# An ex ante evaluation of economic dismissals facilitation on the French labor market: An agent-based model

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**Abstract.** The El Khomri law (also called "Work law") has triggered a lot of conflicting judgements among French economists. However no model has been used to evaluate its effects ex ante. We have developed over the past 10 years a model of the recent French labor market, in order to analyze in detail this market and do policy design and analysis. The model integrates the heterogeneity of agents, and their decisions (firms and workers) based on "search theory", which gives rational microeconomic foundations to behavior, albeit with decision rules using bounded rationality rather than optimal rules which cannot be computed in the complex system that the modeled labor market constitutes. We introduce many institutions and specially the two main labor contracts, Open-Ended contracts and Fixed Term Contracts. The WorkSim model simulates the gross flows between inactivity, unemployment and these two types of employment, with a consistent accounting system. It is calibrated by a powerful algorithm to set 63 parameters to fit more than 64 aggregate real variables. We analyze only the facilitation of the economic dismissals allowed by the El Khomri law but it is the most essential element of the law for the labor market. We find that it has little effect on global unemployment but benefits the young who crowd out the seniors. This result is based on the substitution by the employers of more precarious Open Ended Contracts to Fixed Duration Contracts which become useless, and the fact that young workers are more often in Fixed Duration Contracts than the other age categories. The labor market is deeply transformed. When aggregate demand is exogenously changed, the experiment shows that the employment and the unemployment react faster than before the law.

## 1 Introduction

The El Khomri law project also called "Work" law has recently set the war not only on the French political scene, but also between French economists who do not hesitate to take a categorical position in favor or against it. As we have developed a model of the French labor market which is a complex system, with many interactions, and uncovered some of these complexities in a previous reform called the "Generation Contract" in [Ballot et al., 2016], we are puzzled by many flat statements. Some predictions are based on the Spanish and the Italian evolution of employment and unemployment after the labor market reforms in these countries, but the simple observation of an improvement in

employment cannot be used to prove that the reform has had an impact. The state of the art in econometrics requires that there is a natural experiment, i.e. that the reform has been applied to only to a part of the country, and comparison is then made controlling for the heterogeneity between the treated and the untreated part. This is not the case, and it will be close to impossible to evaluate Matteo Renzi's Job Act as well as the present law ex-post, since the effect can be caused by an external demand shock or other causes. Although the previous criticism is sufficient, we will emphasize that there are plenty of institutional and other differences between France and the mentioned countries, and the El Khomri law is also different. In fact modeling the successive versions of the El-Khomri law has shown some differences in the results. Finally statements should be backed by a model of the labor market with the law integrated in it, to get an understanding of the mechanisms by which the law can have effects. It is far too imprecise to rely on cross-country econometric analysis of reforms, as for instance in [Kahn, 2010] who uses aggregate indexes of Employment Protection Legislation (EPL) for each country, even if two specific indexes are used for the two main types of contracts. We argue that the details of the legislation matter (see [Holmlund, 2014] along the same line of criticism). We propose a modeling approach which has the fundamental advantage to be ex-ante. Moreover many factors and the detailed institutions before and after the law are taken into account. We use the latest WorkSim model version we have developed in [Ballot et al., 2015] to analyze the ex- ante effects of an essential element of the law El Khomri, namely the facilitation of the economic dismissals. The Law project contains a great number of other elements. Some are measures that are too complex to be included at this stage. Some only open the possibility to negotiate some changes at the firm level rather than at the sector level. We have also done a preliminary study on the change in the wage rate for hours beyond the legal weekly duration of work (35 hours) but space is lacking. It cannot be excluded that these simultaneous changes, and specially those concerning the duration of work modify some of the net effects of the Law. However the facilitation of economic dismissals can be expected to be the most important change for the labor market, and our results confirm that the effects are fundamental. Moreover the most essential purpose of the paper is to propose a method to do ex ante analysis of a labor law in a detailed labor market with heterogeneous autonomous agents, a method that has not been used so far. The paper, due to space constraints, presents only the results corresponding to the final version of the law, voted on July 21, 2016. The present results may then differ somewhat from those we gave to the media, which rely on non final versions of the law. The important limit of the study is that we do not have a macroeconomic model at this stage, so that we explore the direct effects that a change in the institutions of the labor market may have on the employment and unemployment, leaving aside

induced changes in aggregate demand and investment which in turn modify employment again. One way to look at this is to assume that they are second order effects, but this may not be true. Our view is rather that it is legitimate to do the intellectual experiment of isolating the direct specific role of lowering the so-called "labor market rigidities", since the international institutions repeatedly point to their responsibility in the high French unemployment rate, either at the global level, or at the level of some specific categories (young, low skilled...). If the direct effects are not important, this emphasis may be misplaced. If they are, further development of our model into a macroeconomic model becomes a research agenda.

