniority. This reference wage is equal to his/her average wage of the last three months in the firm. But collective agreements generally enhances this legal redundancy pay.

marginal adustment costs depend of the firm' size[2]. Thus the adjustment cost for the hiring or for the firing of one employee will not be the same in a small firm that a large firm.

In our work, the asymmetry of adjustment cost is due to the value of the coefficient a_z. Indeed, if a_h ($a_z = a_h$ if $H_t > 0$) is superior to a_f ($a_z = a_f$ if $F_t > 0$), there exists a positive asymmetry: hiring costs are larger than firing costs (and conversely if a_h is inferior to a_f). Moreover, the advantage of this form, compare to the usual quadratic form, is that it yields a linear dynamic demand in function of several hiring and firing rates when introduced into a dynamic firm program.

2.3 A model of dynamic labor demand

Firms adjust their level of employment facing their environment. Consequently, they have to build their behavior dynamically. In this subsection we set up a discrete time model which highlights the importance of firing and hiring costs in the dynamic labor model.

Assume that firms maximize the expected present value of net cash flow π_t given an available information set Ω_t on infinite time horizon:

$$Max \left\{ \underset{t}{\mathbb{E}} \left[\sum_{\tau=0}^{\infty} \left(\frac{1}{1+r} \right)^{\tau} \left(\pi \left(K_{t+\tau}, L_{t+\tau}, H_{t+\tau}, F_{t+\tau} \right) \right) \mid \Omega_t \right] \right\}, \tag{2}$$

where $\underset{t}{\mathbb{E}} [X_{t+\tau} \mid \Omega_t]$ denotes the conditional expectation of X at time $t+\tau$ using all information available Ω at time t; r is the discount rate. The value of the net cash flow is then given by:

$$\begin{aligned} \pi_t(.) &= \pi \left(K_t, L_t, H_t, F_t \right), & (3) \\ &= F \left(K_t, L_t \right) - w_t L_t - c_t K_t - AC_H \left(H_t, L_t \right) - AC_F \left(F_t, L_t \right). & (4) \end{aligned}$$

$F(\cdot)$ is the production function depending on two production factors, labor (L_t) and capital (K_t); w is the price of labor[3] and c is the user capital cost; $AC(\cdot)$ denotes the adjustment costs function. For simplicity, we do not consider the dynamics for capital accumulation (Bond and Van Reenen (2001) relax this assumption). In this framework, the firm chooses the path of hiring and firing that maximizes the value of its net cash flow subject to a constraint which describes the evolution of the number of workers:

$$L_t = (1-\delta) L_{t-1} + H_t - F_t \quad with \quad H_t = H_t^S + H_t^I \quad and \quad F_t = F_t^L + F_t^V + F_t^E, \tag{5}$$

where δ denotes the exogenous rate of terminations. Following previous studies, we distinguish different contracts for workers: fixed-term contracts (H^S = number of hirings on a short-term contract) and indefinite-term contracts (H^I = number of hirings on an indefinite-term contract). Similarly, we distinguish different exits processes: layoffs (F^L), voluntary quits (F^V) and end of fixed-term contract (F^E). These five flows explain almost entirely net changes in employment.

[2] $MAC(Z_t, X_t) = \frac{\partial AC(Z_t, X_t)}{\partial Z_t} = a_z \frac{Z_t}{X_t}$.

[3] Goux, Maurin and Pauchet (2001) show that there exists à differential between the wage paid to workers on indefinite-term contracts and the wage paid to workers on short-term contracts. However, this inter-contract wage differential would be relatively low and we do not distinguish wages by type of contract.

Other flows may be quoted, but they are marginal (military service, trial period, sick leave,...). In this study those flows are treated as exogenous variables.

In our model, the expected present value of net cash flow is the sum of the present value of cash flows π_t and of the expected value of future net cash flows $V_{t+1}(L_t)$ (see Blundell, Bond and Meghir (1996)):

$$\begin{aligned} V_t(L_{t-1}) &= Max\left\{\mathbb{E}_t\left[\sum_{\tau=0}^{\infty}\left(\frac{1}{1+r}\right)^{\tau}\left(\pi\left(K_{t+\tau},L_{t+\tau},H_{t+\tau},F_{t+\tau}\right)\right)\mid\Omega_t\right]\right\}, \\ &= Max\left\{\pi_t\left(.\right)+\mathbb{E}_t\left[\left(\frac{1}{1+r}\right)V_{t+1}(L_t)\mid\Omega_t\right]\right\}. \end{aligned} \tag{6}$$

From (3) and (5) one has:

$$\pi_t\left(.\right)=\pi\left(K_t,h\left(L_{t-1},H_t,F_t\right),H_t,F_t\right). \tag{7}$$

