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Dual labor markets and the macroeconomy

Normann Rion

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THÈSE DE DOCTORAT

DE L'UNIVERSITÉ PSL

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Marchés du travail duaux et macroéconomie

Soutenu par

Normann RION

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Sorbonne**

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Chapter 1

General introduction

At the end of the 1980s, the economic downturn following the oil shocks lead firms to ask for looser firing rules. Consequently, many European countries enforced policies to make labor markets more flexible. Fixed-term contracts were thus introduced in France in 1979.

1.1 Labor contracts and the law

In France, the law regulates many aspects of the relationship between employers and workers. Ray (2020) describes its highways and byways.

Open-ended contracts cover most employees. Open-ended contracts include a probationary-employment period of up to 4 months. Both the employer and the worker may costlessly dissolve the agreement during this time. Once the probationary period has come to an end, the employer may invoke economic or personal motives for redundancies, which they should be able to justify on court if the involved worker challenges the employer's decision. Economic redundancies compel the employer to demonstrate that reducing employment is the only available solution, while personal redundancies impose showing that the worker cannot fulfill the job he was hired for. Blatant misconducts excepted, the firm has to notify the worker before laying him off. The worker carries on in his position until the notification delay expires. For example, a worker with a seniority between 6 months and 2 years has to be notified at least 1 month before being dismissed. The notification delay amounts to 2 months if seniority exceeds 2 years.

Employer-initiated terminations and retirements confer severance payments to the involved workers. Severance payments are difficult to assess as they depend on agreements reached through sector-level collective bargaining, firm-level collective bargaining or individual bargaining. Labor law sets a minimum level rule for severance payment, though. The severance payment cannot be lower than 1/4th of the monthly reference wage per year for the first 10 years of seniority and 1/3rd of the monthly reference wage per year beyond these first 10 years. A generous formula pinpoints the reference wage, which is the highest amount between last year's average monthly wage, or one third of last quarter's total wages with 1/12th of bonuses if any. Note that collective and individual redundancies do not abide by the same rules. Firms with more than 50 employees that dismiss more than 10 workers in a month have to formulate a specific plan, which sets a limit in

the number of redundancies and offers specific training or job proposals to ease the fired workers' reclassification. As workers or unions can question their dismissal in court, firing costs extend far beyond the minimum severance payment labor law spells out. Abowd and Kramarz (2003) and Kramarz and Michaud (2010) notably estimate firing costs for French firms. Their results confirm that the actual cost of terminations is much larger than the minimal one labor law delineates as severance payments. Yazidi and Darmaillacq (2014) and Fraisse et al. (2015) quantify the extent of legal actions in front of labor courts in France. In 2013, 60% of disputes are challenged in appeal, which is far higher than in other types of courts.

On the workers' side, an employee can quit its open-ended job at the expense of an advance notice delay. Quitting workers cannot get unemployment benefits or severance payments in contrast with dismissed workers. An employer-worker pair can also bargain on termination conditions if both parties want to end the contractual relationship. In this case, the employer has to compensate the worker for at least the minimum legal severance payment. The worker is better off than quitting as he can get unemployment benefits as well as a severance payment once laid off. The employer may avoid time-consuming and expensive legal actions classic redundancies entail. Note that the procedure must be validated by an administrative authority. After its approval, the worker can challenge the reached agreement for one year. Thus, negotiated terminations do not utterly prevent labor court judges from taking action into redundancies.

Nowadays, quantitatively speaking, quits represent roughly 40% of terminations. 20% of terminations occur at the end of the probationary-employment period. Terminations involving personal motives amount to 16% of all redundancies, whereas economic terminations represent only 3% of terminations. Negotiated terminations cover 10% of redundancies¹.

In legal terms, open-ended contracts are considered the normal form of any labor relationship². Thus, employers must justify the resort to fixed-term contracts. Legitimate reasons include replacing an ill worker, workload fluctuations and dealing with seasonal activities³. Fixed-term contracts can generally last up to 18 months, including up to two renewals. Beyond this maximum duration, both parties need to sign an open-ended contract to carry on the labor relationship. Milin (2018) reports

¹I take these figures from the *DMMO-EMMO* surveys (Dares, 2020)

²article L1221-2, *Code du travail*

³article L1242-2, *Code du travail*

that the average duration of fixed-term contracts was 46 days in 2017. The distribution of duration is strongly skewed to the right: 25% of fixed-term contracts last less than 5 days, 75% less than 27 days. At the end of the contract, the firm pays the worker a precariousness severance payment amounting to 10% of the total gross wages paid during the contractual relationship. Theoretically, the law punishes the abusive resort to fixed-term contracts, which may lead the involved employer to redefine the contract as open-ended and pay damages to the worker.

In general, fixed-term contracts cannot end before their stipulated termination date at zero cost. The requester exposes himself to paying a compensation to the other party. Labor courts decide on each party's potential misconducts. A few exceptions arise, though. Beyond exceptional situations, the firm and the worker can costlessly repeal the contract by mutual agreement. Moreover, a fixed-term worker can freely leave his current position if he signs an open-ended contract. In this case, the worker has to notice his employer at most 2 weeks before leaving. Fixed-term contracts scarcely end before their stipulated termination date. According to Milin (2018), only 2% of fixed-term contracts terminated prematurely in 2017.

Nevertheless, the term "fixed-term contract" covers a myriad of different types of contracts. For example, some fixed-term contracts called *contrats d'usage* significantly contribute to the shortening of fixed-term contracts, especially in the service sector. A few industries may use these contracts, which include no constraints on renewals or precariousness severance payment. As stated above, the law chastises the abusive resort to *contrats d'usage*. However, the worker has little incentive to prosecute a malicious employer. Such a legal action negatively impacts the worker's reputation towards other employers in the same industry, which in turn harms the worker's future employment prospects.

Interim work may also be considered as fixed-term employment as it is legally constrained as well. At the blurry frontier of fixed-term employment, self-employed workers who ensure temporary missions for very few customers can also be considered. These workers do not benefit from the same legal protection as employees, which may encourage their use. Expanding digital platforms resort a lot to self-employed workers. Note that this specific form of temporary employment also covers countries where fixed-term contracts do not legally exist.

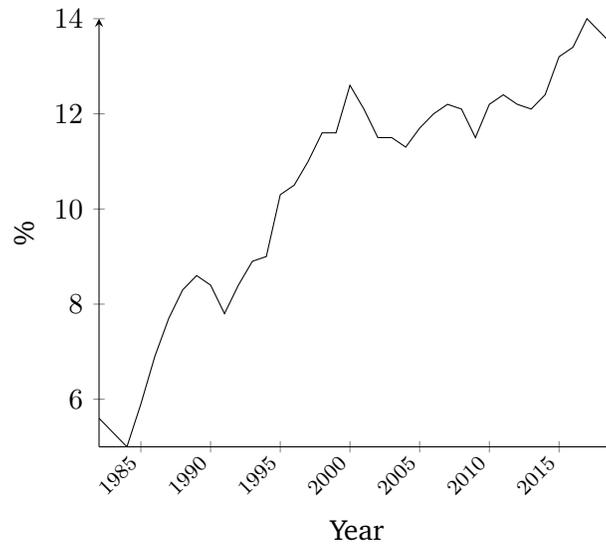


Figure 1.1: A sharp increase in the proportion of fixed-term contracts over the last decades

POPULATION: Employees who are between 15 year-old and 64 year-old and live in France, apprentices excluded.

SOURCE: *Insee, enquête Emploi*

Fixed-term employees include fixed-term workers (*Contrat à Durée Déterminée* in French) and interim workers.

1.2 Employment protection and the macro-economy

1.2.1 Stylized facts

As I have shown above, French labor law supposedly constrains the resort to fixed-term contracts. However, it has not prevented fixed-term employment from expanding. Figure 1.1 shows the proportion of fixed-term contracts among employees. The share of fixed-term workers has steeply increased, from 6% of employees in 1982 to nearly 13% in 2019. Hires essentially occur through fixed-term contracts.

Figure 1.2 shows the share of each type of contract in job creation, distinguishing fixed-term contracts of more than one month and less than one month. Fixed-term contracts are shorter and shorter; the share of fixed-term contracts of less than one month in job creation has increased from nearly 50% in 2000 up to 70% now. Fontaine and Malherbet (2016) contends that it is specifically occurring in France and not necessarily in other European countries. The share of fixed-term contracts of more than one month has decreased from 30% in 2000 down to 17% now. Nowadays, fixed-term contracts represent 85% of hires. Milin (2018) provides further details about the resort to fixed-term

contracts. Some sectors particularly contribute to the expansion of fixed-term contracts lasting less than one month such as residential care activities, the audio-visual industry and catering.

Insee (2019) reports that fixed-term contracts notably affect young workers. In 2019, fixed-term and interim employment cover 35% of workers aged 15 to 24. This share falls to 10% for workers aged 24 to 49 and to 6% for workers aged at least 50. Using cross-country data, OECD (2006) finds that stringent employment protection reduces youth employment whereas it advantages older workers. The role of fixed-term contracts as an entry point towards open-ended employment has been extensively discussed in the literature⁴. Fixed-term employment does not clearly facilitate transition towards open-ended employment when compared to unemployment. In France, Givord and Wilner (2015) shows that 1/10th of fixed-term contracts quarterly transit into open-ended contracts.

In countries with segmented labor markets, fixed-term workers benefit less from on-the-job training than open-ended contracts⁵. Firms do not have incentives to invest in training for short-term workers. Hagen (2002), Booth et al. (2002) and Pfeifer (2012, 2014) estimate the contractual wage gap using British, Spanish and German panel data. All else equal, fixed-term workers earn a few per cent less compared to open-ended workers.

Fixed-term employment vary in prominence across Europe. Figure 1.3 shows the share of fixed-term contracts in dependent employment in various European countries. In 2019, fixed-term employment is particularly strong in Spain, Poland, Portugal and Netherlands, where it represents more than 20% of dependent employment. At the other end of the spectrum, fixed-term employment represent less than 5% of dependent employment in Great Britain, Bulgaria and Baltic countries.

European countries vary much in their employment protection, which makes international comparisons difficult⁶. The OECD built a widely used indicator to sum up the stringency of employment protection. As OECD (2020b) describes, the indicator takes into account four dimensions: (i) procedural requirements before notice to the open-ended employee; (ii) notice period and severance

⁴See Blasco and Givord (2010), Ichino et al. (2008), Güell and Petrongolo (2007), Berton et al. (2011), de Graaf-Zijl et al. (2011), OECD (2014) and Givord and Wilner (2015)

⁵See Arulampalam and Booth (1998); Arulampalam et al. (2004); Albert et al. (2005); Cutuli and Guetto (2012); OECD (2014)

⁶In a pioneering work, Piore (1986) compares employment protection in France, Spain, Italy and West Germany and finds substantial differences.

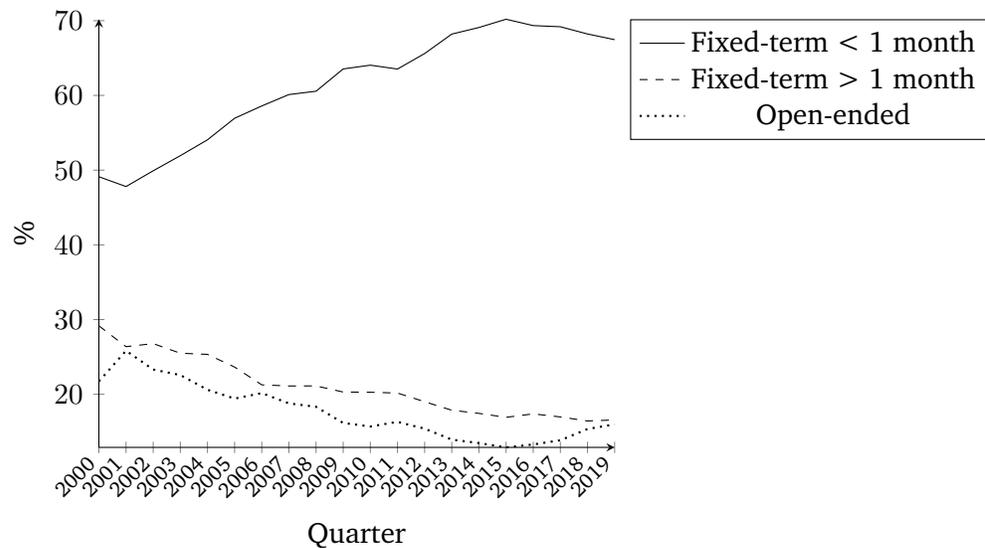


Figure 1.2: Contractual composition of hires

POPULATION: Employees who are between 15 year-old and 64 year-old and live in France, interim workers and apprentices excluded

SOURCE: *Acoiss-Urssaf, Déclarations Préalables à l'Embauche*

pay; (iii) the regulatory framework for unfair dismissals and (iv) enforcement of unfair dismissal regulation. Overall, most OECD countries impose stronger restrictions on collective lay-offs than individual ones. English-speaking countries constrain less redundancies than continental Europe countries as far as regular contracts are concerned. Strict employment protection legislation often goes hand in hand with stringent constraints on the resort to fixed-term contracts. Beyond OECD countries, the International Labor Organization has built a comprehensive database about employment protection legislation, the Employment Protection Legislation Database EPLex⁷. It includes many countries over topics such as fixed-term contracts, severance payments and dismissal procedures among many others.

1.2.2 Employment protection and the labor market

The impact of employment protection on labor markets, especially unemployment, has been extensively discussed in the literature. The raise of a high and persistent unemployment in Western Europe stirred up the interest for this issue. Piore (1986) compares American employment pro-

⁷See <https://eplex.ilo.org/>

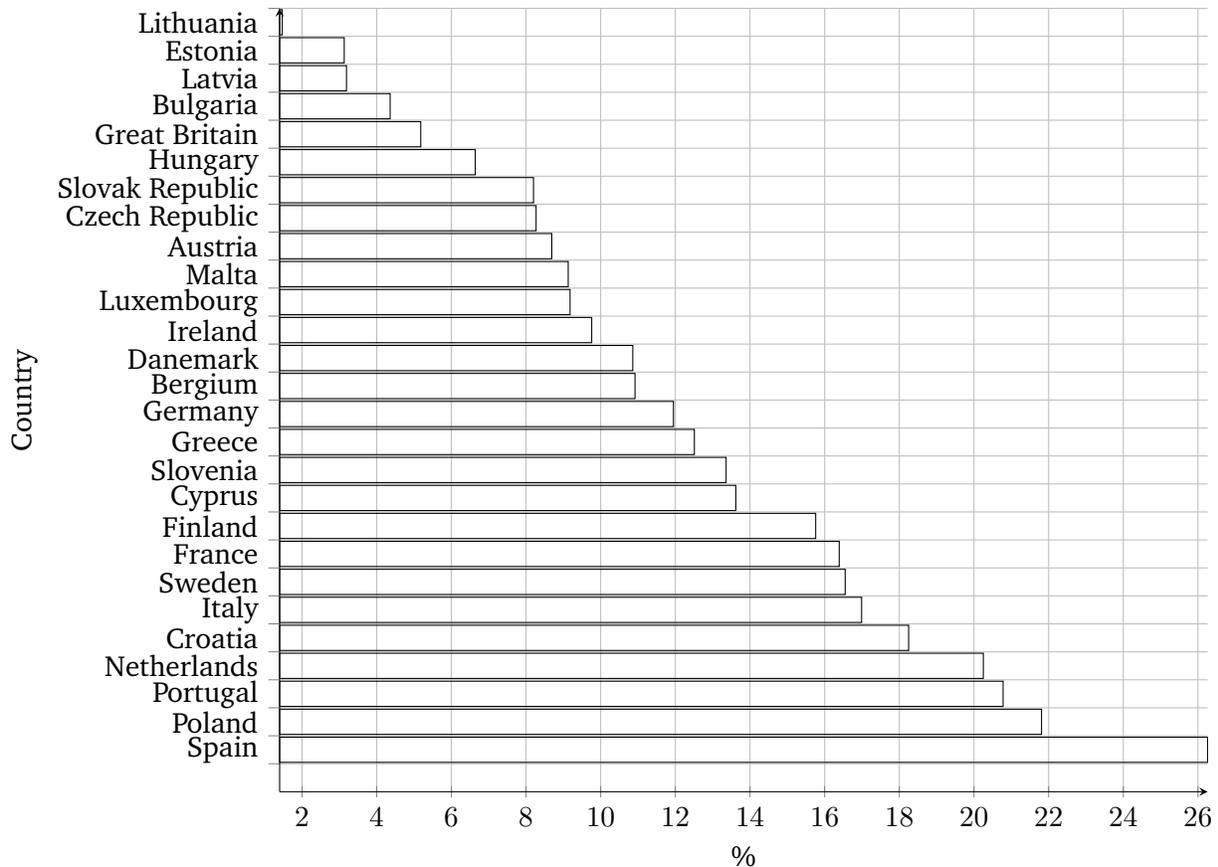


Figure 1.3: Share of fixed-term contracts in dependent employment: an overview of European countries in 2019

SOURCE: OECD (2020a)

Fixed-term employees include fixed-term workers (*Contrat à Durée Déterminée* in French) and interim workers.

tection legislations to the situation in some European countires and contends that both are rigid in different ways. Still, many academics point at high severance payments as responsible for the sticky European unemployment rates. Blanchard and Summers (1986) describe the perverse role of stringent employment protection legislation in this hysteresis phenomenon. Companies are reluctant to hire, out of fear for future firing costs. The important severance payments provide the in-place employees with a stronger bargaining position. In-place employees decide wages such that it is not profitable to fire them. The consequent wage-setting rules are persistent and so is the unemployment rate. Galí (2015) estimate that this hypothesis alone could not account for persistent unemployment rates.