The Agent-Based methodology is used. Agents are autonomous and there is then no need for an auctioneer, an unrealistic fiction in orthodox models, and this is has consequences since the labor market is very (not totally) decentralized. The agents take decisions based on their information and the calculation of costs and benefits, and the profit (for the firms) or utility (for the individuals) they expect. The environment is very complex because of the institutions and the interactions, and changing, and their rationality is bounded in the sense of [Simon, 1956]. Therefore, when in a given state, they choose the best of a few possible solutions (see below for examples). They do mistakes when deciding, but in WorkSim, they can learn and revise their requirements. The institutions and legal rules that constrain the decisions are modeled precisely. Summation is done only on individual outcomes in order to compute the aggregated statistics, and this can be done for different categories of a same type of agents (young, blue-collars ...). The models then allow for non-linear relations between aggregate variables, and notably crowding-out effects, often important in labor markets. The computed effects of the present law will bring a resounding example. These models can be calibrated with a varying degree of sophistication, and when the purpose is to study a policy, as in this paper, it is an essential part of the research. The development of macroeconomic Agent-Based models with labor market has a thin but long history, dating back from Barbara Bergmann and Gunnar Eliasson micro to macro models [Bergmann, 1974,Eliasson, 1977], while [Ballot, 1981,Ballot, 2002] built ARTEMIS, a detailed model of the French labor market, and a forerunner for the present model.

## 2 Overview of the model WorkSim

In this paper, we extend WorkSim, a detailed model of the French labor market, which reproduces the gross flows of individuals between the main states, employment, unemployment and inactivity Employment is subdivided into the fixed term contracts (FTC) and open-ended contracts (OEC). Due to lack of space, the presentation will not include the equations which can be found in

[Goudet et al., 2016]. The flows are generated by the interactions of the rational decisions of numerous heterogeneous agents (around 20 000 in our simulations), representing multi-job firms and individuals, who belong to households. The individuals take into account the incomes of the other members of their household when they decide. They also age and the demographic events of the households are reproduced, based on current statistics, but aiming for a steady state. Individuals retire and die, and are replaced by young individuals who become agents when they are 15 years old. The flows generate a consistent system of flows accounts, so that all the costs and benefits induced by each flow unit are accounted for, a necessary tool for precise market and policy analysis. The core theoretical framework for the decisions is costly search of jobs by the individuals and of workers by the firms, named "search theory" and the most used and flexible intellectual framework in economics for studying labor markets as flows of creation and destruction of jobs and as mobility flow systems as well (see [Mortensen and Pissarides, 1994]). The individuals base their decisions on comparisons of utility between the different states they can reach or try to reach. For instance an employed individual may choose between searching for a new job, either searching on-the-job or quitting to be a full time unemployed searcher, quitting for inactivity, or just staying a non-searching employee in the same firm. The firms compute the expected profits from decisions about opening vacant jobs or not, firing or not, etc. This decision methodology implies modeling anticipations.

The institutions constrain the decisions: among the important institutions are the minimum wage, the welfare system, and the main features of Labor Law such as the firing costs, the need for "serious economic problems" to trigger economic dismissals without undergoing the risk of litigation, and the grace period before opening again a terminated FTC. It is possible to modify an institution and study the effects on the variables of interest at the aggregate level of the market or at the level of the different categories of workers. The model is then a powerful exploratory tool for labor market policy. The demand for the good is exogenous (and stable) but the market share of each firm follows a random walk (combined with a random trend changing each year), which can be interpreted as representing the stochastic changes of tastes of consumers for the variety of the good that a given firm produces. The decision of a firm on the opening of a new job, when present demand exceeds production capacity, is based on an computation of the expected discounted future profit on such a job, taking into account the expected revenue from the sales, and costs, namely the (learned) cost per period of the vacancy over the expected vacancy duration, the expected costs of labor (wages, social security..). These are general benefits and costs for any type of job. However the model goes beyond to endogenize the choice between an OEC and a FTC, and in the latter case, endogenizes the specified duration of the FTC. We have undertaken a thorough treatment