Using the envelope theorem and differentiating (6) with respect to the single state variable L_{t-1} and to the five control variables $(H_t^k, k=S,I)$ and $(F_t^j, j=L,V,E)$ (see Bond and Meghir (1994) for details), one gets:

$$\frac{\partial V_t(L_{t-1})}{\partial L_{t-1}}=(1-\delta)\frac{\partial\pi_t\left(.\right)}{\partial L_t}+(1-\delta)\mathbb{E}_t\left[\left(\frac{1}{1+r}\right)\frac{\partial V_{t+1}(L_t)}{\partial L_t}\mid\Omega_t\right], \tag{8}$$

and, first order conditions for hirings (H_t^k) and exits (F_t^j) are:

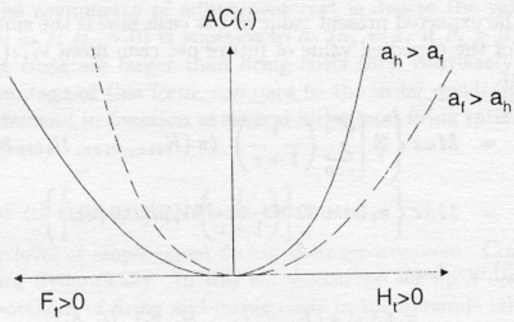
$$\frac{\partial V_t(L_{t-1})}{\partial L_{t-1}} = -(1-\delta)\frac{\partial\pi_t\left(.\right)}{\partial H_t^k} \quad , \quad k=S,I, \tag{9}$$

$$\frac{\partial V_t(L_{t-1})}{\partial L_{t-1}} = (1-\delta)\frac{\partial\pi_t\left(.\right)}{\partial F_t^j} \quad , \quad j=L,V,E. \tag{10}$$

Because of the marginal adjustment costs, it is not rational for a firm to layoff a worker and at the same time to hire another worker with the same characteristics and the same productivity (see Goux, Maurin and Pauchet (2001)). Nevertheless, a firm may swap a worker with another more productive or with a less costly worker in a lower skill group. As pointed out by most of the studies (e.g. Davis, Haltiwanger, and Schuh (1996), Hamermesh, Hassink, and Van Ours (1996)) entries and exits coexist mainly because of unobservable heterogeneity in apparently homogenous skill groups. In such a case, workers are not perfect substitutes. Unfortunately, we can not observe this heterogeneity within panel data sets.

One may quote some theoretical arguments to explain simultaneity in flows. Davis and Haltiwanger (1992) emphasize the fact that these flows are mainly due to the lack of information. As a matter of fact, firms do not have perfect knowledge regarding the quality of workers they could hired and similarly they do not know their productivity. Nevertheless, when time goes on, the information set to firms increases, so that firms could have incentives to fire a worker in order to hire another one. Ballot (1996) develops an argument based on a Schumpeterian approach. An innovating firm will hire workers for the production of a new good and it will fire workers in the production process of older goods if they are not able to switch to the production of new goods. In the following, we will study simultaneously entry flows and exit flows.

Figure 1: Adjustment costs function



Combining equations (8) and (9) and equations (8) and (10), one has the following dynamic equations :

$$\mathbb{E}_t\left[\frac{\partial \pi_{t+1}(.)}{\partial H^k_{t+1}} \mid \Omega_t\right] = \Phi\frac{\partial \pi_t(.)}{\partial L_t} + \Phi\frac{\partial \pi_t(.)}{\partial H^k_t} \quad , \quad k = S, I, \tag{11}$$

$$\mathbb{E}_t\left[\frac{\partial \pi_{t+1}(.)}{\partial F^j_{t+1}} \mid \Omega_t\right] = -\Phi\frac{\partial \pi_t(.)}{\partial L_t} + \Phi\frac{\partial \pi_t(.)}{\partial F^j_t} \quad , \quad j = L, V, E, \tag{12}$$

where $\Phi = \left(\frac{1-\delta}{1+r}\right)^{-1}$.

To derive explicitly the solution of the previous system, assume that $F(K_t, L_t)$ is described by a Cobb-Douglas function, $F(K_t, L_t) = cteK_t^{\beta}L_t^{\alpha}$. Moreover, assume that $AC^j_F(F^j_t, L_t)$ is symmetric and linearly homogeneous in firings and labor, and that $AC^k_H(H^k_t, L_t)$ is symmetric and linearly homogeneous in hirings and labor. Following Summers (1981), adjustment costs are described by :

$$AC^k_H(L_t, H^k_t) = \frac{1}{2}a^k_h\left(\frac{H^k_t}{L_t}\right)^2 L_t \quad , \quad k = S, I,$$

$$\textit{and} \quad AC^j_F(L_t, F^j_t) = \frac{1}{2}a^j_f\left(\frac{F^j_t}{L_t}\right)^2 L_t \quad , \quad j = L, V, E.$$