Employment protection legislation also has macroeconomic consequences in terms of employment

volatility. Blanchard and Landier (2002) builds up a matching model with exogenous firing costs. New matches deliver a low productivity and come with a low firing cost. Firms can either change the expired entry-level jobs into regular jobs with an higher expected productivity and enlarged firing costs, or fire the worker and reopen a vacancy. Entry-level jobs embody fixed-term contracts, which are prominent among the young. Firms assesses the quality of matches before signing regular contracts and do not entrust new employees with many critical tasks, which explains why entry-level jobs are not as productive as regular jobs. A trade-off appears when entry-level jobs expire: transformations into regular contracts may deliver a higher productivity, but the nature of the contract prevents from looking for matches with a higher quality. As the firing costs associated with regular contracts increase, firms are more reluctant to keep entry-level workers into regular jobs as the regular wages are higher. The demanded productivity of a regular job rises as it is cheaper to try out new matches. Firms resort to entry-level jobs more frequently, which lowers the average productivity and output in the economy. Introducing temporary contracts may thus increase unemployment and decrease the outsiders' welfare. Lazear (1990) estimates the impact of severance payments on aggregate labor market variables using cross-country differences and finds that higher severance payments reduce employment. Bentolila et al. (2012b) calibrates a matching model of dual labor markets to both France and Spain. It finds that Spanish looser constraints on the resort to fixed-term employment as well as stronger employment protection of regular contracts account for the post-2008-crisis dramatic increase in unemployment compared to the French situation.

Such clear-cut conclusions about the impact of employment protection on employment is not wide-spread, though. Employment protection both reduces job creation and job destruction flows, which ambiguously impacts unemployment. Boeri (2011) reviews the literature and confirms the inconclusiveness of empirical work in that matter. Theoretical work is on the same page⁸. This conclusion has already been advertised in the literature before segmented labor markets were considered. Many papers have modeled labor demand when firms face labor adjustment costs⁹. Overall, these models conclude that firing costs decrease both job creation in good times and job destruction in bad times. The impact of firing costs on unemployment is thus unclear.

⁸See among others Cahuc and Postel-Vinay (2002); Ljungqvist (2002)

⁹See among others Nickell (1978, 1979, 1986); Bentolila and Bertola (1990); Bertola (1992); Hopenhayn and Rogerson (1993); Saint-Paul (1996); Risager and Sørensen (1997); Dolado et al. (2002)

The literature has also considered the impact of employment protection on productivity. OECD (2008) finds a small negative impact of employment protection legislation on long-run productivity growth using cross-country data. Employment protection prevents workers from moving into more productive activities. Overall, OECD (2010) shows that employment protection has a negative effect on labor reallocation. Variety in employment protection explains between 20 and 30% of cross-country differences in workers reallocation rates. Using cross-country data, Bassanini et al. (2014) shows that employment protection reduces productivity growth in industries with many open-ended contracts. Employment protection does not impact the productivity of fixed-term workers, though. As for the impact of growth on fixed-term employment, Wasmer (1999) builds a matching model and shows that a slowdown in growth increases the share of fixed-term employment in total employment.

In terms of labor market dynamics, Bentolila and Saint-Paul (1992) builds a partial-equilibrium dynamic model to account for the effects of temporary contracts introduction. It compares labor market dynamics in a models involving open-ended contracts with and without fixed-term contracts as an alternative. It finds that aggregate fluctuations in employment are larger with fixed-term contracts while less persistent. Open-ended employees are costly to fire in opposition to fixed-term ones. Firms just need to wait for the expiry of fixed-term contracts to get rid of them in bad times. Thus, firms have an incentive to hire open-ended workers who will never be fired and face all demand fluctuations with fixed-term contracts. When a negative shock occurs, the firm separates from all temporary workers before considering laying off permanent workers. The on-shock response of employment is thus stronger. When the situation improves, the firm can hire fixed-term workers to meet its orders: employment gets back faster to its initial value. The insider-outsider divide lies in this dynamic scheme. Permanent workers are never laid off and benefit from a strong bargaining position whereas temporary workers face successive periods of unemployment separated by short-time jobs. Saint-Paul (1996) studies in depth this phenomenon from a theoretical point of view.

The fact that employment protection stabilizes open-ended employment and exacerbates fluctuations of fixed-term employment is a well-known result in the literature. Sala et al. (2012) builds a discrete time model to study business-cycle features of dual labor markets and finds that introducing fixed-

term contracts increases unemployment volatility. Cahuc et al. (2016) also highlights the excessive turnover on the fixed-term side of the labor market.

1.2.3 The contractual choice at the hiring stage

Job creation flows substantially contribute to unemployment fluctuations¹⁰. As we have seen, flows highly differ across contract types. Thus, in segmented labor markets, the choice between hiring through fixed-term or open-ended contracts matters a lot to unemployment fluctuations.

In empirical terms, Rémy (2017) surveys French employers' motives for hiring fixed-term contracts in 2017: 69% of employers state that they hire through fixed-term contracts because of limited-time needs; 65% refer to a way of assessing workers' skills; 56% cite the habit of hiring fixed-term contracts for specific jobs as well as avoiding risks associated with future downturns; 45% mention avoiding employment protection rules associated with open-ended employment.

Some opportunities of production may be too short to be exploited through permanent contracts but adapted to the durations of temporary ones. Dräger and Marx (2017) carries out empirical analyses over a firm-level data including 20 countries. They demonstrate that workload fluctuations explain a significant share of the probability to hire a temporary worker. Interestingly, this result limits to rigid labor markets. The introduction of temporary contracts changes the way firms deal with workload fluctuations. Cahuc et al. (2016) builds a Mortensen-Pissarides model with heterogeneous arrival rates in adverse productivity shocks. When adverse productivity shocks are frequent, fixed-term contracts are preferable. On the contrary, open-ended contracts cover matches with low arrival rates of adverse productivity shocks.

Faccini (2014) explore the screening motive for hiring fixed-term workers¹¹. It builds a random-search model where matches have either a bad or high productivity. Matches perceive the productivity of the match with some noise. Fixed-term contracts provide some time to discover the productivity of the job and may costlessly split if the quality of the match is low. An open-ended contract incurs firing costs with such a termination. Thus, the screening motive encourages the use of fixed-term contracts. Screening cannot account for most job creations in France. Indeed, 75% of fixed-term

¹⁰See Shimer (2012); Petrongolo and Pissarides (2008); Fujita and Ramey (2009); Elsby et al. (2013).

¹¹See also Bucher (2010); Portugal and Varejão (2009)

contracts last less than 27 days, whereas the probationary employment of open-ended contracts lasts up to 4 months. Fixed-term employment as a screening device is credible for highly complex jobs; a few months of probationary employment may not be enough to accurately assess the workers' skills. Financial constraints may also impact the contractual composition of hires. Caggese and Cuñat (2008) settles a discrete-time model where firms experience decreasing returns to scale and use labor as sole input. Investment in labor occurs one period before production and is financially constrained. Both contracts are perfect substitutes, but fixed-term contracts are less productive than open-ended contracts. Fixed-term contracts last one-period and reducing open-ended employment requires firing costs. Financial constraints encourage firms to use fixed-term employment rather than open-ended ones out of fear of paying for future firing costs. It is even more the case for expanding firms, which suffer more from financial frictions.

Cao et al. (2010) highlights how on-the-job search may impact the contractual choice at the hiring stage. Firm-worker matches are heterogeneous in productivity. All else equal, open-ended contracts offer higher wages than fixed-term contracts because of firing costs. Firms tend to offer open-ended contracts to most productive matches to avoid losing the worker through on-the-job search. As for lower productivities, losing the worker through on-the-job search does not incur a big loss and a fixed-term contract fits the bill.

Heterogeneous job-finding and job-filling rates could also be a criterion to rank contracts in vacancy posting and job search activities. Berton and Garibaldi (2012) models a segmented labor market with directed search. Open-ended contracts stipulate firing costs, whereas fixed-term matches can split any time at zero cost. Workers are heterogeneous in their unemployment utility flow. Workers with the lowest unemployment utility flows are ready to accept contracts that yield a lower surplus, which are fixed-term contracts in this case. On the contrary, fixed-term contracts do not inspire workers with high unemployment utility flows, who prefer open-ended contracts. At the equilibrium, workers searching on the fixed-term side are compensated for the lower surplus with a high job-finding rate, whereas workers looking for open-ended jobs experience a low job-finding rate. Overall, workers that experience heterogeneous outside options rank contracts with respect to the associated job-finding rates, which enables segmented labor markets to emerge as equilibria.

Fixed-term contracts may also serve as a waiting device for firms before they find a suitable worker.

Smith (2007) builds a matching model with separate pools of workers. Firms pay a fee to review candidates in a given pool of worker. If a great worker is in the pool, a contract with a long duration is chosen to lock up the match. On the contrary, if the quality of matches is too low, the firm may have an interest to opt for a short contract. It may then review the workers' pool once the contract is over. New workers may have regenerated the candidates' pool.

1.2.4 Reforming dual labor markets

Academics have proposed many reforms to improve the functioning of segmented labor markets. I follow the review of Fontaine and Malherbet (2016) in that regard. I do not consider 2013's French reform and Italian Jobs act it is beyond the scope of the issues my dissertation deals with. I discuss some ingredients of these reforms below.

The social cost of expanding fixed-term employment arouses great interest in terms of policy action. Some academics call for targeted policies for the low-skilled and the young, who are more prone to experience fixed-term contracts. For example, Dolado et al. (2007) makes a case for reducing firing costs for workers with volatile and lower productivity. It would favor employment of workers usually trapped in streams of unemployment and short temporary jobs. More generally, a large body of literature deals with active labor market policies including vocational training, subsidized employment and wages or job search assistance¹². Despite the involvement of important fiscal resources, results are rather controversial.

Some academics also call for a transition towards a unique contract. Such an approach would make labor law simpler. However, as Lepage-Saucier et al. (2013) and Barthelemy and Cette (2016) state, the unique contract is a holdall term that gathers a variety of policies. According to a first definition, the unique contract would gradually provide for higher severance payments with seniority. Under a second definition, the probationary employment time would be longer. Siassi et al. (2015) analyzes the optimal way of implementing such a unique contract under the two scenarii above. It also considers transitional and steady-state winners and losers of such a reform.

Complementary proposals cover the funding of unemployment benefits. In France, firms fund

¹²See Caliendo and Schmidl (2015) for a recent review

unemployment benefits through payroll taxes, which do not depend on each firm's use of fixed-term contracts. However, fixed-term workers frequently oscillate between short employment periods and unemployment. Thus, the funding of unemployment benefits indirectly encourages firms to resort to fixed-term employment. In the United States, an experience rating system was adopted; the federal government changes contribution rates considering each firm's balance with respect to the unemployment benefit system. In this manner, it encourages firms to ensure long-lasting jobs.¹³

1.3 Contributions

As far as labor is concerned, policymakers' activism has been mind-boggling over the last decades. Between 2005 and 2013, Fontaine and Malherbet (2016) report that employment protection legislation was marginally changed 49 times in Italy, 38 times in Spain, 23 times in Greece and 17 times in Portugal and France¹⁴. Most papers only study steady-state movements after changes in employment protection and overlook transitions¹⁵. My second chapter tries to bridge that gap. I build a standard continuous-time random-search model where matches are heterogeneous in productivity. Matches face i.i.d productivity shocks that occur at a given rate and negotiate wages through Nash bargaining. Open-ended contracts stipulate a red-tape firing cost, whereas fixed-term contracts have a settled average duration. New firm-worker pairs choose the contract that maximizes their joint surplus depending on their productivity.

In this framework, I find that most productive matches end up in open-ended contracts. Most productive matches are ready to pay for future firing costs to make the most out of their current good productivity draw; fixed-term contracts may be too short to do so. A firm-worker pair with a mediocre productivity is better off producing for a while and go back hunting for high productivity draws. The model is flexible; when firing costs are low, only open-ended contracts emerge in equilibrium. If firing costs are high enough, both open-ended and fixed-term contracts intervene in job creation. The model being entirely tractable, it is possible to analytically derive transitions after changes in firing costs. I calibrate the model to French data and find that a contractual

¹³See Anderson and Meyer (2000) for a natural-experiment assessment of the experience rating system in the US.

¹⁴In France, Collectif (1996) portrays 40 years of labor policy and the hords of acronym-designated targeted contracts that go with it.

¹⁵Bertola and Ichino (2014) and Siassi et al. (2015) are notable exceptions

substitution effect and a general-equilibrium effect shape steady-state. I notably study the transition from a benchmark dual equilibrium towards a labor market with open-ended contracts only and a reduced firing cost. I find that it is adverse to open-ended employment and takes up to several years to complete. I also find that frequent stochastic changes in firing costs tend to increase average fixed-term employment.

Employment protection affects the way firms optimize their labor force to maximize profits. It is all the more true with a segmented labor market, where labor reallocation essentially takes place on the fixed-term side of the labor market. Fixed-term contracts being a short-term tool, firms are likely to use them a lot to face shocks, especially if they face price rigidity. Thus, employment protection impacts the way firms adjust prices in response to shocks on costs and demand. Fluctuations in fixed-term employment could reflect firms' expectations over demand and costs. I tackle these issues in my third chapter, where I build a New-Keynesian model with a dual labor market. The New-Keynesian framework is standard and includes price rigidity, aggregate productivity shocks, cost-push shocks, monetary policy shocks and government-spending shocks. The model embeds a classic discrete-time Mortensen-Pissarides model: firms and workers negotiate wages using Nash bargaining and face i.i.d productivity shocks. Open-ended contracts are protected by a firing tax and fixed-term contracts have a given average duration. In contrast with the second chapter, I assume that fixed-term contracts are less productive than open-ended contracts all else equal. New firm-worker pairs trade off between flexibility and productivity at the hiring stage: the agents choose the contract yielding the highest joint surplus at job creation. It is worth hiring most productive matches using open-ended contracts as expected firing costs are worth less than the productivity gain such contracts yield compared to fixed-term contracts. As for matches with an intermediate productivity, fixed-term contracts are better.

I calibrate some parameters using Euro area labor market moments. I estimate the parameters associated with nominal rigidities and shocks with Euro Area quarterly time series. using a Sequential Monte Carlo method. I do not use time series that are specific to a dual labor market for estimation; I use inflation, interest rate, GDP and employment time series. Still, the model replicates well labor market moments. Ideally, I would need Euro area data about labor market dualism to assess the fit of the model. Unfortunately, I do not dispose of such data. I use French labor market data data to

assess the fit of the model as it is available on a quarterly basis and seems a good middle ground in terms of employment protection among Western European countries. The model replicates well the counter-cyclical share of fixed-term jobs in job creation and the Beveridge curve, which is notably difficult to obtain in real business cycle models with matching frictions. I find that a change in firing costs does not change inflation volatility but alters dynamics of inflation components. Using a third-order perturbation method and introducing stochastic volatility in shock processes, I find that uncertainty shocks increase fixed-term employment, whereas a negative demand shock decreases fixed-term employment. Fixed-term employment could provide a way of disentangling negative demand shocks and uncertainty shocks. It is all the more relevant as telling apart uncertainty shocks and negative demand shocks is a notably difficult task in macroeconomics with standard models.

Fluctuations in job creation flows mostly explain unemployment fluctuations. Yet, few models account for the choice between fixed-term and open-ended contracts in job creation. Many models use *ad hoc* hiring rules that specify the share of new matches directed to each type of contract. My fourth chapter reviews the literature dealing with segmented labor markets using matching models from the perspective of job creation. I delineate a distinction based on the modeling of fixed-term contracts. Some papers model fixed-term contracts as flexible; fixed-term jobs can be terminated anytime at no cost. Others assume that fixed-term matches cannot split before reaching their stipulated end. Assuming fixed-term contracts as flexible makes them highly desirable compared to open-ended contract and the associated firing costs. If job creation were to occur without constraints, new matches would tend to hire through fixed-term contracts only. It is counter-factual as job creation involves open-ended contracts as well. As a result, some papers resort to hiring rules which assign each new match to a given contract type with a given probability. On the contrary, modeling fixed-term contracts as rigid leaves room for both contracts in job creation. Rigid fixed-term contracts are less profitable than flexible ones; a match may have to bear a depressed joint surplus for a while after an adverse shock as it cannot split before the stipulate end date. This enables open-ended contracts to be involved in job creation along with fixed-term contracts. Models with rigid fixed-term contracts lack robustness, though. In particular, the ranking of contracts in job creation chapters 2 and 3 display changes if expiring fixed-term contracts are convertible into open-ended contracts. Most productive matches end up in fixed-term contracts, whereas open-ended

contracts are relegated to mediocre productivities. If new firm-worker pairs can optimize the average duration of fixed-term contracts, I show that the shortest contracts are the most likely to be converted into open-ended contracts, which is counter-factual. In models with heterogeneous processes for workload fluctuations, the latter counter-factual result arises as well if the productivity of new matches is no longer fixed. Thus, a successful model of job creation in a dual labor market would craftily navigate between the pros and cons of the flexible and rigid approaches.

The three chapters detailed above follow. Then, I conclude.