of this choice, and it leads to the main contribution that we can bring to the analysis of the El Khomri law project. The firms make anticipations on own future demand at the horizons of the contracts they may sign. More precisely each firm makes three scenarios of the demand evolution within a range that is given by the history of its demand (trend and variance): upper and lower values for a standard error, and the trend scenario. For each type of contract (and each duration of a FTC contract, taking discrete values) we compute the complete costs and revenue at the horizon. Then, the firm will weight each scenario (the weights will be calibrated). The firm then chooses the contract which gives the highest expected profit. If the expected profit is negative the job is not created. This framework sets the stage to a multidimensional arbitrage between opening a FTC and an OEC when present demand is higher than capacity. For the first time in the (tiny) literature on the endogeneization of the choice between these contract types, we consider that it is not a question of substitution based on one motive only, but that there are two types of substitutions, and also two types of complementarities, so that the methodology we use (agent based model plus calibration) appears as a powerful tool to evaluate the mix of the two contracts, and the effects that policy can have on that mix. The first substitution factor is the only one which has received analysis although we detail it much more. The OECs have a cost of termination which is the firing costs. We add an estimate of the hoarding costs until the employer considers he runs into a "serious economic problem", that he estimates a judge will consider a sufficient justification for firing, and then expected litigation costs. For FTCs, we consider costs specific to them, such as the grace period which delays a new hire when the contract is terminated. The second important substitution factor is the amortization of the costs of training newly hired workers (or the low productivity when learning the job), which can be far too high on a short FTC. We have highlighted two complementarity factors. The first one is the screening that FTCs allow before hiring on an OEC. The second is the buffer that FTCs constitute when the firm faces the uncertain future demand we mentioned. If the employer has a sufficient number of FTCs, he can still decide to hire an OEC since he can calculate that the FTCs will come to an end and he does not have to fire the OEC if demand falls. The cost of dismissal is avoided and the benefit from a better amortization of the training costs is gained. The computation of all the terms of the arbitrage determines the net benefits of each type of contract and the duration if the FTCs of all durations are more profitable than an OEC. The distribution of durations of FTCs is then endogenous, its variance is high, and the (very) short durations the majority. These are prominent stylized facts in the French labor market, and a social issue.

Some firms may go bankrupt and are replaced with an entrepreneur who starts alone. The model is at a scale of 1 to 4700 and has the week as the base period, in order to reproduce the gross flows, rather than transition rates

between distant dates, which would miss most of the very short spells in FTCs (as is the case for studies based on the Labor Survey), and most mobilities.

The model is calibrated by the CMA-ES algorithm CMA-ES (Covariance Matrix Adaptation Evolution Strategy) designed by
[Hansen and Ostermeier, 2001]. The principle of this evolutionary algorithm is to test step-by-step new generations of points in the parameters space. Each new generation of points is drawn stochastically according to the results obtained with the previous generation of points. The mean and the covariance matrix of the distribution of the new randomly drawn points are updated incrementally in order to move towards the best results obtained by previous generations. The fitness function is minimized at the horizon of 400 periods in a steady state. Presently the steady state reproduces 64 observed variables for the year 2014 as weighted targets in the fitness function and we obtain a median standard error of 8.5%. There are 63 parameters calibrated and the others are taken from the law or demographic statistics.

The model generates some important specific characteristics of the French Labor Market such as the very important share of FTCs in terms of flows, 80% in 2014), and the contrasting fairly low figure of the share of the workers employed in such contracts: 10%. The unemployment of the young is also much higher than the unemployment of the older workers. This confirms the dualism in the French Labor Market, which is displayed by the differences in the patterns of gross flows of the categories of workers. The model computes all the simulated flows, but allows for comparison with those which can be measured by the published statistics, and the results fit roughly. Most workers are stable in their OECs, while a minority undergoes short spells of employment in FTCs and spells of unemployment between them. Moreover this dualism persists for part of the young workers when they age while the others obtain more stable OEC. More novel results are obtained but will not be detailed here, since they are not the core of this paper.

## 3 The El Khomri Law project

First we simulate the facilitation of the economic dismissals, for a steady state of the exogenous aggregate demand, and secondly we study the differential effect on unemployment between the present law and the El-Khomri law when demand changes exogeneously. Before the law, the economic dismissals are allowed if the firm faces "serious economic problems" which in our understanding of case law we interpret as losses over a period of year which can lead to the failure of the firm. Judges may have their own interpretation over the minimum level of losses which could lead to failure. The minimum level is then not our arbitrary decision but calibrated simultaneously with the other parameters of the model, and found as 28% of sales revenue in the reference simulation. The