To describe asymmetric adjustment cost functions, one has to assume different coefficient in adjustment costs functions for hirings and firings (see Figure (??)). If a_f is greater than a_h then firing costs are greater than hiring costs. In the same way, if a^I_h is greater than a^S_h, then adjustment costs for hiring on indefinite-term contract are more important than adjustment costs for hiring on short-term contract. Given the production function and adjustment costs functions, one has:

$$\frac{\partial \pi_t(.)}{\partial L_t} = \alpha \left(\frac{Y_t}{L_t}\right) + \frac{1}{2}\sum_k \left(a_h^k \left(\frac{H_t^k}{L_t}\right)^2\right) + \frac{1}{2}\sum_j \left(a_f^j \left(\frac{F_t^j}{L_t}\right)^2\right) - w_t,$$

$$\frac{\partial \pi_t(.)}{\partial H_t^k} = -a_h^k \left(\frac{H_t^k}{L_t}\right) \quad , \quad k = S, I,$$

$$\frac{\partial \pi_t(.)}{\partial F_t^j} = -a_f^j \left(\frac{F_t^j}{L_t}\right) \quad , \quad j = L, V, E.$$

Substituting these derivatives in (11) and (12):

$$\left(\frac{H_{t+1}^k}{L_{t+1}}\right) = +\Phi \left(\frac{H_t^k}{L_t}\right) - \frac{\Phi}{2a_h^k}\sum_k \left(a_h^k \left(\frac{H_t^k}{L_t}\right)^2\right) - \frac{\Phi}{2a_h^k}\sum_j \left(a_f^j \left(\frac{F_t^j}{L_t}\right)^2\right) - \frac{\alpha}{a_h^k}\Phi \left(\frac{Y_t}{L_t}\right) + \frac{\Phi}{a_h^k} w_t, \tag{13}$$

$$\left(\frac{F_{t+1}^j}{L_{t+1}}\right) = +\Phi \left(\frac{F_t^j}{L_t}\right) + \frac{\Phi}{2a_f^j}\sum_j \left(a_f^j \left(\frac{F_t^j}{L_t}\right)^2\right) + \frac{\Phi}{2a_f^j}\sum_k \left(a_h^k \left(\frac{H_t^k}{L_t}\right)^2\right) + \frac{\alpha}{a_f^j}\Phi \left(\frac{Y_t}{L_t}\right) - \frac{\Phi}{a_f^j} w_t. \tag{14}$$

Note that the number of equations is equal to the number of the control variables. The determination of one rate depends on the determination of all others rates, we will take into account these dynamics simultaneously.

Thus, the dynamic labor demand is described by this set of equations. Note that the hiring rate for a specific contract (fixed-term contract or indefinite-term contract) depends on past firing and hiring rates for all contracts (including other types of contracts). Moreover, in the long run, the cost of labor is not affected by adjustment costs. In other words, the marginal productivity of labor equals the labor cost, i.e. adjustment costs have not impact in the long run, there is no hysteresis phenomen. The determination of adjustment cost asymmetry is necessary to capture the short run dynamics of labor demand (see Pfann and Palm (1993)).

3 The data and the econometric methodology

We use data for French firms which come from two different sources: the monthly workers movement declaration (déclaration mensuelle des mouvements de la main d'oeuvre; DMMO) and the survey for corporate tax returns (bénéfices industriels et commerciaux; BIC). These two surveys are administrative records, the first one regards firms over 50 employees. Once matched, these two data sets give a balanced panel of about 1,000 firms over the period 1988-1992 (see Dormont and Pauchet (1997) and Goux, Maurin and Pauchet (2001) for details on the panel data set[4]).

Equations to estimate are, in our framework, dynamic (see equations (13) and (14)). Therefore a consistent estimator is the generalized method of moment estimator. This method requires an orthogonality condition between instrumental variables and the error structure. We consider the following model:

$$y_{it} = f(x_{it}, \theta) + \varepsilon_{it} \qquad , \qquad i = 1, ..., N, \tag{15}$$

where y_{it} is a vector of endogenous variables, x_{it} is a matrix of exogenous variables and lagged endogenous variables. θ is the vector of parameters to estimate and ε_{it} denotes the error term. Let N be the number of firms. Assume that expectations are rational in this model, thus:

$$\mathbb{E}_t [y_{i,t+1} \mid \Omega_t] = y_{i,t+1} - \varepsilon_{it} \qquad with \qquad \varepsilon_{it} = \alpha_i + v_{it}, \tag{16}$$

where α_i are firm specific effects and v_{it} are idiosyncratic shocks. We wipe out individual firm effects after first differencing (see Arellano and Bond (1991)). Given our assumptions, the orthogonality condition is:

$$E\left\{Z_{it}^{\intercal} \Delta \varepsilon_{it}\right\} = 0 \qquad , \qquad i = 1, ..., N,$$

where Z_{it} is a matrix of instrumental variables.