Chapter 2

Waiting for the Prince Charming: Fixed-Term Contracts as Stopgaps

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Abstract

In this paper, I build a simple Mortensen-Pissarides model embedding a dual labor market. I derive conditions for the existence of an equilibrium with both protected open-ended contracts and exogenously short fixed-term contracts. I also study dynamics after a change in firing costs. Fixed-term contracts play the role of fillers while open-ended contracts are used to lock up most productive matches. High firing costs favor the emergence of a dual equilibrium and encourage the resort to fixed-term employment in job creation. This substitution scheme is intertwined with a general-equilibrium effect. Open-ended contracts represent the bulk of employed workers; higher firing costs reduces aggregate job destruction, which pushes down unemployment and in turn reduces job creation flows through fixed-term contracts. I calibrate the model on the French labor market. Policy experiments demonstrate that there is no joint gain in employment and social welfare through changes on firing costs around the baseline economy. Welfare improving policies consist in large cuts in firing costs, where fixed-term employment eventually disappears. Increases in firing costs within a dual labor market lead to a sluggish adjustment, while large cuts in firing costs lead to a quicker one. The adjustment time is highly non-monotonous between these two extremes. Uncertainty over firing costs significantly strengthens fixed-term employment on behalf of open-ended employment.

JEL Classification: J41, J64, J38, J68

Keywords: Fixed-term Contracts; Unemployment; Employment Protection; Policy; Dynamics

2.1 Introduction

Since the end of the 1980s and the introduction of fixed-term contracts, the segmentation of European labor markets, opposing strongly protected open-ended contracts and short fixed-term contracts, has worsened. In France, fixed-term contracts represented more than 80 % of created jobs in 2018. Academics often point at firing costs as encouraging the resort to fixed-term contracts.

Should a dual labor market be reformed? Which post-reform dynamic behavior should we expect? To address these questions, I extend the classic model of Mortensen and Pissarides (1994) to include both open-ended and fixed-term contracts. As in the latter, firms and workers meet following a matching function and negotiate wages through Nash bargaining. Matches are heterogeneous in productivity and face i.i.d productivity shocks. When a firm-worker pair forms, it draws a productivity from a given distribution and assesses accordingly whether an open-ended or a fixed-term contract is preferable. The latter differ only over one dimension; open-ended contracts stipulate a red-tape firing cost, while fixed-term contracts have a high exogenous job destruction rate. I calibrate the model to the French labor market.

My contribution includes theoretical and numerical insights. I design the model to be the most tractable possible allowing an endogenous choice between open-ended contracts and fixed-term contracts at the hiring stage, which facilitates its integration into more complex frameworks, as is done in my third chapter. In numerical terms, I analyze the dynamic response of the dual labor market following reforms on employment protection legislation, which, as far as I know, has not been done yet. Overall, the resulting model provides rich theoretical insights about the economic schemes at stake in a dual labor market. It also provides results on the desirability of employment protection legislation reforms in terms of welfare and employment. The numerical results I present must be taken with a grain of salt considering the assumptions made to ensure tractability: productivity shocks are i.i.d, agents are risk neutral and there is no on-the-job search.

At the equilibrium, when a firm-worker pair meets and draws a high productivity, the best way to maximize benefits consists in locking up the pair through an open-ended contract. Otherwise, agents can commit to a short productive relationship through a fixed-term contract or go back to searching for a better match on the labor market. The meeting process being costly, agents opt for a fixed-term

contract if the productivity draw is not too disappointing. Thus, fixed-term contracts provide a productive interlude, while enabling to go back to seeking a high-productivity match before long: fixed-term contracts act as fillers before meeting the Prince Charming².

I find that two opposed effects mix up to shape the behavior of the labor market with respect to firing costs. The first effect is a substitution effect towards fixed-term employment as firing costs increase. Higher firing costs make open-ended contracts more rigid and fosters the resort to less productive fixed-term contracts for the sake of flexibility. Thus, higher firing costs provide an incentive to hire more fixed-term contracts and favor the emergence of an equilibrium with coexisting fixed-term and open-ended contracts. The second effect is a general-equilibrium effect. Higher firing costs reduce open-ended job destruction. Since most workers operate under open-ended contracts, aggregate job destruction decreases and so does unemployment. In turn, the depressed unemployment rate reduces fixed-term job creation flows.

As for the social welfare and employment, I find that there is no free lunch when the dual nature of the labor market is preserved: a benevolent planner cannot both decrease unemployment and improve welfare around the baseline economy. The optimal policy consists in a large cut in firing costs, which both increases welfare and decreases unemployment. If the cut in firing costs is large enough, fixed-term employment is no longer relevant and only open-ended employment remains at the equilibrium. Consequently, this model supports a transition towards a unique open-ended contract, a reform the literature has extensively tackled³.

In terms of dynamics, an increase in firing costs with respect to the baseline calibration leads to a several-year long adjustment. Indeed, flows are reduced on the open-ended side of the labor market, which tends to slow down transitions. Conversely, a strong decrease in firing costs enhances open-ended job creation and destruction flows, which reduces the adjustment duration. Between these two endpoints, the behavior of the adjustment time after a moderate cut in firing posts is non-monotonous and intricate. Transitions toward a unique-contract equilibrium with a cut in firing costs end by 2 years. Taking account of frequent marginal employment protection legislation reforms

²This all the more true if on-the-job search is an option. Polivka (1996) finds that most contingent workers do not search for a perennial job. The model thus delineates a lower bound in terms of fixed-term contracts' desirability at the hiring stage

³See Lepage-Saucier et al. (2013) and Amable (2014) for reviews

- one every 7 months on average in France - I extend the model to include uncertainty with respect to firing costs. This policy risk significantly bolsters fixed-term employment on behalf of open-ended employment and pushes up unemployment.

My paper relates to three strands in the literature. First, it contributes to explain the dynamic interaction between fixed-term and open-ended contracts as Saint-Paul (1996) and Dolado et al. (2002) do.

Secondly, it delineates the mechanisms underpinning the choice between fixed-term and open-ended contracts⁴. Smith (2007) has first highlighted the role of fixed-term contracts as stopgaps. In his stock-flow matching model, firms hire poorly productive workers on limited duration to be ready to hire highly productive workers when they appear. Its framework is very different, though; search is directed and labor market institutions are not explicitly modeled.

Thirdly, my paper contributes to the literature assessing policy measures using structural models of the labor market. The closest papers in that regard are Dolado et al. (2018) and Cahuc et al. (2019).

Cahuc et al. (2016, 2019) build a matching model where firm-worker pairs face heterogeneous arrival rates in adverse productivity shocks. Firms-worker pairs opt for fixed-term contracts when adverse productivity shocks are frequent, whereas open-ended contracts are beneficial when adverse productivity shocks are unusual. Expiring fixed-term contracts can be converted into open-ended contracts. In addition, firm-worker pairs optimize hired fixed-term contracts' duration. Cahuc et al. (2016) calibrate the model on French data and find that higher firing costs do not change aggregate employment much but dramatically increase turnover on the fixed-term side of the market. Cahuc et al. (2019) extend the model of Cahuc et al. (2016) and assume that the resort to fixed-term contracts is taxed depending on the duration of contracts. Taxes may be refunded if the fixed-term contract is converted into an open-ended contract one at expiry. The authors estimate the model on French data and find a detrimental effect of taxes on the duration of fixed-term contracts. My paper departs from Cahuc et al. (2016, 2019) in several aspects; new matches are heterogeneous in productivity and not in productivity shock arrival rate. Moreover, I consider transitions between states while Cahuc et al. (2016, 2019) limit to steady-state analyses.

⁴See Cahuc et al. (2016) and the general introduction for a review

Siassi et al. (2015) is the closest paper in terms of ambitions when it comes to studying post-reform dynamics, but it is rather a complement than a substitute. Siassi et al. (2015) builds a discrete-time stochastic life-cycle model where workers are risk-averse. One-job firms and workers meet according to a standard matching function. When matches split, firms pay severance payments to the workers that enables them to smooth consumption while unemployed. The severance payment is a function of the worker's tenure. The model is calibrated on Spanish data with the 2008's severance payment scheme. The authors derive the optimal linear severance scheme with respect new entrants' utility. They find that the actual severance payment scheme is too generous and increases unemployment. The authors then derive transitions from the actual severance payment scheme towards the optimal one.

I depart from Siassi et al. (2015) in three important dimensions. First, I model labor both fixed-term and open-ended contracts explicitly. In Siassi et al. (2015), the workers with low-tenure workers stand for fixed-term contracts while high-tenure workers embody open-ended contracts. This approach overlooks the rigidity of fixed-term contracts before their stipulated end date. Secondly, I focus more on theoretical mechanisms than numerical results. Siassi et al. (2015) uses computer-intensive methods to derive equilibria and transitions. The transition paths I derive have an analytic expression, which provides a transparent appraisal of the phenomena at stake. Thirdly, I consider red-tape firing costs instead of severance payments. Severance payments are a pure transfer between the firm and the worker. Thus, they do not impact jointly efficient job destruction decisions⁵. Severance payments indirectly impact job creation through the stronger workers' bargaining position and, thus, higher wages. Note that the impact of severance payments can be offset through a bargaining process with full commitment⁶. On the contrary, red-tape firing costs impact directly the surplus of open-ended matches and distort job destruction decisions. They also push up wages, which alters job creation incentives. Unlike severance payments, a full-commitment bargaining of wages before the hiring decision cannot offset the distortion red-tape firing costs induce. Beyond the fact that red-tape firing costs have an allocative role in contrast with severance payments, red-tape firing costs are substantial. Kramarz and Michaud (2010) shows that the sole law-prescribed severance payment understates the extent of termination costs.

⁵Hiring and firing decisions are jointly efficient if firms and workers negotiate wages using Nash bargaining, which is the case in both the current chapter and Siassi et al. (2015).

⁶Lazear (1990) detail this idea.

The paper is structured as follows. Section 2 describes the model and derives the main theoretical results. In Section 3, I calibrate the model on French data, study employment protection legislation reforms, the associated post-reform dynamics and the impact of regulatory uncertainty. Section 4 concludes.

2.2 The model

In this model a-la Mortensen and Pissarides (1994), there are two continua of risk neutral firms and households and time is continuous. The interest rate is denoted r . Firms are numerous and can either employ one worker or maintain a vacancy opened. They face i.i.d idiosyncratic productivity shocks that occur with a probability λ per unit of time and are drawn from a log-Normal distribution $\log \mathcal{N}(0, \sigma_z^2)$ with cumulative distribution function G and support $(0, \infty)$. Our model mainly departs from the classic Mortensen-Pissarides framework by assuming that workers are either employed through open-ended contracts or fixed-term contracts.

The matching function is standard, with constant returns to scale over the number of vacancies v and the number of job seekers e . The number of matches per unit of time is denoted $m(e, v)$, while the job market tightness θ is classically set as the number of vacancies over the number of job seekers $\theta = v/e$. The constant-return-to-scale feature of the matching function entails that the job-meeting probability $p = m(e, v)/e$ and the seeker-meeting probability $q = m(e, v)/v$ only depend on the labor market tightness. q is a non-increasing function, whereas p is a non-decreasing one. Both q and p are convex. When paired with a worker, firms can hire through a fixed-term contract or hire through an open-ended contract. They are also able to resume searching for a worker if they are not satisfied with the productivity of the match.

As in the classic Mortensen-Pissarides model with Nash bargaining, the surplus of matches entirely determine hiring and firing decisions. Joint surpluses are defined as the sum of workers' and firms' surpluses. The surplus of a firm with a continuing open-ended contract with productivity z is $J^p(z) - (V - F) = J^p(z) - V + F$, where $J^p(z)$ is the firm's surplus from a continuing open-ended contract with productivity z , V the firm's surplus from an unfilled vacancy and F is the firing cost. Interestingly, the firm's surplus for a new open-ended match with productivity z is $J_0^p(z) - V$, where

$J_0^p(z)$ is the firm's surplus from a new open-ended contract with productivity z . Indeed, when a contact occurs between a firm and a worker, the firm's outside option does not include the payment of a firing cost if no contract is signed. The open-ended and fixed-term workers' surpluses are standard. We denote $W^p(z)$ the worker's surplus from a continuing open-ended contract with productivity z , $W_0^p(z)$ the worker's surplus from a new open-ended contract with productivity z , $W^f(z)$ the worker's surplus from a fixed-term contract with a productivity z and U the unemployed's surplus.

$$\begin{aligned} S^f(z) &= (J^f(z) - V) + (W^f(z) - U) \\ S^p(z) &= (J^p(z) - [V - F]) + (W^p(z) - U) \\ S_0^p(z) &= (J_0^p(z) - V) + (W_0^p(z) - U) \end{aligned}$$

Wages are determined following a Nash bargaining. I mark down the workers' bargaining power as η . It is common to both open-ended and fixed-term contracts. Indeed, analyzing the role of employment protection legislation implies shutting down all differences between open-ended and fixed-term contracts, with the exception of genuinely legal ones.

$$J^p(z) - (V - F) = (1 - \eta) S^p(z) \tag{2.1}$$

$$J_0^p(z) - V = (1 - \eta) S_0^p(z) \tag{2.2}$$

$$J^f(z) - V = (1 - \eta) S^f(z) \tag{2.3}$$

Nash-bargaining makes endogenous separations as well as hiring decisions jointly efficient. In other words, there is no conflict over the hiring and firing choices between firms and workers. The formulas above enable the computation of the workers' rents.

$$\begin{aligned}
W^p(z) &= U + \frac{\eta}{1-\eta} (J^p(z) - V) + \frac{\eta}{1-\eta} F \\
W_0^p(z) &= U + \frac{\eta}{1-\eta} (J_0^p(z) - V) \\
W^f(z) &= U + \frac{\eta}{1-\eta} (J^f(z) - V)
\end{aligned}$$

Workers appropriate a fraction of the firms' surplus because of the sunk hiring costs firms pawn. The matching procedure can be considered as a production function with two inputs : job seekers and vacancies. The involvement of firms through recruiting costs in this process before any production takes place generates a hold-up situation favoring workers at the moment of wage bargaining⁷ and enables them to extract a rent. Moreover, continuing open-ended workers benefit from a supplementary rent $\eta F/(1-\eta)$ when compared with fixed-term workers and new open-ended workers. The firing cost pushes up the open-ended workers' bargaining position by enhancing the threat of a costly separation. The firm will reward the worker through the wage for avoiding the separation and its associated cost F . Thus, the firing cost influences labor market outcomes through two channels: as a pure firing tax and through wages. The firing cost is not involved in Nash bargaining for a new open-ended match since the worker is not yet an insider.

2.2.1 The agents' value functions

Vacancies and unemployed workers A firm-worker contact occurs with probability $q(\theta)$ per unit of time. The cost of a vacancy is γ per unit of time regardless of the contract type. When the idiosyncratic productivity of the match reveals, the firm chooses between hiring the worker through an open-ended contract or a fixed-term contract and letting the worker go back into the unemployed's pool.

$$rV = -\gamma + q(\theta) \int \max [J_0^p(z) - V, J^f(z) - V, 0] dG(z) \quad (2.4)$$

Firing costs only apply if the match is validated in the first place. The potentially ephemeral

⁷See Grout (1984) for a thorough development of this question

constitution of a match does not boil down to the payment of firing costs if immediate separation is preferable. Thus, the role of firing costs is not unrealistically exacerbated in job creation.

The unemployed workers' value function embeds the unemployment benefit b and the various possibilities stemming from the eventual contact with a firm, which occurs with probability $p(\theta)$ per unit of time.

$$rU = b + p(\theta) \int \max [W_0^p(z') - U, W^f(z') - U, 0] dG(z') \quad (2.5)$$

Open-ended contracts The firm's capital value of a continuing open-ended match consists in an immediate profit from production z net of the worker's wage $w^p(z)$. When the match exogenously separates with probability s , the firm goes back to searching a worker without paying the firing cost. In real life, this probability is associated with events such as quits, retirements or probationary employment terminations. In this case, firms do not have to pay firing costs. The firm may also face a productivity shock with probability λ and assess whether it keeps or lays off the worker regarding the new idiosyncratic productivity of the match. Firms laying off workers because of adverse productivity shocks have to pay firing costs.

$$rJ^p(z) = z - w^p(z) + s(V - J^p(z)) + \lambda \int (\max [J^p(z'), V - F] - J^p(z)) dG(z') \quad (2.6)$$

J^p being increasing in the idiosyncratic productivity of the match, there exists a job destruction margin for continuing open-ended contracts z^p defined as

$$J^p(z^p) = V - F$$

The subsequent probability of separation for open-ended contracts is

$$\xi = s + \lambda G(z^p) \quad (2.7)$$

The workers' value function when he is under a continuing open-ended contract firstly consists in

the wage w^p . The different alternatives mentioned above apply.

$$rW^p(z) = w^p(z) + \lambda \int (\max [W^p(z'), U] - W^p(z)) dG(z') + s(U - W^p(z)) \quad (2.8)$$

The value function associated with new open-ended contracts is analogous. The only notable difference originates from a specific wage function w_0^p and the transformation into a continuing open-ended contract when a productivity shock occurs. The new productivity either entails a costly separation or a renegotiation of wages, which include the payment of firing costs as a possible outcome of the negotiation. Consequently, the reassessed relationship corresponds to a continuing open-ended contract.

$$rJ_0^p(z) = z - w_0^p(z) + \lambda \int (\max [J^p(z'), V - F] - J_0^p(z)) dG(z') + s(V - J_0^p(z)) \quad (2.9)$$

$$rW_0^p(z) = w_0^p(z) + \lambda \int \max ([W^p(z'), U] - W_0^p(z)) dG(z') + s(U - W_0^p(z)) \quad (2.10)$$

Note that new open-ended matches become continuing open-ended matches after the first productivity shock. It is counter-factual as the probationary employment period is legally prescribed. In France, as far as open-ended contracts are concerned, probationary employment lasts at most 4 months, 6 months and 8 months for employees, supervisors and executives respectively. Fixed-term contracts that last more than 6 months generally have a 1-month probationary employment. As for fixed-term contracts that last less than 6 months, probationary employment lasts at most 2 weeks. Probationary employment enables both the firm and the worker to terminate the contractual relationship at zero cost. Theoretically speaking, the end of a contract during the probationary employment needs not to be justified. However, it is subject to an advance notice and a worker may legally challenge it and claim for compensation if he suspects his employer's decision is not bound to his lack of skill. Economic reasons cannot justify an end of contract during probationary employment, for example.