judge intervenes only if the fired workers sue, which happens in 1% of cases. However the workers win in 64% of the litigations. The final version of the El-Khomri law (article 30) conditions firing to a decline either in its demand or its turnover computed over a certain period, which depends on the firm size. For firms under 11 employees, the period is 1 quarter, for those between 11 and less than 50 the period is 2 quarters, for firms between 50 and less than 300, the delay is 3 quarters, and for firms with 300 employees or more the delay is 4 quarters. We name it ECO 4 since we have presented some of the other versions in the media. Two remarks are in order. First the writing of the law is ambiguous and allows for an interpretation in which the demand in each quarter should be compared to the corresponding quarter in the preceding year, a more demanding condition. We have simulated this version (called ECO 3), which yields less flexibility, but will not report it here through lack of space, and because it is less likely. Second other alternative motives for firing such as technological mutation are written in the law. The conditions are not precise, and moreover, many of them already existed before the El-Khomri law. They do not change the comparison then, and we leave them aside.

### 3.1 Effects under a stable aggregate demand

ECO4 yields effects which change over time after the introduction of the law. They evolve during the first 3 years to stabilize generally after 4 years. The first can be termed short run effects and the latter long run effects. This comes from the fact that it takes time for the firing conditions to be filled even under the new law. The immense majority of French firms are small or very small and it takes time for such firms to face a cumulated change large enough to be willing to fire at least one employee. At the level of the whole population, the effects are quickly favorable since hiring does not meet legal conditions, but decline so that after 4 years they are no longer significant. After 2 years the decline in unemployment is 160,000 (0.59 point) but only 44,000 after 4 years (compared to the reference simulation). Employment rises by 248,000 after 2 years and only by 117,000 after 4 years. The increase in employment is higher than the decrease in unemployment since the latter stimulates entry of non participants into the labor market, a well documented labor market behavior. However ECO 4 is favorable to the young (15-24), both in the short and the long run, with a decline in unemployment of 265,000 after 2 years meaning a huge decrease of the unemployment rate from 26.1% to 16.8%, and an increase of 323,000 in employment (over 4 points). However these favorable short run results decline steadily since after 4 years the gain in the unemployment is only 6% against 9.3%, and after 8 years it falls to 3.2%. If we turn to the age class (25-49), after 2 years, there is a small decrease in unemployment (-53,000) and an increase in employment (+71,000). However after 4 years

the law has no significant effect on this age class. Finally the seniors (50-65) undergo a substantial rise in unemployment (+157,000), rising from 6.48 to 8.59%, i.e. 2 points, and an decrease in employment (-147,000). The long run, specially after 8 years improves their situation which becomes only very slightly worse than before the law. This is only part of the story. The mobility on the labor market is found to change very deeply, and the nature of the labor market is transformed. The share of FTCs in the hires falls from 79% to 27%. The share of OECs in hires then rises from 21% to 73%. The OEC becomes the dominant hiring contract. The proportion of FTCs in ongoing contracts falls from 8.33% to 2.03%, yet with a decrease of the mean duration (renewal not included) from 3.7 weeks to 1.9 weeks, meaning that the FTCs are now used only when future demand forecasts are bad and no training is required. the economic dismissal rate jumps from 0.5% to 18%, a major change in a labor market characterised by a very low and decreasing economic dismissal rate. A caveat should be included here. We presently do not model the "conventional separations" (*ruptures conventionnelles*) of OECs, which are a bargained separation between the employer and an employee, and are included in the personal dismissals. These conventional separations can be expected to rise in order to avoid litigation and smooth somewhat the explosion of economic dismissals. Yet this would not change the fact that the median duration of OECs falls from 4.8 to 2 years, as a consequence of the rise of economic dismissals. Two major conclusions can be drawn. First a significant substitution of the young to the seniors takes place, although it declines with time. Second the new load of adjustment set on the OECs has the logical effect of making the FTCs an almost useless tool of flexibility for the employers except for very short expected durations. The explanation of the opposed effects over the young versus the other categories is clear. The young were much more often than the others in FTCs (22% against 7.6% for the 25-50 and 4.9% for the seniors) and benefit from their fall. The effect then goes much beyond the higher flexibility of OECs. It raises the integration of the young in (more precarious) OECs, and this shows that the screening and experience enhancing roles of FTCs were not sufficient. This mechanism, the substitution of OECs to FTCs, and its consequence, the substitution of young workers to seniors, has been overlooked or greatly underestimated by non quantitative analysis of the law.