Define the empirical moment as:

$$m(\theta) = \frac{1}{N} \sum_i Z_i^{\intercal} \Delta (y_i - f(x_i, \theta)) = 0.$$

The GMM amounts to minimize for θ the following quantity:

$$\underset{\theta}{Min} \left[m(\theta)^{\intercal} (W)^{-1} m(\theta)\right], \tag{17}$$

where W is a weighting matrix of moments and is a positive-definite symmetric matrix. An estimate of W is given by (White (1980)):

$$W = Z^{\intercal} \Omega Z = \frac{1}{N} \sum_{i=1}^{N} \left(Z_i^{\intercal} (\Delta \widehat{\varepsilon}_i) (\Delta \widehat{\varepsilon}_i)^{\intercal} Z_i\right), \tag{18}$$

where $\Delta \widehat{\varepsilon}_i$ are the residuals from (17) at a first stage when $(W \equiv I)$.

The set of instrumental variables has been chosen following the model specification. Instruments used depend from the dependent variable. To test for overidentifying restrictions, following Arellano and Bond (1991), we use:

[4]We used the same panel, but with specific data processing adapted to our study of adjustment costs by size of firm.

$$HS = (\Delta\overline{\varepsilon})^{\intercal}\, Z \left[\sum_{i=1}^{N} \left(Z_i^{\intercal}\, (\Delta\overline{\varepsilon}_i)\, (\Delta\overline{\varepsilon}_i)^{\intercal}\, Z_i \right) \right] Z^{\intercal}\, (\Delta\overline{\varepsilon}) \rightsquigarrow \chi^2_{Tq-p}. \tag{19}$$

HS has a chi-square distribution with $Tq - p$ degrees of freedom, where T is the total number of years, q the number of instrumental variables and p is the number of parameters in θ. Therefore, Tq is the number of columns in Z. $\overline{\varepsilon}_i$ denotes the residuals in a second stage when (17) is minimized.

By assumption, the instrumental variables are correlated with the endogenous variables, but are uncorrelated with the error term. In Arellano and Bond (1991), variables in equations are in first difference and the instrumental variables are in level. Blundell and Bond (1998) propose to estimate a system of equations in first difference and in level, i.e. one in first difference with instrumental variables in level, and, a second one in level with instrumental variables in first difference. They show that, when the number of time-series observations is small, the use of a system including first-differenced and levels equations "improve dramatically on the performance of the usual first-differenced GMM estimator ...".

In our study, from equations (13) and (14), it is obvious that the solution is a system of equations, and, the number of equations depends on the number of control variables. If we use the Blundell-Bond method we must estimate two equations for each specific workers flows (hirings on indefinite-term contract, hirings on short-term contract, firings, end of short term contract and voluntary exists). Each equation corresponding to a specific flow. Note that we will choose a specific set of instrument for each flow. Thus, the instrumental variable matrix is written as[5]:

$$Z = \begin{pmatrix} Z_1 & \cdots & 0 & \cdots & 0 \\ \vdots & \ddots & & \ddots & \vdots \\ 0 & & Z_a & & 0 \\ \vdots & \ddots & & \ddots & \vdots \\ 0 & \cdots & 0 & \cdots & Z_{nf} \end{pmatrix} \quad with \quad Z_a = \begin{pmatrix} Z_{a,90} & \cdots & 0 \\ \vdots & & \vdots \\ 0 & \cdots & Z_{a,92} \end{pmatrix}, a = 1, \ldots, nf.$$

Note that Z is diagonal, $Z_1, \ldots, Z_a, \ldots, Z_{nf}$ are instrumental variable matrices for each flow. nf is the number of equations and consequently the number of flows in our framework. Moreover, each element of a matrix Z_a is a set of instrumental variable for a specific year. In other words, we choose different instruments for each equation and each year. In this study we follow Blundell and Bond given the fact that we have for each flow two equations: one in first difference with instrumental variables in level, and, a second one in level with instrumental variables in first difference.

[5] The program used for the estimations has been developped by Blanchard et *alii* (1996) in the ERUDITE, University of Paris XII.

4 Empirical analysis

We use a sample of about 1,000 firms observed over the period 1988-1992. In a first step, we derive some descriptive statistics. To perform this analysis, we consider balance sheet variables, such as total output, work force, wages, and we compare them to worker flows. Because we compute entry and exit rates to study worker flows, only 4 years will be under investigation (1989-1992). In a second step, the econometric analysis will rely on the use of GMM. As pointed out in the previous section, this method requires instrumental variables. Lagged values of explanatory variables will be used for the estimation on the period 1990-1992.

4.1 Descriptive statistics

We start with some simple descriptive statistics. The panel combines times series and cross sectional data for about 1,000 French firms in the manufacturing sector during a period of 4 years (1989-1992). We consider two entry flows and three exit flows: hirings on indefinite-term contracts (H^I), hirings on short-term contracts (H^S), firings (F^L), end of short-term contract (F^E), and voluntary exits (F^V) .Residual flows (military service, trial period, sick leave, transfers to other plants,...) are considered exogenous in this study. These exogenous flows (denoted EX) are about 5% of the flows for any firm and remain stable for the period under investigation (see again Table (8)). We analyse the magnitude of worker flows, the correlations between those flows and other economic variables and the incidence of business cycle.