A match in probationary employment learning about its disappointing productivity may choose to split. In my framework, new firm-worker pairs immediately learn about their productivity. The probationary employment period is skipped in this case. I include probationary employment terminations in the costless separation rate s . Introducing uncertainty over the productivity of the match and some learning effects over it would go beyond the scope of this paper. Bucher (2010) and Faccini (2014) do so in a dual labor market.

Fixed-term contracts Similarly to open-ended contracts, the firm employing a fixed-term worker gets an immediate profit from a match with productivity z . It also pays a wage $w^f(z)$. The match may split if the stipulated termination date is reached, which happens with probability δ per unit of time. In this case, the firm gets back to the labor market and earns the net return $V - J^f(z)$. A productivity shock may also take place with probability λ per unit of time.

$$rJ^f(z) = z - w^f(z) + \lambda \int (J^f(z') - J^f(z)) dG(z') + \delta (V - J^f(z)) \quad (2.11)$$

The fixed-term worker's value function embeds the wage $w^f(z)$ and the expectations about next-period outcomes. If the match is not separated, the worker expects to get the average worker's value from a fixed-term contract. If a split occurs, the worker returns searching for a job.

$$rW^f(z) = w^f(z) + \lambda \int (W^f(z') - W^f(z)) dG(z') + \delta (U - W^f(z)) \quad (2.12)$$

Note that fixed-term matches split because of expiry shocks only. The probability of resignation, retirement or probationary employment termination s does not apply here as it is not empirically relevant. According to Milin (2018), only 2 % of fixed-term contracts terminated before their stipulated date in 2017.

Two serious discrepancies between the model and the actual French labor code need to be highlighted. The desire for simplicity guides these two strong assumptions.

First, the duration of fixed-term contracts is exogenous. Endogenous separations for fixed-term contracts are not possible. At first view, a certain lack of realism must be pointed at here. Indeed,

according to the French legislation, a firm may fire a fixed-term worker before the stipulated date through the payment of a firing cost. Nevertheless, this makes the analysis vainly cumbersome. The main trade-off between fixed-term and open-ended contracts is set between long-lasting rigid open-ended contracts and very short fixed-term contracts. Consequently, the advantage of immediately paying the firing cost when fixed-term contracts are very short is thin when the firm can wait for the stipulated termination date to get rid of the worker. For the sake of simplicity, I assume that firms always prefer to wait for the end of fixed-term contracts instead of paying firing costs. The results barely change when this subtlety is accounted for. Here, the separation probability δ implicitly models the average duration of fixed-term contracts.

Secondly, the model does not embed the possibility of conversion into an open-ended contract when the stipulated duration of the fixed-term contract is reached, whereas the convertibility option actually exists. French data shows that fixed-term contracts seldom convert into open-ended contracts. The quarterly probability of transition from fixed-term to open-ended employment constitutes an upper bound of the conversion probability and amounts to 7.4 % according to Hairault et al. (2015). Meanwhile, the distribution of the duration of fixed-term contracts has its mean at 1.5 months and a median located around 5 days as Milin (2018) mentions. Thus, these 7.4 % more likely include multiple round trips between fixed-term employment and unemployment somehow ending into open-ended employment rather than unique and direct fixed-term-to-open-ended-employment trajectories. Consequently, the conversion rate probably lies far below transition rates from fixed-term to open-ended employment. Our calibration being carried out on a monthly basis, the value of the conversion probability becomes insignificant. The no-convertibility assumption is not innocuous in theoretical terms, as I demonstrate in chapter 4.

2.2.2 Joint surpluses and wages

At the equilibrium, we assume that there is free-entry in the vacancy posting activity. The present discounted value of a vacancy is zero. Competition between firms depletes the profit opportunities from new jobs. In other words, the rent provided by the posting of vacancies attracts new entrants until its disappearance at the equilibrium.

$$V = 0$$

The free-entry condition leads to a condition for job creation, which states that the firm's expected cost for a firm-worker contact $\gamma/q(\theta)$ equals the expected profit it yields.

$$\frac{\gamma}{q(\theta)} = \int \max [J_0^p(z), J^f(z), 0] dG(z) \quad (2.13)$$

Using the Nash-bargaining rules (2.1)–(2.3) and the job creation condition (2.13), I get

$$\frac{\gamma}{(1-\eta)q(\theta)} = \int \max [S_0^p(z), S^f(z), 0] dG(z) \quad (2.14)$$

Deriving the expression for surpluses using the proper value functions along with (2.14), I get

$$(r + s + \lambda)S^p(z) = z - rU + (r + s)F + \lambda \int \max [S^p(z'), 0] dG(z') \quad (2.15)$$

$$S_0^p(z) = S^p(z) - F \quad (2.16)$$

$$(r + \delta + \lambda)S^f(z) = z - rU + \lambda \int S^f(z') dG(z') \quad (2.17)$$

$$rU = b + \frac{\eta\gamma\theta}{1-\eta} \quad (2.18)$$

The unemployed value the benefit b and the rent they obtain from finding a job on the next-period. A common rent for all ex-post insiders is a share of the firms' recruitment cost. γ is lost for the firm at the very moment of agreement over the formation of a match and the subsequent wage bargaining. The asset value of being unemployed is also the employed's outside option.

Nash-sharing rules as well as workers' and joint surpluses pinpoint wages.

$$w^p(z) = \eta(z + (r + s)F + \gamma\theta) + (1 - \eta)b \quad (2.19)$$

$$w_0^p(z) = \eta(z - \lambda F + \gamma\theta) + (1 - \eta)b \quad (2.20)$$

$$w^f(z) = \eta(z + \gamma\theta) + (1 - \eta)b \quad (2.21)$$

Open-ended workers' wages verify that $w_0^p(z) = w^p(z) - \eta(r + s + \lambda)F$. The wages of new open-ended workers are lower than continuing open-ended workers' ones. It reflects the lower threat point of outsiders. On one hand, at a given labor market tightness θ , the new open-ended workers' wages decrease with the firing cost. After the signature of the open-ended contract, firms have to pay the firing cost in case of an adverse productivity shock. Consequently, before the occurrence of any productivity shock, firms compensate the new worker's expected gain of bargaining position and the expected loss in profits by decreasing the current wage proposal, which does not entail the payment of firing costs in case of disagreement. On the other hand, continuing open-ended workers benefit from firing costs in the firms' outside option. Thus, continuing open-ended workers' wages increase with firing costs. Overall, wages increase with unemployment benefits and recruitment cost: they enhance the workers' outside option. Similarly, a higher labor market tightness encompasses greater job-finding opportunities for unemployed workers, which raises their outside option: wages increase.

2.2.3 Job creation and job destruction

Joint surpluses of matches are enough to pinpoint hiring and firing decisions. Joint surpluses are linear and increasing in match productivities. Consequently, I define the job destruction margin for continuing open-ended contracts z^p as

$$S^p(z^p) = 0 \quad (2.22)$$

An open-ended match separates when the pair prefers paying the firing cost instead of continuing. The productivity must be sufficiently low to fill this requirement ; the worker and the firm benefit from a separation if $z < z^p$. Using an integration by part in the definition of z^p (2.22) jointly with

the definition of S^p (2.15), the job destruction condition for open-ended contracts is

$$z^p - b + (r + s)F + \frac{\lambda}{r + s + \lambda} \int_{z^p}^{+\infty} (1 - G(z)) dz = \frac{\eta\gamma\theta}{1 - \eta} \quad (2.23)$$

The above equation defines a positive relationship between θ and z^p . The intuition behind this result is classic in the literature. A looser market tightness implies a higher job-finding probability for the unemployed, which makes their outside option stronger at the moment of wage bargaining: wages raise. It encourages firms to be more demanding in terms of match productivities and to increase the job destruction margin. An enhanced firing cost diminishes the job destruction margin; firms are more reluctant to pay firing costs and accept to maintain matches with worse productivities than before. Interestingly, a continuing open-ended match behaves as if it held a bond with face value F and yield $(r + s)$ and used it to pay firing costs in case of an endogenous separation.

In the same manner, I define the threshold z^f as follows

$$S^f(z^f) = 0 \quad (2.24)$$

The interpretation of this threshold is twofold. As far as a contact between a vacancy and a job-seeker is concerned, it states whether a fixed-term contract is profitable. A fixed-term contract is profitable as soon as $z \geq z^f$ ⁸. Conversely, when $z < z^f$, an existing match would have interest into splitting. The firm and the worker would prefer to get back into searching. (2.24) jointly with the Nash-bargaining rule (2.3) entail

$$z^f = \left(1 + \frac{\lambda}{r + \delta}\right) \left(b + \frac{\eta\gamma\theta}{1 - \eta}\right) - \frac{\lambda}{r + \delta} Ez \quad (2.25)$$

where $Ez = \int z dG(z)$. As previously, a higher labor market tightness enlarges wages because of stronger workers' outside option. Fixed-term contracts are profitable on a thinner range and z^f increases. A higher average productivity Ez encourages the resort to fixed-term contracts: the profitability margin decreases as fixed-term contracts become more often beneficial.

⁸Of course, if a fixed-term contract is profitable, but still less beneficial than a open-ended contract, then the hire takes place through a open-ended contract.

An analogous threshold z^c can be defined for the desirability of new open-ended contracts

$$S_0^p(z^c) = 0 \quad (2.26)$$

Meanwhile, since $S^p(z^p) = 0$ and $\partial S^p/\partial z = 1/(r + s + \lambda)$, I can rewrite S^p as

$$S^p(z) = \frac{z - z^p}{r + s + \lambda} \quad (2.27)$$

(2.26) and (2.27) enable a convenient writing for z^c .

$$z^c = z^p + (r + s + \lambda)F \quad (2.28)$$

Similarly, the joint surpluses of fixed-term matches and new open-ended matches verify

$$S^f(z) = \frac{z - z^f}{r + \delta + \lambda} \quad (2.29)$$

$$S_0^p(z) = \frac{z - z^c}{r + s + \lambda} \quad (2.30)$$

Note that $\partial S_0^p/\partial z = 1/(r + s + \lambda) > 1/(r + \delta + \lambda) = \partial S^f/\partial z$ if and only if $s < \delta$. I assume the validity of the latter condition, which states that the destruction rate of fixed-term contract is higher than the exogenous separation rate of open-ended contracts. It is undoubtedly the case in the data as I show in the calibration section. As a result, S_0^p and S^f being increasing and linear in z , there exists z^* such that

$$S_0^p(z^*) = S^f(z^*) \quad (2.31)$$

For all $z \geq z^*$, $S_0^p(z) \geq S^f(z)$. I use (2.29), (2.30) and (2.31) to derive z^* .

$$\left(\frac{1}{r + s + \lambda} - \frac{1}{r + \delta + \lambda} \right) z^* = \frac{z^c}{r + s + \lambda} - \frac{z^f}{r + \delta + \lambda} \quad (2.32)$$

The behavior of the thresholds is characterized by the following proposition

Proposition 1. *These assertions are equivalent*

1. $z^* > z^f$
2. $z^* > z^c$
3. $z^c > z^f$

Proof. See Appendix 2.B □

In the same manner, the equality of two of the thresholds z^f , z^c or z^* is equivalent to the equality between all of them $z^f = z^c = z^*$.

One ambition of this paper is to describe the endogenous choice between fixed-term contracts and open-ended contracts in job creation. With the thresholds previously defined and the increasing character of S_0^p and S^f , the job creation condition (2.14) becomes

$$\frac{\gamma}{(1-\eta)q(\theta)} = \int_{\max[z^c, z^*]}^{+\infty} S_0^p(z) dG(z) + \int_{z^f}^{\max[z^f, z^*]} S^f(z) dG(z) \quad (2.33)$$

Using two integrations by parts, the definitions of thresholds and proposition 1, the above equation writes

$$\frac{\gamma}{(1-\eta)q(\theta)} = \frac{1}{r+s+\lambda} \int_{\max[z^c, z^*]}^{+\infty} (1-G(z)) dz + \frac{1}{r+\delta+\lambda} \int_{z^f}^{\max[z^f, z^*]} (1-G(z)) dz \quad (2.34)$$

Now, I spell out the formal definition of a steady-state equilibrium in this model.

Definition 1. *A steady-state equilibrium in this economy is characterized by the tuple $(\theta, z^p, z^c, z^f, z^*)$ verifying equations (2.23), (2.25), (2.28), (2.32) and (2.34).*

This job creation condition (2.34) heavily depends on the distribution of idiosyncratic shocks and the subsequent value of thresholds. It is possible to have no fixed-term contracts as well as both contracts at the hiring stage. Thus, a formal definition of dual job creation is useful.

Definition 2. Job creation is said to be dual if one kind of contracts is not systematically preferred to the other at the hiring stage.

In this model, job creation obeys the following proposition

Proposition 2. Considering an equilibrium $(\theta, z^p, z^c, z^f, z^*)$.

- Job creation only occurs through open-ended contracts if and only if $z^* \leq z^f \leq z^c$. Open-ended contracts are hired when $z \in (\max[0, z^c], +\infty)$ as figure 2.1 displays.

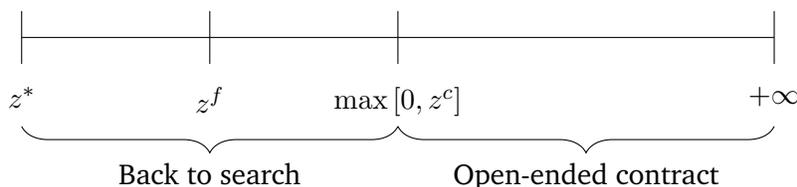


Figure 2.1: Hiring open-ended contracts only

- Job creation is dual if and only if $\max[0, z^f] < z^*$. Fixed-term contracts are hired when $z \in (\max[0, z^f], z^*)$ and open-ended contracts are hired when $z \in (z^*, +\infty)$. Figure 2.2 sums it up.

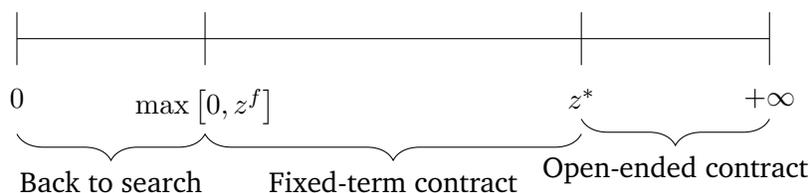


Figure 2.2: Dual job creation

Proof. See Appendix 2.B □

The proposition above states that dual job creation requires the immediate gains of hiring an open-ended contract in good times to overcome the losses due to firing costs in future bad times. A new firm-worker pair drawing a high idiosyncratic productivity may want to take advantage of this opportunity in full. To this extent, the best way to make the most of the situation consists in hiring through an open-ended contract, which lasts longer and thus provides a higher surplus than a

fixed-term contract. The match willingly locks itself through an open-ended contract in order to maximize the expected surplus. Otherwise, when the firm-worker pair draws a low productivity, both the worker and the firm go back searching. Fixed-term contracts serve as a compromise between a rigid contract or no productive relationship at all. Hiring through a fixed-term contract appears as an intermediate action: it generates a surplus through production while enabling to go back to searching for a better match before long. Fixed-term contracts are expedients to still take advantage of some positive surplus while waiting for better days to come. When, finally, a high productivity shock arises in a firm-worker meeting, an open-ended contract is signed.

In the current model, the exogenous separation rate s accounts for quits in open-ended matches among other costless termination channels.⁹ However, most quits are job-to-job transitions. What would happen if we explicitly modeled on-the-job search in the current framework? Assume workers review offers at the same rate as the unemployed. A worker quits his current position if and only if he finds a match that delivers a higher surplus. Note that, according to the law, fixed-term contracts can leave their position before the stipulated expiry date if they are hired under an open-ended contract. Thus, fixed-term workers can search on the job too. If there is no search cost, every worker searches on the job. In this case, on-the-job search simply increases the workers' outside option compared to the baseline case. Now, assume that workers search at a cost. The higher the workers' surplus, the lower the eventual gain from on-the-job search. As continuing open-ended contracts deliver higher wages than fixed-term jobs all else equal, fixed-term workers would tend to search on the job more than open-ended workers do. A highly productive new firm-worker pair would sign an open-ended contract to lock up the match and avoid losing the worker through on-the-job search. Thus, a priori, on-the-job search would not change the ranking of contracts in job creation. Cao et al. (2010) studies in depth this question and builds a dual labor market with on-the-job search.

2.2.4 Aggregate flows and stocks on a dual labor market

The share of open-ended workers that moves into unemployment falls into exogenous separations, which occur with probability s , and endogenous separations, which occur when an adverse produc-

⁹Quits are marginal in fixed-term matches: only 2% of fixed-term contracts terminate before their stipulated end (Milin, 2018).

tivity shock takes place. Thus, the associated probability is $\xi = s + \lambda G(z^p)$. Unemployed workers' probability to become employed under open-ended contracts is $\mu^p = p(\theta)(1 - G(\max[z^*, z^c]))$. On the fixed-term side of the labor market, matches come to their stipulated end date with probability δ . An unemployed worker finds a fixed-term job if he contacts a firm and the productivity of the resulting match is in the proper region. It occurs with probability $\mu^f = p(\theta)(G(\max[z^*, z^f]) - G(z^f))$. Denoting u the measure of non-employed workers, n^p the measure of open-ended workers and n^f the measure of fixed-term workers, fixed-term and open-ended employments evolve according to the following system.

$$\dot{n}^p = -\xi n^p + \mu^p u \quad (2.35)$$

$$\dot{n}^f = -\delta n^f + \mu^f u \quad (2.36)$$

Normalizing the workers' population to 1 leads to the following expressions for steady-state open-ended employment, fixed-term employment and non-employment.

$$n^p = \frac{\mu^p \delta}{\mu^p \delta + \xi \delta + \mu^f \xi} \quad (2.37)$$

$$n^f = \frac{\mu^f \xi}{\mu^p \delta + \xi \delta + \mu^f \xi} \quad (2.38)$$

$$u = \frac{\xi \delta}{\mu^p \delta + \xi \delta + \mu^f \xi} \quad (2.39)$$

As previously, an increase in θ has ambiguous consequences. On one hand, it strengthens the workers' outside option, which in turn raises wages, encourages the destruction of open-ended jobs and makes firms more demanding at the hiring stage in terms of productivity. On the other hand, job creation is bolstered by the enlarged probability of contact. Therefore, the impact on labor market stocks is ambiguous.