### 3.2 Sensitivity of adjustment to aggregate demand

We now change exogenously aggregate demand in order to compare the effects on the unemployment rate of the firing conditions before the law and after the law. Figure 1 gives values after 2 years. It shows that the adjustment of the labor force is predicted to be more important after the law. When demand declines under its value in the reference simulation, economic dismissals are more

important, the suppression of the hoarded labor is more complete, and unemployment rises more under the law El-Khomri. When demand rises above the reference value, the employers hire more easily on OECs, and unemployment decreases more under the law. The responses are not symmetric for large (and unrealistic) changes since if demand is very high, there always remains some search unemployment by workers who take the time to find a job which satisfies their reservation utility. This experiment on changing exogenous demand reveals the increased flexibility which was a purpose of the law, concerning economic dismissal conditions. It shows that if demand increases, the unemployment declines more than without the law, but not that it declines just because the law is implemented.

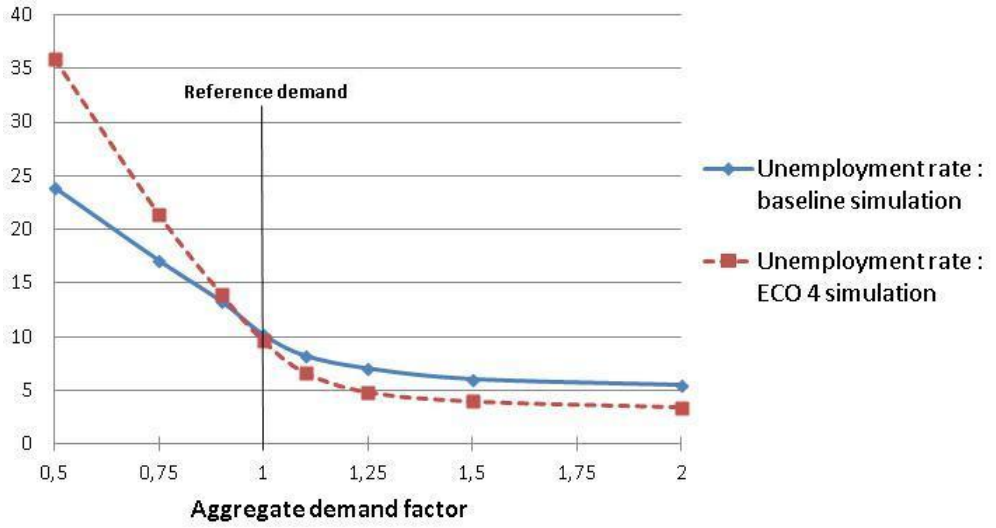


Fig. 1: Sensitivity to demand shocks. x-axis displays the demand factor $df \in [0,5;2]$, where the total demand $D_{tot}$ becomes $df \times D_{tot}^{ref}$

## 4 Conclusion

The conclusion of these experiments brings food for thought since they are not exactly what the proponents expected, when writing the law. First hopes to raise employment by facilitating the economic dismissals are not confirmed. The null effect is in line with the theoretical literature on firing costs reforms since [Bentolila and Bertola, 1990], which takes into account that employers forecast when hiring on OECs that firing will be costly: lower firing costs increase fires and hires but the impact on the average level of employment and unemployment is ambiguous. Second several effects that have not been

studied precisely in the literature before appear with force in our study: two opposed effects on precariousness appear, that show the complexity of a labor market policy: the FTCs fall abruptly, a decrease in precariousness, and the median duration of an OEC is cut by more than half, a rise in precariousness. Both effects are intuitive but our study of the change in the law shows massive effects can be expected. Our figures might be maximum effects, since, for the sake of avoiding ad hoc assumptions, we have set no ceiling to the substitution between OECs and FTCs. In the real world, some jobs can only be FTCs or OECs. A better integration of the young in OECs is achieved, although the effect decreases in the long run. Moreover the young substitute (or crowd out) the seniors since as shown, the total effect is neutral. Finally the changes in exogenous demand show that the EL-Khomri law appears as a favorable condition to decrease unemployment if demand rises, not a sufficient condition. Moreover the adjustment is higher also in case of demand decrease. Other elements of the law may alter its effects. The employers may be tempted to increase the duration of work since the supplementary hours are less costly, and this lowers the employment in the firm which puts this increase into practice. However macroeconomic effects of the duration of work through the salaries, the profits, and the change in competitiveness are complex. We have also left aside for future work another element in the law, the "guarantee for the young", aimed at providing them a welfare subsidy and an strengthened help for finding a job. However more precisions would be needed to model such a help, since crowding out effects - that our model can easily - study are possible. Therefore we will avoid a flat judgment on this complex law, beyond the important consequences that our experiments have uncovered.

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