As the description of theorical model, we begin to introduce the descriptive statisctics on the usal definition of flows. In a secaond time, we highlihgt the role of law and firm size on the different flows.

4.1.1 Main features:

- Worker flows are more adequate than job flows
  - Over the period, the average growth rate of production is about 2.3%, close to the average growth rate of the mean production by employee (+2.4%). This result follows directly from the fact that there is almost no change in the labor force level (see Table (1)). However, worker flows are much higher (see Table (2)). We verify a stylized fact already found by previous studies: worker flows are much more important than the net employment change.
  - Worker flows are five times larger than job flows. The average labor turnover for a firm (LT_t, *i.e.* the sum of worker entries and exits) is about 65 per year whereas the job turnover (JT_t, *i.e.* the sum of job creations and destructions) is only about 12 (see Table (5)). We verify the classical inequality presented above: $\Delta L_t \leq JT_t \leq LT_t$. Note that most studies take only account of the net employment change and consequently loose some information regarding firms behavior.
  - If we consider the aggregated flows, Table (4) shows that firms take their hiring and firing decisions simultaneously rather than independently. 95% of firms hire and fire at least one employee within the same year.

- Impact of business cycle on the flows
  - Our panel reflects two important features of the French economy during the period 1989-1992: an expansion of activity in 1989 (+7.1% for production and +1.9% for employment) and a recession in 1992 (-2.5% for production and -2.3% for employment (see Table (4)).
  - From Table (4), it appears that the behavior of firms (hiring or firing) reverses between the two dates. In 1989, 56.5% of firms have simultaneously hired and fired workers but *in fine* the net employment change is positive. In the same period 32.9% of firms have simultaneously hired and fired workers and *in fine* the net employment change is negative. In 1992, we have the opposite situation: 32.6% of firms have these two flows but the net employment change is positive, and 54.9% of firms have hired and fired workers but the net employment change is negative.

4.1.2 Worker flows: the role of law and firm size

- Firm size and worker flows:
  - Flows depend on firm size: the larger a firm is, the higher hirings and firings are, and the smaller the hiring and firing rates are (see Table (2)). Taking account of heterogeneity in firms we consider three subsamples based on employment average during the period under investigation. The first group (A) corresponds to $L < 100$, the second group (B) is defined by $100 \leq L < 250$, and the last group (C) is such that $L \geq 250$. For small firms the hiring rate reaches 16.5% and the firing rate is about 16.9% whereas those rates are respectively 12.9% and 13.4% for the largest firms.This result is similar to the one found by Davis, Haltiwanger and Scott (1996). One of the explanations for the French economy may be the existence of collective agreements and unions in the large firms, which would limite turnover.
  - As mentioned above, we consider two entry flows and three exit flows: hirings on indefinite-term contracts (H^I), hirings on short-term contracts (H^S), firings (F^L), end of short-term contract (F^E), and voluntary exits (F^V) . When we decompose workers flows into those five flows, we find again that hiring and firing rates increase with the firm size: the larger the firm is and the smaller flows are (see Table (8)). We also refind the result of Hamemersh (1995), *i.e.* that quit rates are higher among small firms.

- Incidence of business cycle on workers flows, 1989 *vs* 1992:
  - The sum of job creations and destructions (JT) evolves independently of the business cycle while the sum of worker entries and exits (LT) decreases when the production decreases (see Table (5)).
  - Hirings, as expected, are stronger in expansion periods than during recessions. Total hirings are about 47 in 1989, and only about 24 in 1992 (see Table (5)). This procyclical pattern is due to hirings on short-term contracts (H^S) which are about 3.5 times as numerous as hirings on indefinite-term contracts (H^I) over the period 1989-1992. H^I appears to be independent of the business cycle.

- Exit flows exhibit different patterns. End of short-term contract F^E is the most important exit flow, in volume, (62.4% of total flows over the period), and it has a pro-cyclical pattern. The same result holds for quits F^V, which seem closely, and pro-cyclically, related to the economic environment. On the contrary, layoffs are strongly contra-cyclical: they increase when the production decreases, from about 3 workers in 1989 to 5 workers in 1992.
- Table (7) undoubtedly shows that firms hire and fire simultaneously. As a matter of fact, in 1989, 430 firms have positive records in H^S, H^I, and in F^L, F^V, and F^E. Similarly, in 1992, 420 firms have positive records in H^S, H^I, and in F^L, F^V, and F^E. Table (7) shows the importance and the close association between H^S and F^E. Indeed there are 794 (resp. 690) firms for which we have positive records in H^S and in F^E in 1989 (resp. 1992).
- Moreover, from Table (6), we uncover an explanation to the high correlation between H and F. This is due to the high correlation (0.922) between hirings on short-term contract (H^S) and exits for end of short-term contract (F^E). This result is a consequence of the legal framework and the constraint of a maximal duration for short-term contracts. All other correlations between hiring and firings are much more lower.