2.2.5 Comparative statics

In this subsection, I carry out comparative-statics exercises to describe the steady-state behavior of the model.

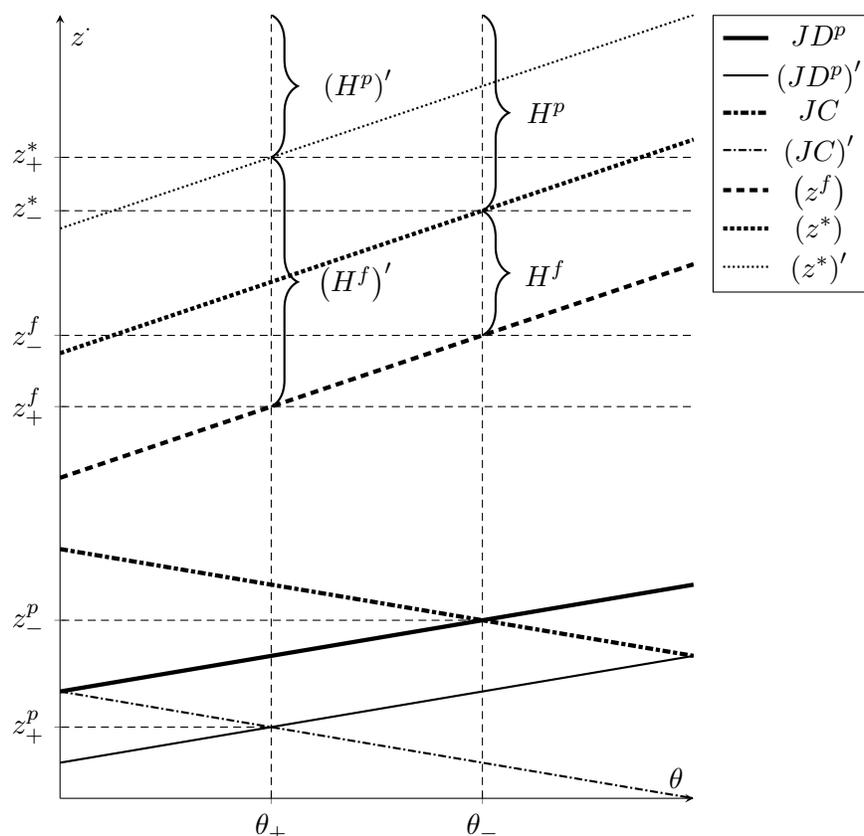


Figure 2.3: An increase in firing costs in the dual Mortensen-Pissarides model

The plus + and minus - subscripts respectively denote the equilibrium values before and after the change in firing costs. H^p and $(H^p)'$ respectively are the hiring regions under open-ended contracts before and after the change in firing costs. H^f and $(H^f)'$ are their counterparts for fixed-term contracts.

Figure 2.3 diagrammatically sums up the movements of the different loci equations (JD^p) (2.23), (z^f) (2.25), (z^*) (2.32) and (JC) (2.34) after an increase in firing costs.

Enlarged firing costs decrease the job destruction margin for a given labor market tightness. The job destruction curve (JD^p) moves downward to reach $(JD^p)'$. Firm-worker pairs compensate their losses in the expected surplus of a continuing match by demanding more productive newcomers: (z^*) shifts upwards to $(z^*)'$. The locus for profitability of the fixed-term contracts (z^f) , as for it, remains unchanged. Consequently, higher firing costs necessarily increase the share of fixed-term

contracts in job creation. This phenomenon causes a shift of the job creation condition downward: at a given θ , the expected profit from a firm-worker contact decreases as the signatures of open-ended contracts dwindle and are replaced by fixed-term contracts at the margin. (JC) shifts downward to reach its new position $(JC)'$. The job creation curve shifts further than the job destruction curve and the equilibrium labor market tightness decreases. Note that the subsequent reduction in the labor market tightness is stronger when only open-ended contracts are allowed. The replacement of open-ended hires with fixed-term ones at the margin mitigates the fall in the expected surplus from a contact and abates the fall in the posting of vacancies. Indeed, at the margin, matches with marginal productivity lower than z^c delivered no opportunities of a positive profit in the classic framework, whereas the matches with marginal productivity slightly lower than z^* deliver a positive profit through fixed-term employment in the dual framework.

Overall, the evolution of open-ended employment is ambiguous : job creation reduces as well as job destruction. As for fixed-term employment, job creation probability increases but the evolution of unemployment is unclear. Therefore, the response of the fixed-term job creation flow to an increase in firing costs is ambiguous.

An important alternative situation where the reasoning above is no longer valid consists in the insensibility of the steady-state equilibrium to firing costs. This happens if there is no endogenous destruction of open-ended jobs. Proposition 3 mathematically recapitulates the previous results.

Proposition 3. *At the steady-state equilibrium,*

- *with endogenous job destruction of open-ended contracts*

$$\frac{\partial \theta}{\partial F} < 0, \frac{\partial z^p}{\partial F} < 0, \frac{\partial z^c}{\partial F} > 0, \frac{\partial z^f}{\partial F} < 0, \frac{\partial z^*}{\partial F} > 0$$

- *otherwise*

$$\frac{\partial \theta}{\partial F} = \frac{\partial z^c}{\partial F} = \frac{\partial z_i^f}{\partial F} = \frac{\partial z^*}{\partial F} = 0$$

Proof. See Appendix 2.B □

An increase in firing costs entails a substitution towards fixed-term employment on behalf of open-

ended employment, while the classic result of an ambiguous response of unemployment remains. The enhanced relative flexibility of fixed-term contracts makes them significantly more attractive than open-ended contracts, which are progressively replaced by fixed-term contracts at the margin. When there is no endogenous destruction of open-ended jobs, the equilibrium becomes insensitive to firing costs.

The above exercise shows that the relative desirability of each contract at the hiring stage heavily depends on firing costs. Intuitively, sufficiently low firing costs lead to a complete shutdown of fixed-term employment, the corner case being firing costs such that $z^c = z^f = z^*$ as propositions 1 and 2 suggest. Similarly, prohibitively high firing costs should drive open-ended employment to zero through the utter disappearance of job creation through open-ended contracts, which seems pretty unrealistic. It may occur if the distribution of idiosyncratic shocks is bounded upwards. In our case, an intermediate case arises. When firing costs are high enough, endogenous open-ended job destruction vanishes. It makes the equilibrium insensitive to further increases in firing costs. The knife-edge value of firing costs solution corresponds to the equilibrium where $z^p = 0$. The following proposition formalizes this intuition.

Proposition 4. *There exists \hat{F} and \tilde{F} such that the steady-state equilibria verify*

- *If $F \leq \hat{F}$, there are only open-ended contracts*
- *If $\hat{F} < F < \tilde{F}$, open-ended and fixed-term contracts coexist*
- *If $\tilde{F} \leq F$, there are no endogenous job destruction of open-ended contracts. The equilibrium becomes insensitive to F*

Figure 2.4 sums up the different sort of equilibria in terms of contractual composition depending on firing costs.

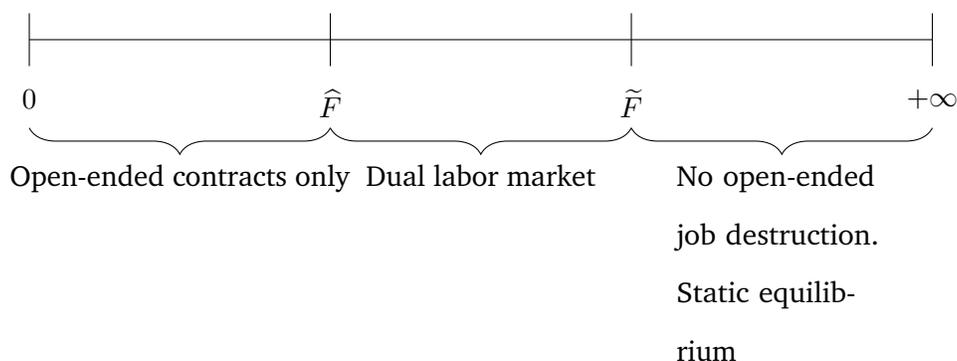


Figure 2.4: Firing costs and equilibrium employment

Proof. See Appendix 2.B. □

The result above demonstrates the adaptability of our approach. The productivity-flexibility trade-off may deliver a classic labor market with a rigid side only, a dual labor market or a fixed-term-oriented labor market. This is ideal to study transitions and steady-state outcomes related large-scale policies, such as the ban of fixed-term contracts or large cuts in firing costs. The insensitive equilibrium associated with $F \geq \tilde{F}$ is interesting too. The data suggests that only 30% of open-ended job destruction is currently endogenous, which is not so far from the 0% of our extreme case. To this extent, the economic schemes at stake in the region close to \tilde{F} might be insightful.

2.3 Numerical analyses

As we saw in the comparative statics section, quantitative analyses are necessary to circumscribe the behavior of employments and unemployment in response to changes in firing costs.

2.3.1 Calibration

In this section, I calibrate a model to mimic the behavior of the French labor market. Availability of data concerning dualism on the labor market guided this choice. Moreover, the scope of the following analyses can be widened to many Western Europe countries, which share quite similar

labor market institutions even though the strength of employment protection legislation may differ. One may quote Germany, Italy, Spain or Portugal among others¹⁰.

I set the unit time period to one month in accordance with the average duration of 1.5 months for temporary contracts in 2017 documented by Milin (2018)¹¹. Interestingly, the median duration associated with temporary contracts is much lower and amounts to 5 days. The interest rate is set to 5 % annually, which boils down to 0.4 % on a monthly basis. The matching function is specified as a Cobb-Douglas function $m(u, v) = mu^\sigma v^{1-\sigma}$. The elasticity of the matching function with respect to unemployment σ is set to 0.6, which stands in the middle of the range 0.5-0.7 estimated as reasonable by Burda and Wyplosz (1994) for Western Europe economies. In order to avoid the effect of congestion externalities and the complexity of their interlacing with the labor market institutions, we set the bargaining power η to 0.6¹². As I mention in the theoretical discussion above, one important question is the distribution of idiosyncratic shocks. Uniform distributions are used in seminal papers¹³ and include important benefits in terms of tractability. However, Tejada (2017) shows that log-normal distributions replicate well the distribution of wages in dual labor markets. Results are qualitatively robust to changes in distributions of idiosyncratic shocks. Table 2.1 sums up the choice of parameters.

r	σ	η	λ	δ
0.4 %	0.6	0.6	0.083	0.67

Table 2.1: Parameters

$F/\overline{w^p}$	$\mu^f / (\mu^p + \mu^f)$	n^f/n	s/ξ	u	$q(\theta)$
1.33	0.83	0.12	0.70	0.26	0.33

Table 2.2: Targets for a calibration of the French labor market

F	b	s	σ_z	m	γ
1.30	1.00	0.013	0.05	0.53	$3.78 \cdot 10^{-3}$

Table 2.3: Calibrated parameters

¹⁰OECD (2013) and ILO detail the employment protection legislations of many countries.

¹¹I essentially rely on this note to target moments characterizing the French labor market. It is based on the *Enquête sur les mouvements de main d'œuvre* carried out by Dares

¹²The Hosios condition is still valid in our framework.

¹³Among others, Mortensen and Pissarides (1994, 1999); Cahuc and Postel-Vinay (2002)

Table 2.2 outlines the targeted labor markets moments. Fontaine et al. (2016) suggests that inactive workers significantly contribute to job creations through fixed-term contracts. As a result, I target an unemployment rate of 26 %, which corresponds to the 2016's French inactivity rate¹⁴. I set the steady state share of fixed-term contracts in employment to 12 %. I target an average share of fixed-term contracts in job creation of 83 %¹⁵. I consider that exogenous splits of open-ended matches constitute 70 % of separations. As for the calibration of the French firing costs, I rely on Kramarz and Michaud (2010). Individual lay-offs marginally cost 4 months of the median wage, while the marginal cost of lay-off within a collective-termination plan represents 12 months of the median wage¹⁶. The former being the most frequent case, I reckon that total firing costs represent 4 months of the open-ended workers' average wage. As in Bentolila and Saint-Paul (1992) and Cahuc et al. (2016), I assume that red-tape costs actually embodied by firing costs only represent one third of total firing costs. Thus, I target a ratio of 4/3 for firing costs F with respect to the monthly open-ended workers' average wage. I also target the quarterly vacancy filling rate to 70 %, which is equivalent to a monthly rate of 33 %. As for the productivity shock arrival λ , there is no consensus stemming from the empirical literature. I assume a yearly average frequency. The calibration results in the determination of $(\sigma_z, F, b, s, m, \gamma)$, whose values are detailed in table 2.3.

2.3.2 Steady-state employment and welfare

Employment Left-hand side of Figure 2.5 displays the steady-state transition probabilities and their evolution with respect to firing costs. As firing costs increase, the separation probability of open-ended contracts decreases. In the same manner, the open-ended-contract job-finding rate decreases with firing costs while the fixed-term-contract job-finding rate increases. Magnified firing costs encourage the substitution towards fixed-term contracts. When firing costs are higher than \hat{F} , the substitution effect is responsible for the lower open-ended job finding rate in a dual labor market compared with a classic labor market with open-ended contracts only. Employees' outside

¹⁴Source: *Recensement de la population 2016 - Insee*

¹⁵Average from Q1-2000 to Q2-2019 computed with data from *Acoff - Urssaf (Déclarations préalables à l'embauche)*

¹⁶To be accurate, Kramarz and Michaud (2010) assesses that firms with more than 50 employees face a marginal cost of 97,727 FFfr (Table 1b), which represents 14 months of the workers' median wage. Consequently, the associated median wage of fired workers is 6980 FFfr. Thus, Table 2 shows that individual terminations cost 27,389 FFfr, which amounts to 4 months of the fired workers' median wage, while the termination within a collective firing plan marginally costs 81,850 FFfr, which equals 12 months of the median wage.

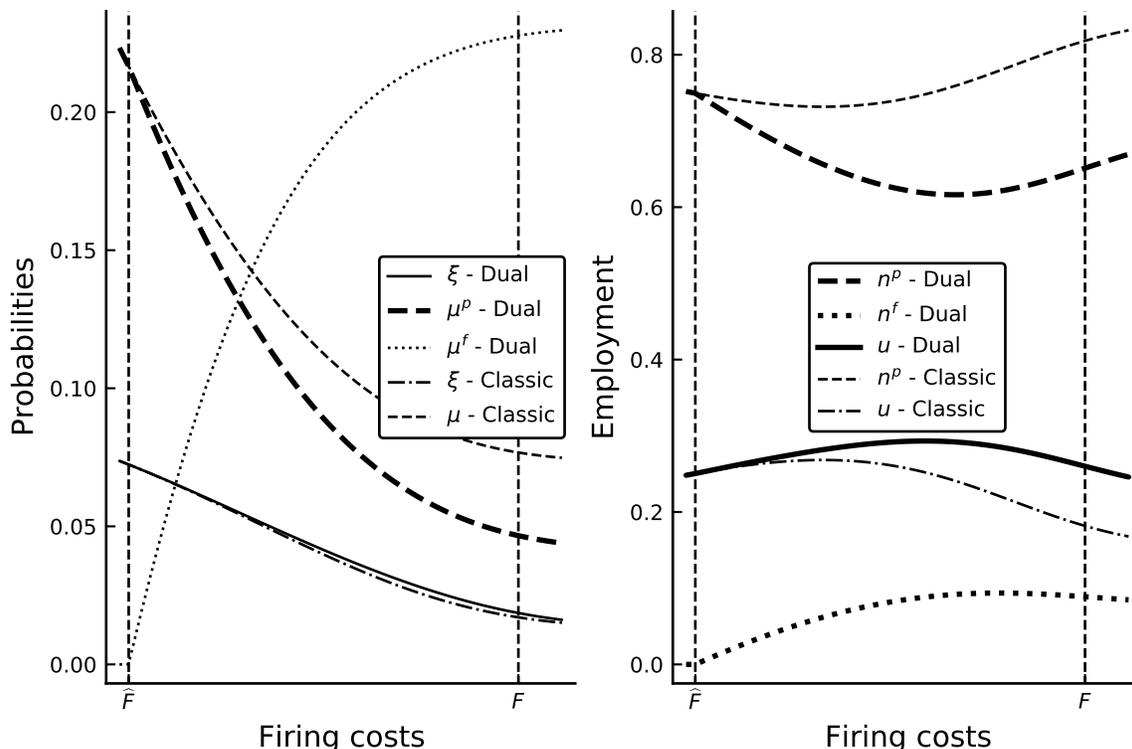


Figure 2.5: Steady-state transition probabilities, employments and firing costs

On the x-axis, \hat{F} is the threshold beyond which firing costs generate an equilibrium with dual job creation and is defined in Proposition 4. F denotes the value of firing costs as specified in the baseline calibration (see Table 2.3).

option is bolstered by the possibility to find a job through fixed-term contracts for a given labor market tightness. Accordingly, the open-ended job destruction margin is higher in the dual than in the classic case and so is the open-ended job destruction probability.

The right-hand side of Figure 2.5 displays the evolution of employments in a classic and a dual Mortensen-Pissarides model. On the left-hand part of the graph, firing costs are lower than \hat{F} . Job creation only happens through open-ended contracts and there is no fixed-term employment. The dual and the classic Mortensen-Pissarides models coincide when firing costs are in $[0, \hat{F}]$. Theoretically, firing costs have a relatively ambiguous effect on employment. On one hand, firing costs discourage lay-offs because of a magnified separation cost. On the other hand, the workers' enhanced threat point in the wage-bargaining process discourages hires. As firing costs exceed \hat{F} , an equilibrium with dual job creation becomes possible. The classic model delivers lower and lower employment levels. At one point, the increase in firing costs ends up jeopardizing hiring incentives

more than it discourages lay-offs: unemployment reaches a minimum level and begins increasing.

In the dual labor market, the same phenomenon takes place regarding overall employment but the outcome differs. The difference between the classic and dual cases stem from the emergence of an additional mechanism in the dual case. When dual job creation is an equilibrium outcome, higher firing costs encourage the substitution of open-ended employment towards fixed-term employment. Starting from \hat{F} , an increase in firing costs widens the spectrum of situations where fixed-term contracts are profitable. As fixed-term workers operate a larger share of new jobs, the job destruction flow enlarges. In my calibration, the widened possibilities of hires brought in by fixed-term contracts decrease less unemployment than magnified job destruction pushes it up : unemployment increases up to a maximum value of 0.28. This substitution effect is quantitatively substantial. Open-ended employment drops to a minimum of 0.62, while fixed-term employment increases from 0 to a maximum of 0.10.

When firing takes even higher values, the behavior of employments reverts. Open-ended employment increases from 0.62 to 0.65, while fixed-term employment decreases from 0.10 to 0.09. At first view, however, fixed-term employment should still increase according to the substitution effect we previously described. A general-equilibrium effect is responsible for this behavior. Since open-ended employment represents the bulk of workers, unemployment tends to decrease as the open-ended job destruction probability shrinks. Even though higher firing costs push up the fixed-term jobs' hiring probability, the latter reduction in unemployment is strong enough to push down the job creation flow into fixed-term employment. Since fixed-term job destruction rates are constant, fixed-term employment shrinks. In the French data, a minor share of open-ended matches' separations induce the payment of a firing cost. The calibrated economy is close to the corner equilibrium with no endogenous open-ended job destruction. The French economy is set in the region where the general-equilibrium effect of an increase in firing costs outreaches the substitution effect. In graphic terms, open-ended employment increases with firing costs in the neighborhood of the baseline firing costs materialized by the dashed vertical line F in Figure 2.5.

Welfare Beyond employment, important considerations include the impact of firing costs on welfare. The comparative statics carried out earlier as well as proposition 3 provide preliminary

results. The unemployed would prefer the highest possible value for θ , which is associated with $F = 0$. Indeed, the unemployed workers value high job-finding probabilities. As for the fixed-term and open-ended matches, the results are theoretically ambiguous and a numerical analysis is necessary. Social welfare SW is defined as the sum of production from open-ended matches, production from fixed-term matches, the unemployed's home production net of the vacancy costs. Therefore, the steady-state social welfare SW verifies

$$rSW = n^p \bar{z}^p + n^f \bar{z}^f + bu - \gamma v - \lambda G(z^p) n^p F$$

where \bar{z}^p and \bar{z}^f are the average productivities of open-ended and fixed-term matches respectively. Figure 2.6 displays steady-state social welfare on the left panel and average productivities on the right panel as firing costs vary.

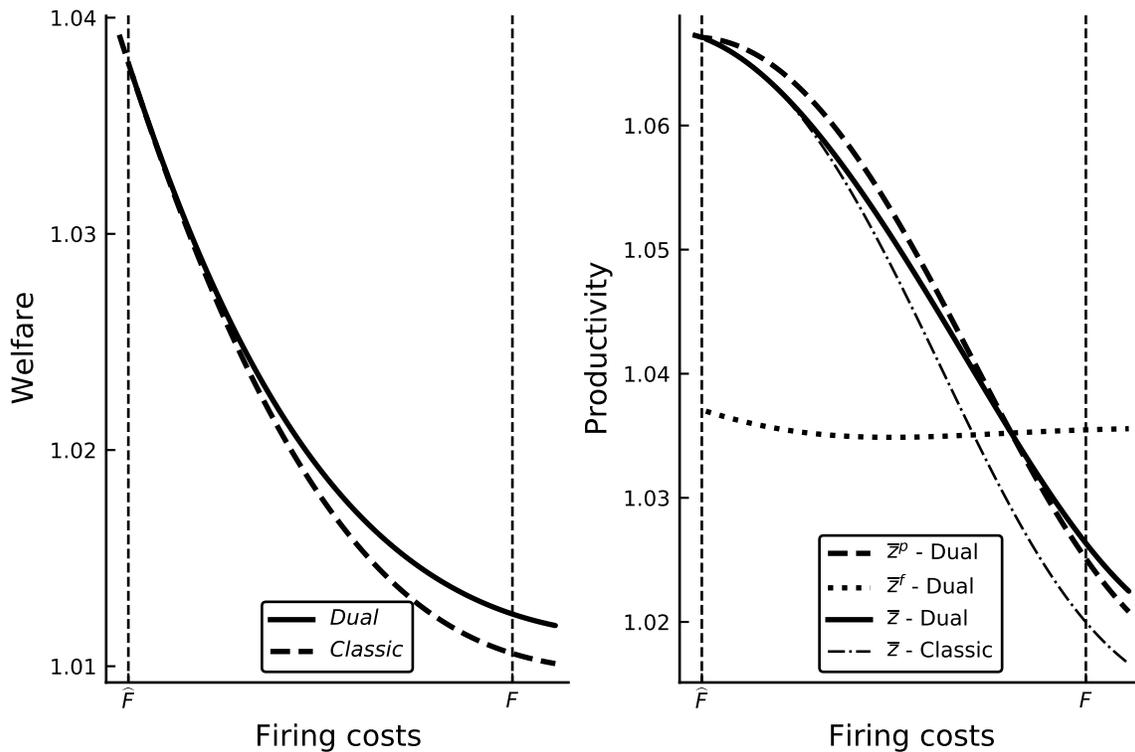


Figure 2.6: Evolution of social welfare and productivities with respect to firing costs

\bar{z}^p and \bar{z}^f are the average productivities of open-ended and fixed-term matches respectively. \bar{z} is the overall average productivity in the economy.

Many competing mechanisms intervene in the variation of social welfare with respect to firing costs. One may divide them in two categories: employment effects and productivity effects. The vacancy cost being tiny, one may neglect its quantitative effect in the comparative-statics analysis of welfare. As employment variations with firing costs are studied above, I now consider the evolution of productivities.

On the open-ended side of the labor market, the higher the firing costs, the lower the rate of open-ended job destruction. As firing costs increase, continuing open-ended contracts become less and less productive. In contrast, augmented firing costs push up the job creation thresholds z^c and z^* . New open-ended contracts become more productive as firing costs enlarge. Overall, though, the stock of continuing open-ended matches is bigger than the stock of new open-ended matches and the former effect prevails. The average productivity of open-ended contracts \bar{z}^p in the dual model and the average productivity of open-ended contracts in the classic model \bar{z} decrease. The productivity of open-ended contracts is higher in the dual model than in the classic model. It essentially stems from the fact that fixed-term employment replaces open-ended employment as firing costs increases beyond \hat{F} . The productivity of new open-ended matches drives the difference between the dual and the classic specification. Indeed, z^* increases faster with firing costs in the dual equilibrium than z^c does in the classic case, and so do the average productivity of new open-ended matches in the dual labor market compared with the average productivity of new open-ended matches in the classic labor market. The average productivity of new open-ended contracts is thus higher in the dual specification than in the classic specification. The open-ended job destruction threshold z^p stay pretty similar in both the dual and the classic specification. As a result, the average productivity of continuing open-ended matches does not differ much across both specifications as firing costs change and the average productivity of new open-ended contracts accounts for the difference between both specifications in that regard.

On the fixed-term side of the labor market, an increase in firing costs has two opposite effects. On the one hand, the higher the firing cost, the lower the labor market tightness and the lower the profitability threshold z^f , which reduces fixed-term jobs' productivity. On the other hand, higher firing costs encourage the substitution towards fixed-term contracts on behalf of open-ended contracts in the neighborhood of z^* because z^* increases with firing costs. This makes fixed-term

contracts more productive on average. The right-hand side graph of figure 2.6 shows that those two effects cancel out over the chosen interval of firing costs.

The average productivity is higher in the dual framework than in the classic framework. The substitution account for this phenomenon. In the dual framework, most job creations occur through fixed-term contracts, and these new jobs are necessarily productive enough to generate a positive joint surplus. Moreover, fixed-term jobs are short enough to remain productive throughout their whole life span. In a classic framework, new open-ended jobs are more and more productive as well, but job creation flows are smaller because of firing costs and the continuing open-ended jobs are less and less productive as job destruction flows tighten. The higher the firing costs, the more the average productivity in the dual framework dominates the average productivity in the classic framework.

The overall behavior of welfare results from the intertwined productivity-related and employment-related mechanisms. As open-ended contracts cover most workers, the negative impact of firing costs on the average productivity of open-ended jobs dominates and the total average productivity decreases with firing costs. Since employment moves between 0.7 and 0.8 in response to changes in firing cost, the decreasing average productivity drives the welfare as the left panel of Figure 2.6. Why is the steady-state welfare higher in a dual labor market than in a classic labor market? The unemployment rate and the average productivity are higher in the dual framework. These two opposite effects lead to an ambiguous result in terms of social welfare. The difference between both frameworks is to be found on the open-ended job destruction side and the welfare loss firing costs induce. Open-ended job destruction rates are comparable between the dual and the classic framework. However, open-ended employment is higher in the classic framework. The welfare loss associated with open-ended job destruction is thus higher in the classic framework than in the dual framework. The latter mechanism tilts the balance in favor of the dual labor market, which dominates the classic labor market in terms of welfare.

A benevolent social planner willing to reduce unemployment and improving welfare faces a dilemma if it wants to keep the dual structure of the labor market at minimum political cost. Indeed, starting from the baseline firing costs, there is no free lunch for small changes in firing costs. In the neighborhood of baseline firing costs F , increasing firing costs decreases unemployment and

welfare, while decreasing firing costs increases unemployment and welfare. A reform improving both unemployment and welfare needs a large cut in firing costs. The post-reform firing costs need to be close to or below \hat{F} . A large welfare gain and a small unemployment decrease come at a high political cost since the optimal reform consists in strongly cutting firing costs, which leads to a persistent increase in unemployment and a persistent decrease in open-ended employment. Interestingly, the shape of the latter reform roughly resembles a unique-contract reform as there are no longer fixed-term contracts with firing costs below \hat{F} .

2.3.3 Dynamics

In this section, we study dynamics after a change in firing costs as well as transitions between dual and classic labor markets. The mathematical aspect of these dynamics is discussed in Appendix 2.C. I also study the consequences of regulatory uncertainty.

Post-reform adjustment speed The speed of adjustment of an economy after a reform constitutes an important factor from the policy maker's point of view. It depends both on employment values and employment transition probabilities. Employment transition probabilities are forward looking because they are functions of the labor market tightness and the thresholds pinpointing job destruction and job creation are forward-looking variables. Therefore, they jump immediately to the new steady-state values after an unexpected change in the parameters¹⁷. As for employment values, they are stock variables. These results are valid for both the classic and dual Mortensen-Pissarides model. Figure 2.7 displays the time at which 99 % of the adjustment is completed for each type of employment.

Starting from the baseline value, a cut in firing costs immediately increases the open-ended job creation and destruction probabilities. Flows thicken in the open-ended side of the labor market. Meanwhile, on impact, the least productive continuing open-ended matches now deliver a negative surplus and split; open-ended employment dives and unemployment soars.

In the classic framework, adjustment time reflects the interaction between the impact reaction and

¹⁷This result is extensively developed in Pissarides et al. (2000) page 59-63.

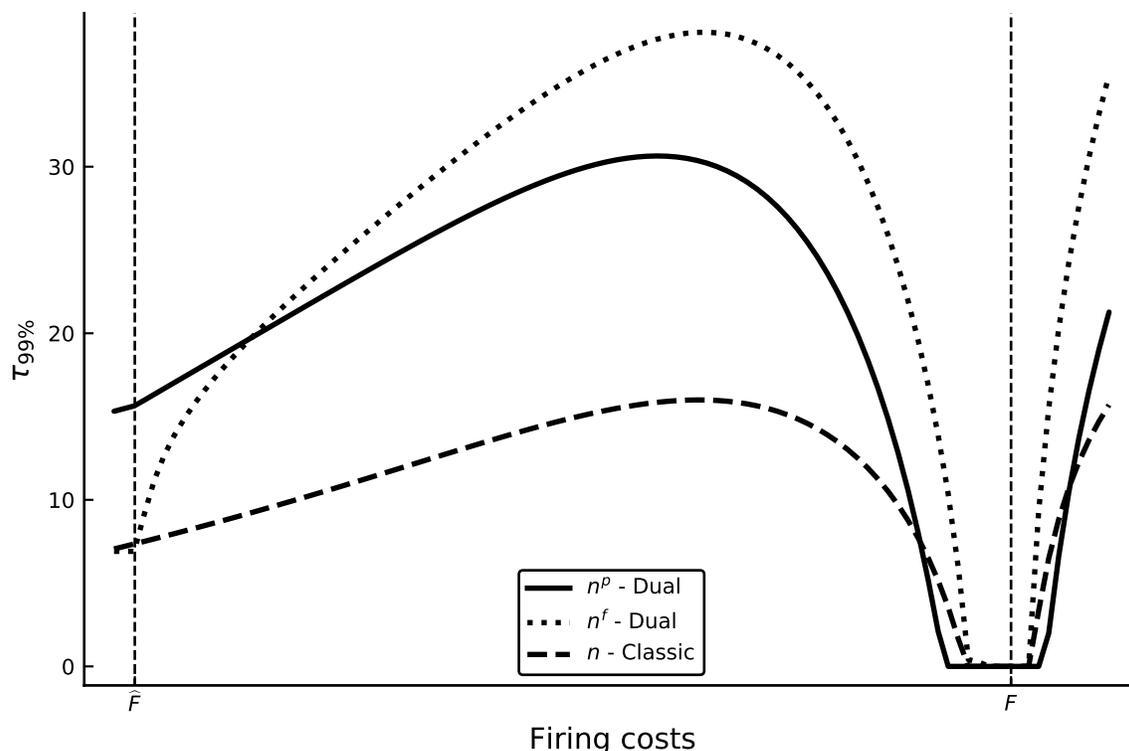


Figure 2.7: $\tau_{99\%}$ of different reforms with respect to the post-reform firing costs in months

The x-axis represents post-reform firing costs and the F -labeled vertical dashed stands for the baseline firing costs. The y-axis represents the time by which 99% of the adjustment is done when considering steady-state values.

its absorption through bigger job creation and destruction flows. On the right-hand side of $[F, \hat{F}]$, as post-reform firing costs move farther and farther from the baseline, the impact reaction brings employment farther and farther from the new steady-state and transition rates do not increase enough to quickly absorb the impact reaction: adjustment time increases and reaches a maximum. As post-reform firing costs decrease, transition rates become high enough to quickly absorb the initial response of employment and adjustment time decreases. Overall, adjustment takes up to 1.5 years in the classic framework. Note that if, by a happy coincidence, the impact response of employment sets it close to its new steady-state, adjustment would be much shorter. It does not take place in the current calibration, but may occur with other specifications. Figure 2.A.6 in Appendix 2.A shows such a case when the average duration between productivity shocks is 3 years. In the classic framework, employment immediately gets close to its new steady-state value when post-reform firing costs are half way between the baseline firing costs and \hat{F} .

In the dual framework, a similar balance between the new steady-state employment values, the new transition probabilities and the employment impact responses shape dynamics. A novel force emerges in contrast with the classic framework; the fixed-term job creation rate decreases as firing costs decrease. Starting from the baseline economy, as post-reform firing costs decrease, the impact response sets open-ended employment further and further from its new steady-state value. The higher open-ended job transition rates cannot overcome this mechanism when firing costs are close to the baseline. The presence of fixed-term contracts that capture a decreasing but still important share of job creations extends the adjustment time. Adjustment times reach a maximum. As post-reform firing costs further decrease, the prominence of fixed-term contracts reduces and open-ended transition rates increase enough to overcome the impact response of open-ended employment. Adjustment takes up to 3 years. In the same manner as in the classic framework, if by chance the impact response brings employment close to its new steady state value, transitions are much shorter. As figure 2.A.3 in Appendix 2.A shows, when the average duration between two productivity shocks is one month, the impact response of open-ended employment brings it close to its new steady state value when post-reform firing costs are a bit higher than \hat{F} .

Starting from the baseline value, an increase in firing costs reduces the transition probabilities on the open-ended side of the labor market. Since open-ended matches represent the bulk of employees in the baseline calibration, the new unemployment value depends on open-ended employment to reach its new steady-state value. The sluggish motion of open-ended employment slows down the adjustment of unemployment. The higher fixed-term job creation rate is not high enough to overcome the low transition rates on the open-ended side of the labor market. It reflects on the adjustment of fixed-term employment, which essentially relies on job creation. A 3-per-cent increase in firing costs needs an adjustment of 30 months, which represents 2.5 years.