The conclusions drawn by this analysis do not differ from the stylized facts uncovered by previous studies: worker flows are very important and they are much more important than net employment changes; the economic situation has an impact on the level of the labor turnover which exhibits a cyclical pattern (contrary to the gross job reallocation which does not exhibit a cyclical pattern) and worker flows depend on the firm size.

4.2 Econometric results

In a first step, we will present results regarding total entries and total exits. We have a set of two equations, equation (13) for entries, and equation (14) for exits. In a second step, we will present results on disaggregated flows, *i.e.* results for two entry flows and for three exit flows. The previous section exhibited a close association between firm size and flows. To take account of this fact, each set of equations will be estimated for three subsamples according to the firm sizes. The econometric methodology is the GMM and we follow the Blundell-Bond approach (1998).

- Total entries and total exits:

  Following the Blundell-Bond approach we obtain four Euler equations: two for total entries (one in level, and one in first difference) and two for total exits (one in level, and one in first difference). Instruments for equations in first difference are in level and conversely. Moreover, the classical static equation which assume equality between wages and the marginal product will be estimated simultaneously with the four previous equations. In fine, we have a set of six equations.

  For equations in first difference, instrumental variables are: the value added of the firm, the average production per employee, wages, entries and exits. Each of these variables will be lagged one and two periods of time. For equations in level, instruments are the same as before but in first difference and lagged once.

See Table (9) for results:

- HS denotes a test for over-identifying restrictions (see equation (19)) : it has a chi-square distribution under the null hypothesis of instrument validity, with degrees of freedom reported in the last line (see Arellano and Bond (1991)). Exogeneity of instruments is confirmed for each sub-sample, but rejected for the total sample.
- Coefficients are significant, values for the elasticity of production with respect to labor are as expected (from 0.649 to 0.663). Moreover, coefficients of adjustment costs are positive and significant ($\widehat{a}_h$ and $\widehat{a}_f$).
- Surprisingly, we do not find any evidence of asymmetrical adjustment costs. As a matter of fact $\widehat{a}_h = \widehat{a}_f$. In other words, we do not observe any differences between hiring and firing costs. Moreover, these coefficients do not evolve with the firm size.

• Disaggregated flows:

We now have twelve simultaneous equations. Note that the number of orthogonality conditions increases rapidly (the computation time is an exponent function of the number of equations). We use different instruments for each flow.

For equations in first difference, instrumental variables are: the value added of the firm (VA), the average production per employee ($\frac{Y}{L}$), wages (w), total entries (H), total exits (F) and the specific flow of each equation. Each variable is lagged of one up to two periods of time. For equations in level, instruments are the same as before but in first difference and lagged of one period of time.

See Table (10) for results:

- For each subsample from the HS statistic, we accept exogeneity of instruments, and we reject it for the total sample.
- Coefficients are significant. Departing from previous results we have lower values for production elasticities with respect to labor (from 0.357 to 0.490). And all coefficients for adjustments costs are positive and significant.
- Of most interest, we now have significant differences for hiring and firing costs.
  * Hiring costs are larger for indefinite-term contract than for short-term contract ($\widehat{a}_h^I > \widehat{a}_h^S$). Indeed, the employer pays much more attention in long run recruitment than in the short run. If we posit the existence of a relationship between adjustment costs and speeds of adjustment (see Debrand (2000)), we have faster speed of adjustment for short-term contract than for indefinite-term contract. As in Bentolila and Saint-Paul (1992) we observe a cyclical sensitivity for short run contracts.
  * Regarding firing costs, we have ($\widehat{a}_f^E < \widehat{a}_f^V$)and ($\widehat{a}_f^E < \widehat{a}_f^L$), *i.e.* quits for end of short-term contract implies the smallest adjustment costs. This result follows from the fact that firms may forecast and anticipate these exits. Moreover, firing costs are much higher than hiring costs for short-term contracts.

- We then compare the firing cost a_f^L with the cost of hiring a worker on indefinite-term contract a_h^I. The results provide some evidence of a weak negative asymmetry $\left(\widehat{a}_h^I \leq \widehat{a}_f^L\right)$. As for fixed-term contract, there is some evidence of a negative asymmetry regarding labor adjustment costs $\left(\widehat{a}_h^S < \widehat{a}_f^E\right)$.
- Note that the last two coefficients for adjustment functions are similar $\left(\widehat{a}_f^L = \widehat{a}_f^V\right)$. Therefore, adjustment costs when an employee quits the firm on a voluntary basis or when he is fired are the same. Voluntary quits result from employee decisions, firms do not have any control on these flows, and cannot anticipate them.
- At sub-sample level, large firms have higher adjustment costs coefficients than small firms. Marginal costs are calculated for averages in each subsamples. Even if adjustment coefficients are positively linked with firm size, the value of marginal adjustment costs are decreasing (see equation (1)):

$$MAC\left(1, \overline{X}^I\right) = \frac{a_z}{\overline{X}^I},$$

where $\overline{X}^I$ is the mean of the employee in the sub-sample I $(I = A, B, C)$ and a_Z is the coefficient for the flow considered $\left(a_z = a_h^S, a_h^I, a_f^V, a_f^E, a_f^L\right)$. As a matter of fact, differences in coefficients are lower than differences in mean firm size from one sample to another. Thus, hiring or firing one more employee is less costly for a large firm than for a small firm.