Overall, the policy maker faces a high uncertainty with respect to adjustment time when it implements a reform. In the following paragraph, we describe the post-reform dynamics in two specific cases.

Post-reform dynamics The left-hand side of figure 2.8 shows the transition from the baseline dual labor market to a classic labor market with half of the baseline firing costs. The labor market fully

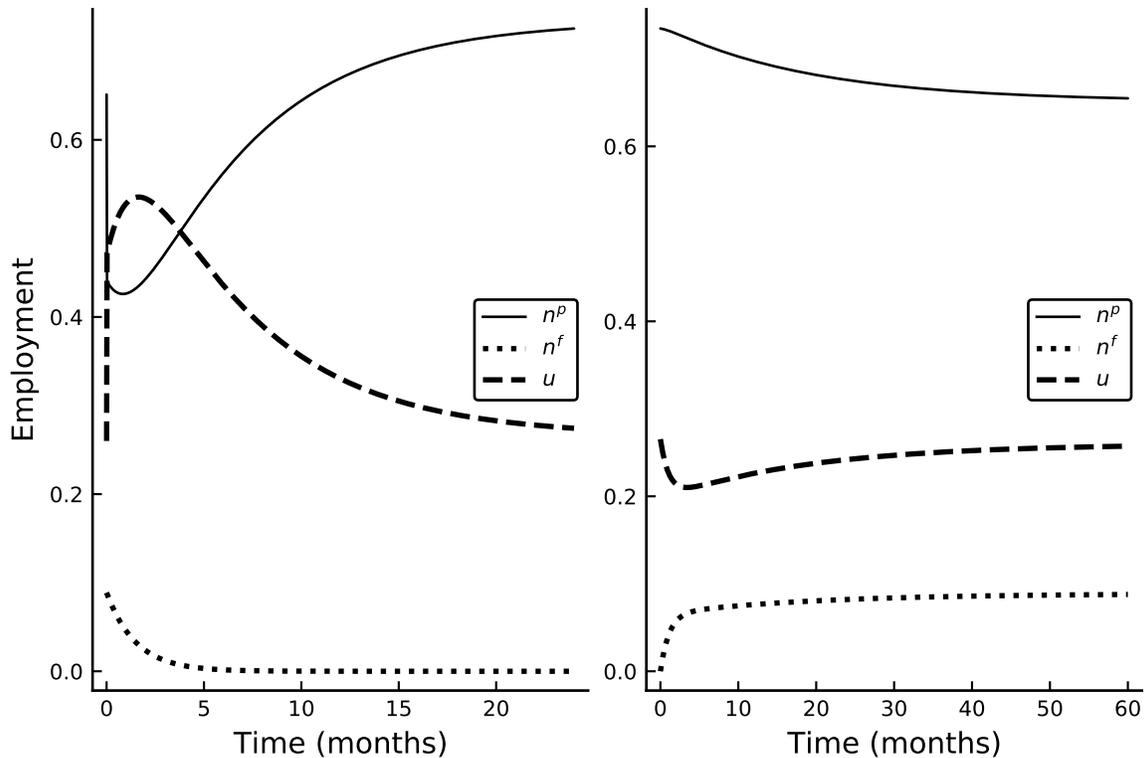


Figure 2.8: Post-reform dynamics

On the left, transitions of employments and unemployment following a unique-contract reform. On the right, transitions of employments and unemployment following the introduction of fixed-term contract

adjusts by roughly 24 months. It reaches a new equilibrium with higher open-ended employment, no fixed-term employment and a roughly similar unemployment. Temporary employment vanishes by 10 months. Unemployment first increases for two reasons. First, the aggregate job-finding rate drops; some of the unemployed who initially found a fixed-term job now remain unemployed. Secondly, the drop in firing costs pushes up the open-ended job destruction margin z^p , which entails the split of the least productive open-ended matches. Importantly, the impact reaction of open-ended employment is at odds with the final steady-state increase in the latter. The policy maker has to deal with a magnified unemployment rate as well as a depleted open-ended employment on the first year of the transition. The cost of such a transition is prominent in terms of open-ended employment and unemployment.

The right-hand side of figure 2.8 represents the transition from a classic to a dual labor market. The adjustment is much slower and takes around 5 years to be 99 % complete. Fixed-term employment

quickly weighs in job creation as the main force, but the fixed-term job creation flows remain small because of the initial reduction in unemployment. The thin job destruction flow from open-ended employment is the only force that may drive up unemployment and the substitution of open-ended employment towards fixed-term employment ends up being slow. These sluggish dynamics after the introduction of fixed-term employment might bring an explanation to the expansion of fixed-term employment in the Western economies over the last decades. At the end of the 1970s, fixed-term contracts were introduced with a restricted scope and unemployment was low. Progressively, the legal constraints on the employability of fixed-term contracts loosened. In our model, an equivalent situation would embed an exogenous probability to accept or refuse a fixed-term match¹⁸. Initially, fixed-term matches are introduced, but most of them are refused. Imagine that the acceptance rate of fixed-term contracts is gradually extended. Considering the 5-year convergence duration as a trustworthy figure, fixed-term employment would take years to reach its equilibrium value if it had to adjust to each of the reforms on the acceptance rate.

In both examples of reforms, the impact response of employments and the post-reform transition probabilities shape the dynamics. As far as I know, there is no exploitable data to verify my findings. Earliest time series of open-ended and fixed-term employments are annual and start on 1982, while fixed-term contracts were introduced in 1979. As for in-depth reforms, there were virtually none about employment protection in France in the last few years. The biggest reform was *Accord national interprofessionnel* concluded on 2013 January 11 and was about introducing a pinch of experience rating in payroll taxes. Relevant data may stem from 2014's Italian Jobs Act, which imposes simpler termination procedures and caps on compensations¹⁹.

Regulatory uncertainty If studying one-and-for-all in-depth reforms is relevant from a policy point of view, it remains a purely theoretical view. According to Fontaine and Malherbet (2016), reforms are actually frequent and often marginal in Western and Southern Europe. Between 2005 and 2013, they count 17 employment protection legislation reforms in France, 49 in Italy, 38 in Spain, 23 in Greece and 17 in Portugal. Thus, a natural question to address concerns the impact of regulatory uncertainty on the labor market equilibrium.

¹⁸Cahuc and Postel-Vinay (2002); Sala and Silva (2009); Bentolila et al. (2012a) and Sala et al. (2012) make this assumption.

¹⁹See Boeri and Garibaldi (2019) for an assessment of the Italian Jobs Act

Let me assume that firing costs undergo i.i.d shocks with probability ϵ per unit of time. Firing costs follow a uniform distribution over $\{F_1, F_2\}$ such that $F_1 < F_2$. I describe the derivation details of the model in Appendix 2.D. I set ϵ to match the French and Portuguese score of 17 reforms in 9 years, which seems to be a lower bound in Western and Southern European countries. Consequently, our results will understate the actual impact of regulatory uncertainty in the mentioned countries. A steady-state no longer exists: the system is now a Markov Jump Non-Linear System²⁰ Figure 2.9 shows the paths of fixed-term and open-ended employment for a given realization of policy shocks.

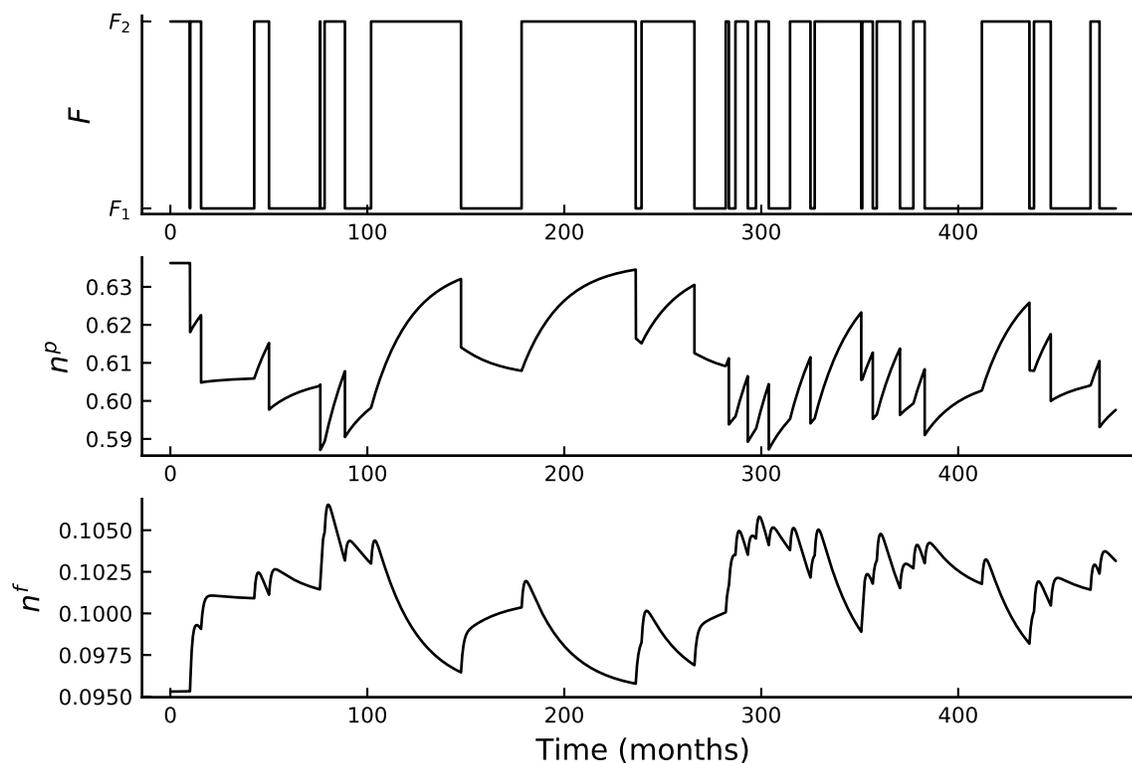


Figure 2.9: Employment dynamics with a given path of policy shocks

Intuitively, uncertainty in firing costs should discourage hires through open-ended contracts. When $F = F_2$, matches with a productivity just over the job destruction cap split if policy shock leads to $F = F_1$. When $F = F_1$, matches fear a shock magnifying firing costs, which encourages substitution towards fixed-term contracts at the hiring step.

To measure the numerical impact of regulatory uncertainty, I consider different ranges for firing costs between states 1 and 2 and find the parameters that match the baseline moments in Table

²⁰do Valle Costa et al. (2012) is an approachable introduction to the linear case.

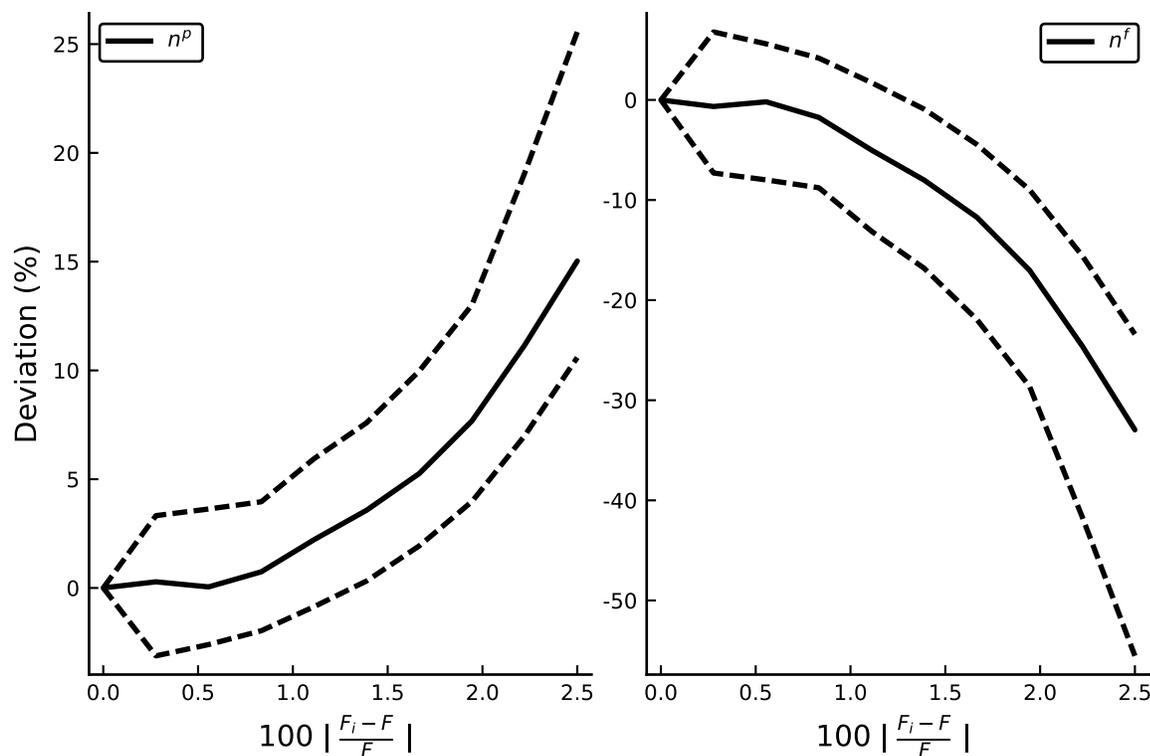


Figure 2.10: Extend of regulatory uncertainty and employment

Steady-state employments when $\epsilon = 0$ and the value of F is the baseline. Parameters are estimated for different values of $\left| \frac{F_1 - F}{F} \right| = \left| \frac{F_2 - F}{F} \right|$ using the model with regulatory uncertainty. A simulated method of moments with 10,000 paths of policy shocks with a 1,000-month duration each is carried. The average and 95-per-cent confidence interval appear as plain and dashed lines.

2.2 using a Simulated Method of Moments. More specifically, I simulate 10,000 paths of policy shocks over 1,000 months randomly starting from one of the steady-states with $F = F_1$ or $F = F_2$. I minimize the wedge between the simulated and actual moments.

Then, I compute the steady state when the shock arrival rate on firing costs ϵ is set to zero and firing costs are back to their baseline value. Figure 2.10 displays the percentage deviation in employments with respect to the baseline steady-state. It shows what happens when the uncertainty over firing costs vanishes. Starting from an equilibrium with 2.5 % changes of firing costs with respect to their baseline value, shutting down uncertainty provides a 15% increase in open-ended employment and 30% decrease in fixed-term employment. The impact of firing cost uncertainty becomes significant at the 5% level when firing costs vary of more than 1.5% around their baseline value. Policy uncertainty significantly fuels substitution towards fixed-term employment, which increases unemployment.

Robustness As previously mentioned, there is a diversity of views about the value of the productivity shock arrival rate λ . In Appendix 2.A²¹, I plot the same graphs for calibrations with significantly higher and lower productivity shock arrival rates. I carry out three calibrations with three different average durations between productivity shocks: a month, a year and the mid-length of a typical business cycle, namely 3 years. In the same manner, the red-tape costs associated with an endogenous job destruction are difficult to assess. I calibrate the model with a zero share of exogenous splits of open-ended contracts to assess the sensitivity of my results to this parameter. Assuming that all inactive workers search for a job may seem a pretty polar case despite the blurry frontier between employment, unemployment and inactivity in the fixed-term contracts. Thus, I also carry out a calibration targeting a 10% unemployment rate.

A higher arrival rate of productivity shocks and a zero share of costless separations of open-ended jobs magnify the curvature of transition probabilities, employments, average productivities, welfare and adjustment time with respect to firing costs. Open-ended job destruction flows are thicker and firing costs are more frequently paid. The differences between the dual and classic labor markets enlarge. In quantitative terms, changes in firing cost with a similar size have a stronger impact in terms of employment and welfare. The productivity shock arrival rate significantly impacts the steady-state outcome of a change in firing costs. If the value of the productivity shock arrival rate is not well known, a cut in firing costs leads to pretty unpredictable steady-state employment outcomes. Higher productivity shock arrival rate lead to longer adjustment durations up to 5 years.

2.4 Conclusion

In this paper, I have built a simple matching model with both fixed-term and open-ended contracts. The model provides a theoretical rationale to explain the contractual choice at the hiring step: fixed-term contracts act as stopgaps, offering both production and a possibility to return quickly on the labor market to fall onto a high-productivity match. In terms of policy, the removal of fixed-term contracts and a strong cut in firing costs leads to a gain in both welfare and employment within 18 months. Frequent marginal changes in firing costs push up unemployment and fixed-term

²¹The interested reader can visualize the impact of different probabilities of productivity-shock occurrence on MyBinder (Project Jupyter et al., 2018)

employment and weakens open-ended employment.

Tractability comes at a high cost: productivity shocks are i.i.d and there is no on-the-job search. However, understanding the mechanisms underpinning dynamics in a dual labor market requires a few sacrifices. The next model should involve fewer restrictive assumptions to make numerical analyses more trustworthy.