5 Concluding remarks

The main purpose of this paper was to uncover and to estimate the incidence of law and firm size on the flows in a dynamic labor demand. From a panel of French firms over the period 1988-1992, five flows were studied: two entry flows and three exit flows. The two entry flows differ in the term of contract, short-term contract *vs* indefinite-term contract. Regarding the exit flows, their differences stem from the identely of the agent who decides to end the contract (employers or employees): firing, end of short-term contract, voluntary quit. Legal frameworks are specific to each kind of contract and consequently to each flow.

In a first stage, descriptive statistics show that the economic activity affects the level of flows. Moreover, the firm size is inversely correlated to entry and exit rates. This study undoubtedly shows that legal framework and flows are closely related. Short-term contracts allow a firm to adjust rapidly to changes in the economic surrounding.

In a second stage, we estimated a dynamic labor demand model which takes into account entry flows and exit flows. To perform this analysis we used a two step approach based on GMM. The first step, was to study the aggregated flows. The second step, more accurate than the first one, has considered disaggregated flows.

When we take account of disaggregated flows we are able to distinguish different adjustment costs for different kind of contract. Moreover, for the exit flows, we exhibit an endogenous hierarchy between adjustment costs. In such a case, we show that adjustment costs are higher for indefinite-term contracts than for short-term contracts. This gap explain in part the fact that entry flows related to short-term contracts are much more sensitive to economic activity

than for indefinite-term contracts. These short-term contracts allow firms to adjust the level of employment given a specific economic situation without departing from their optimal program. Moreover, adjustment costs differ from one exit flow to another. The lowest adjustment costs are those associated to the end of short-term contracts, and they are higher for the two other exit flows. Our clue is that since firms know the end of contract when they hire a worker with a short-term contract, there is almost not uncertainty in this case. On the contrary, voluntary quits and firings which should not be forecast by firms when hiring imply higher adjustment costs.

To sum up, this paper provides further evidence that the legal framework play an important role in determining the dynamic labor demand of firms. New laws, or changes in official rules may deeply affect firms behavior.

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Table 1: Usual statistics

	Mean	S-dev	Min	Q1	Q2	Q3	Max
In level:							
Production	99.09	467.9	4.453	19.58	36.75	74.79	12 025
Mean Productivity	0.260	0.106	0.075	0.195	0.239	0.299	1.159
Employment	343.2	1 636	42	88	148	280	37 220
Wages	173.5	42.5	73.1	148.1	169.8	194.3	788.0
In growth rate							
Production	0.023	0.139	-0.642	-0.041	0.038	0.107	0.580
Mean Productivity	0.024	0.128	-0.629	-0.035	0.036	0.095	0.527
Employment	-0.001	0.070	-0.487	-0.034	0	0.036	0.325
Wages	0.038	0.069	-0.726	0.013	0.042	0.068	0.444

Table 2: Statistics on the total flows

		Employment			Entries (Hirings)		Exits (Firings)	
		L	ΔL	ΔL/L	H	H/L	F	F/L
All	(913)	343.2	-2.97	-0.001	39.09	0.151	41.32	0.153
L <100	A - (260)	77.44	0.003	-0.003	12.96	0.165	13.13	0.169
100≤ L<250	B - (349)	163.9	1.366	0.005	26.07	0.155	25.37	0.153
250≤L	C - (304)	896.7	-12.32	-0.005	87.33	0.129	95.91	0.134

Table 3: Correlation matrix on the total flows

	Y	L	Y/L	W	H	F
Y	1.000	0.975	0.132	0.109	0.519	0.578
L		1.000	0.055	0.060	0.603	0.671
Y/L			1.000	0.724	0.072	0.051
W				1.000	0.042	0.053
H					1.000	0.917
F						1.000

Table 4: Impact of business cycle on the total flows

1989-1992

	ΔL<0	ΔL=0	ΔL>0		level	rate
H>0; F>0	0.442	0.069	0.448	Production	99.09	0.023
H>0; F=0	-	-	0.002	Employment	343.2	-0.001
H=0; F>0	0.020	-	-	Entries	39.09	0.151
H=0; F=0	-	0.001	-	Exits	41.32	0.153

1989

	ΔL<0	ΔL=0	ΔL>0		level	rate
H>0; F>0	0.329	0.063	0.565	Production	98.24	0.071
H>0; F=0	-	-	0.003	Employment	347.3	0.019
H=0; F>0	0.014	-	-	Entries	49.49	0.187
H=0; F=0	-	0.001	-	Exits	43.97	0.166

1990

	ΔL<0	ΔL=0	ΔL>0		level	rate
H>0; F>0	0.375	0.072	0.522	Production	99.91	0.046
H>0; F=0	-	-	0.001	Employment	350.3	0.013
H=0; F>0	0.007	-	-	Entries	44.05	0.173
H=0; F=0	-	0.002	-	Exits	42.37	0.164

1991

	ΔL<0	ΔL=0	ΔL>0		level	rate
H>0; F>0	0.516	0.072	0.377	Production	100.3	-0.001
H>0; F=0	-	-	0.003	Employment	343.5	-0.010
H=0; F>0	0.021	-	-	Entries	33.40	0.131
H=0; F=0	-	0.001	-	Exits	40.75	0.146

1992

	ΔL<0	ΔL=0	ΔL>0		level	rate
H>0; F>0	0.549	0.072	0.326	Production	97.94	-0.023
H>0; F=0	-	-	0.002	Employment	331.8	-0.025
H=0; F>0	0.039	-	-	Entries	29.44	0.114
H=0; F=0	-	0.000	-	Exits	38.19	0.136

Table 5: Statistics on two entries flows and three exits flows

	$\Delta Y/Y$	JT	LT	H^S	H^I	F^L	F^V	F^S
1989-1992	0.023	12.27	64.64	26.93	7.218	4.115	7.341	19.03
1989	0.071	13.16	76.25	39.94	7.538	3.238	8.645	21.89
1990	0.046	11.71	72.91	30.46	8.869	3.353	9.129	21.09
1991	-0.001	12.05	58.44	22.63	6.953	4.604	6.864	17.38
1992	-0.022	12.15	50.97	19.69	5.512	5.267	4.724	15.77

Table 6: Correlation matrix on two entries flows and three exits flows

	Y	L	H	F	H^S	H^I	F^L	F^V	F^E
Y	1.000	0.975	0.519	0.578	0.432	0.533	0.363	0.343	0.431
L		1.000	0.602	0.671	0.519	0.559	0.443	0.476	0.503
H			1.000	0.917	0.972	0.582	0.280	0.587	0.903
F				1.000	0.897	0.497	0.478	0.615	0.928
H^S					1.000	0.394	0.237	0.543	0.922
H^I						1.000	0.264	0.464	0.378
F^L							1.000	0.265	0.258
F^V								1.000	0.410
F^E									1.000

Table 7: Measure of the Simultaneously flows

	1989 (430)						**1992** (420)				
	H^S	H^I	F^L	F^V	F^E	420	H^S	H^I	F^L	F^V	F^E
H^S	846	718	534	765	794	H^S	784	624	585	715	690
H^I		749	495	671	709	H^I		703	550	596	629
F^L			563	503	531	F^L			682	566	599
F^V				776	734	F^V				750	661
F^E					827	F^E					773

Table 8: Flows description by firms size

	Y/L	L	H/L	F/L	EX/L	H^S/L	H^I/L	F^L/L	F^V/L	F^E/L
All	260.8	269.2	0.148	0.131	0.050	0.116	0.031	0.017	0.036	0.078
A	242.1	77.44	0.161	0.146	0.050	0.126	0.034	0.017	0.044	0.085
B	254.4	163.9	0.152	0.131	0.052	0.118	0.033	0.016	0.037	0.077
C	291.5	896.7	0.126	0.114	0.047	0.100	0.026	0.015	0.025	0.073

Table 9: Estimation with total flows

	All	A	B	C
α	0.6564 (158.8)	0.6575 (145.5)	0.6626 (157.0)	0.6491 (116.55)
a_h	1225.01 (7.50)*	953.14 (2.16)	1402.95 (4.87)	1441.67 (5.84)
a_f	1281.09 (16.97)	971.87 (2.14)	1410.99 (5.14)	1399.11 (6.07)
HS	398.63	186.91	188.56	139.51
df**	159	159	159	159
$\chi^2_{(0.05,df)}$	189.42***	189.42	189.42	189.42

* (*t-value*) , ***df*: *Degree of freedom* , *** $\chi^2_{(0.05,159)} = 189.42$

Table 10: Estimation with two entries flows and three exits flows

	All	A	B	C
α	0.4842 (33.58)	0.4151 (23.49)	0.3568 (20.78)	0.4898 (34.10)
a_h^S	755.24 (12.63)	585.52 (7.42)	643.43 (6.61)	717.61 (15.20)
a_h^I	1209.44 (12.70)	900.63 (7.97)	1128.47 (7.08)	1276.68 (14.96)
a_f^V	1147.29 (12.67)	844.15 (8.06)	1144.49 (6.72)	1328.63 (15.18)
a_f^E	892.34 (12.73)	674.88 (7.90)	786.55 (7.04)	759.88 (15.01)
a_f^L	1268.76 (12.01)	958.64 (8.17)	1257.63 (7.21)	1283.72 (14.74)
HS	503.22	247.29	276.47	182.72
df	381	381	381	381
$\chi^2_{(0.05,df)}$	427.51	427.51	427.51	427.51