Appendix

2.A Robustness Checks

2.A.1 $\lambda = 1$

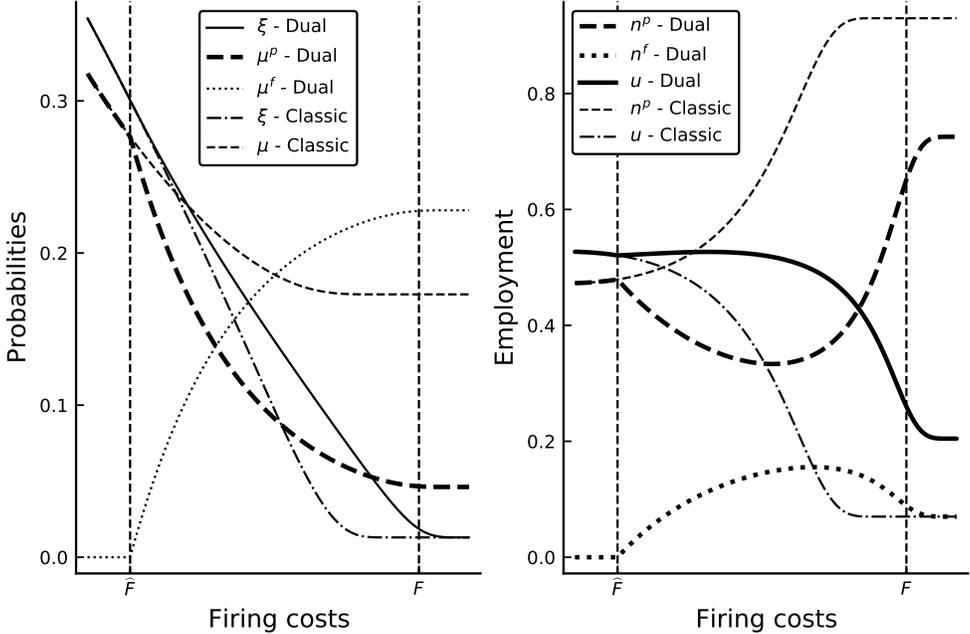


Figure 2.A.1: Steady-state employment values and firing costs

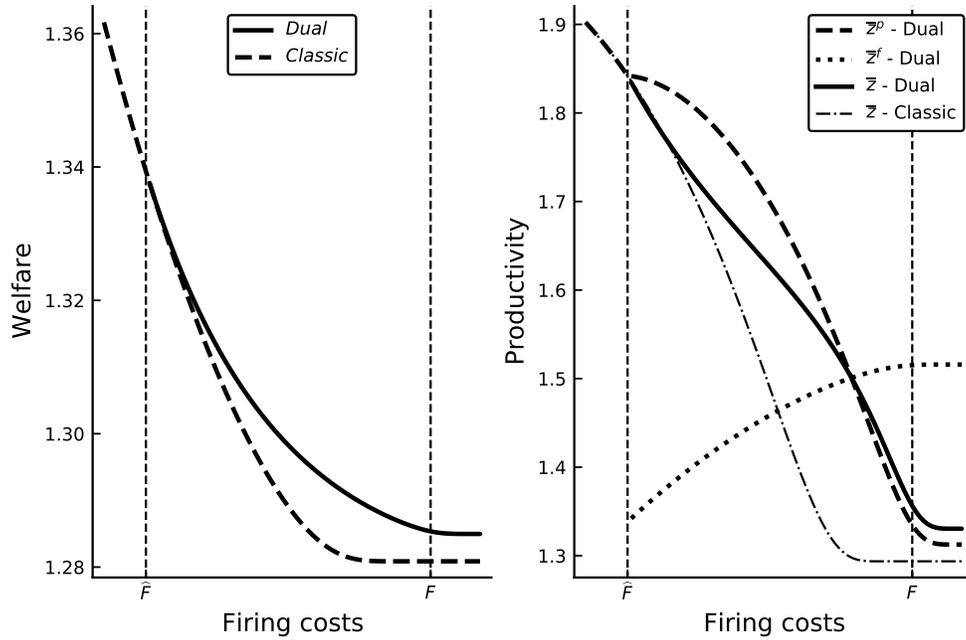


Figure 2.A.2: Social welfare and firing costs

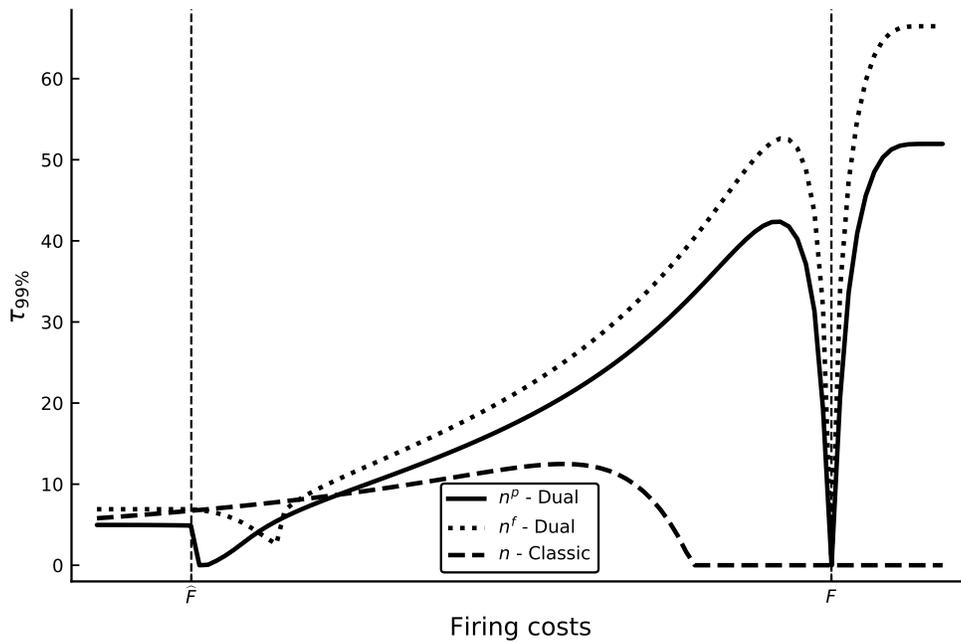


Figure 2.A.3: $\tau_{99\%}$ of different reforms with respect to the post-reform firing costs in months

2.A.2 $\lambda = 1/36$

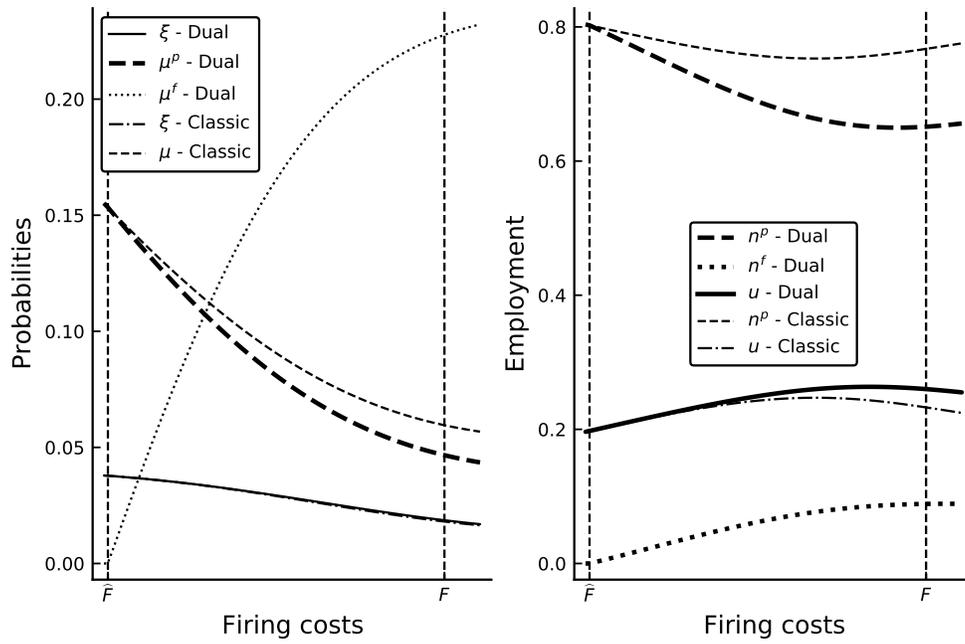


Figure 2.A.4: Steady-state employment values and firing costs

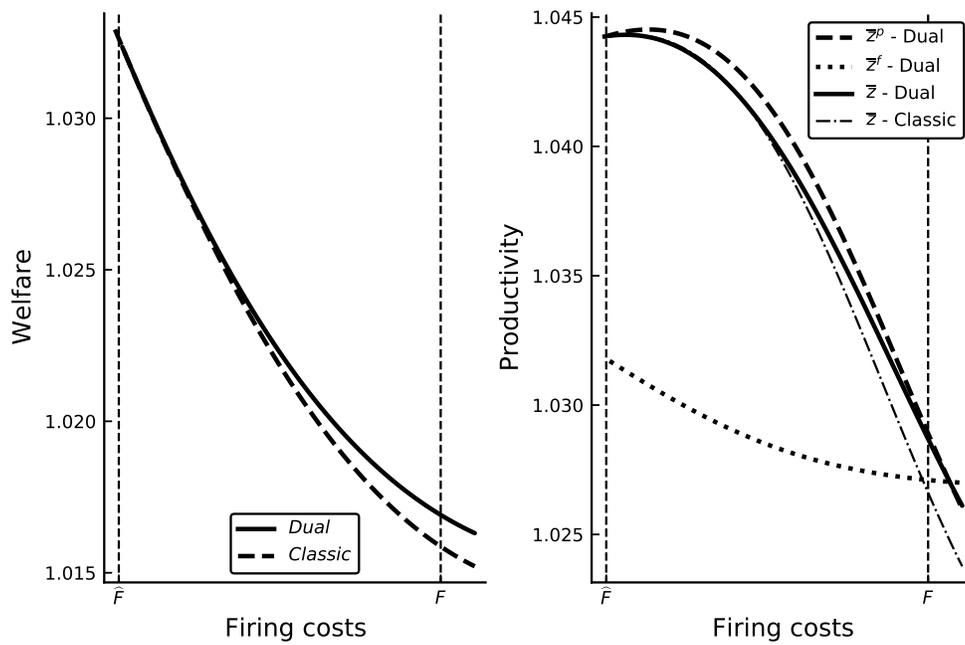


Figure 2.A.5: Social welfare and firing costs

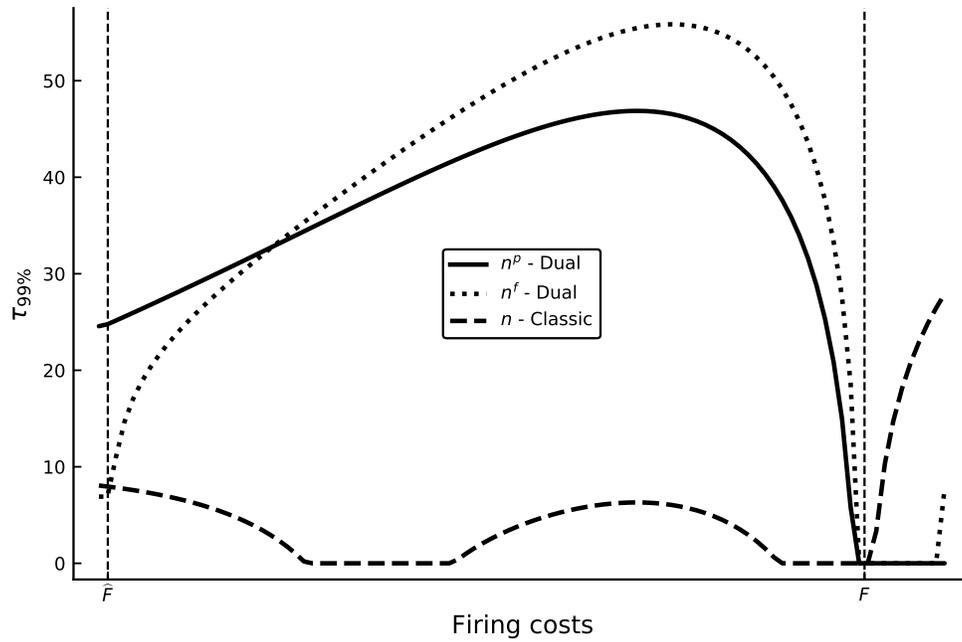


Figure 2.A.6: $\tau_{99\%}$ of different reforms with respect to the post-reform firing costs in months

2.A.3 $s/\xi = 0$

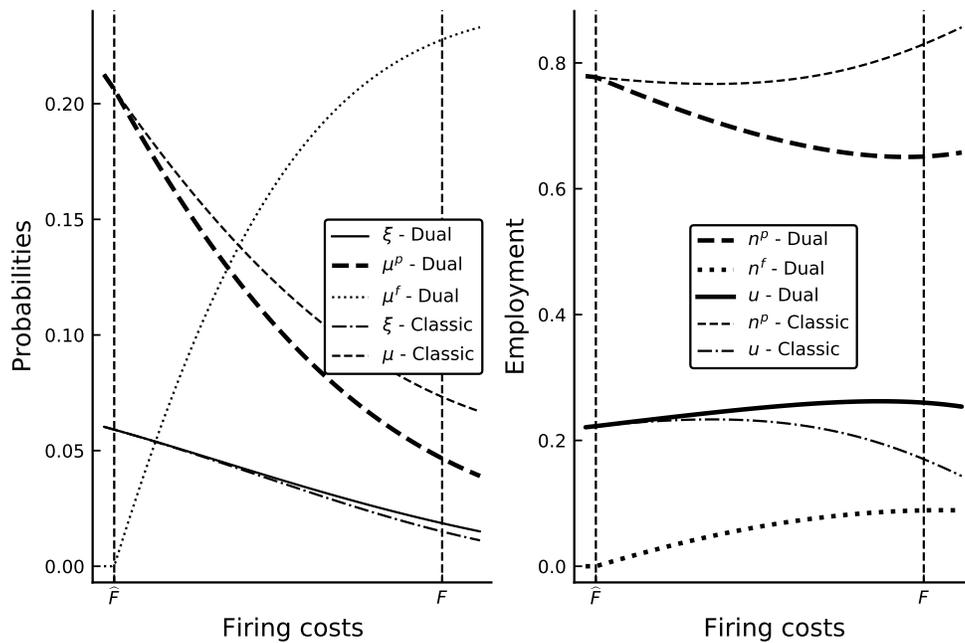


Figure 2.A.7: Steady-state employment values and firing costs

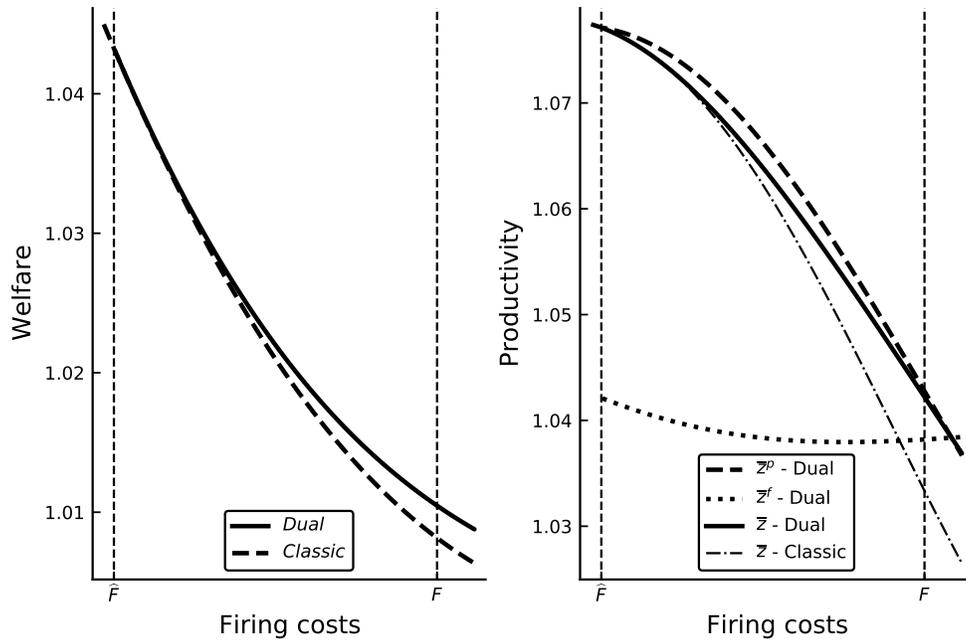


Figure 2.A.8: Social welfare and firing costs

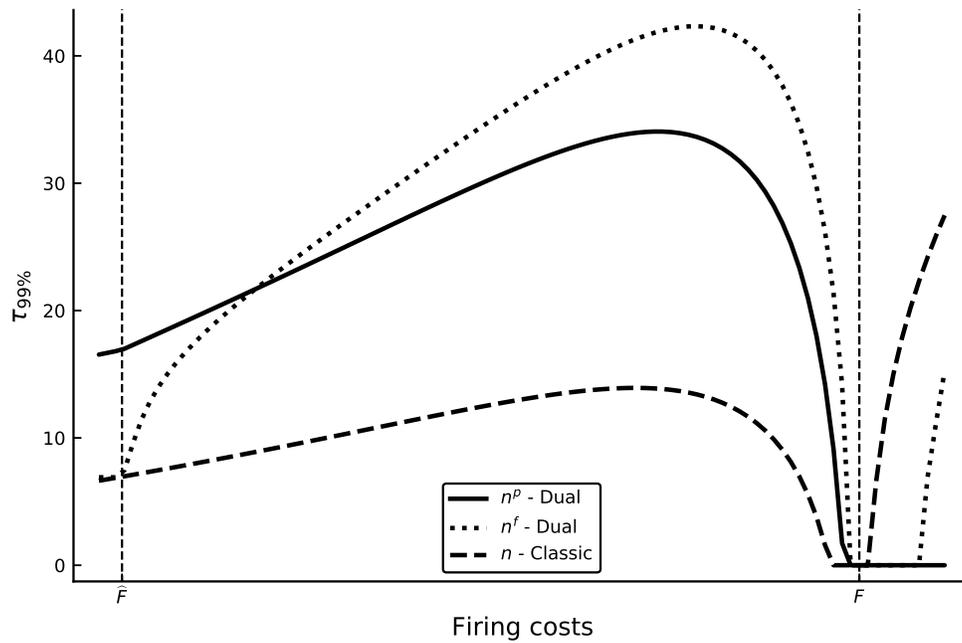


Figure 2.A.9: $\tau_{99\%}$ of different reforms with respect to the post-reform firing costs in months

2.A.4 $u = 0.1$

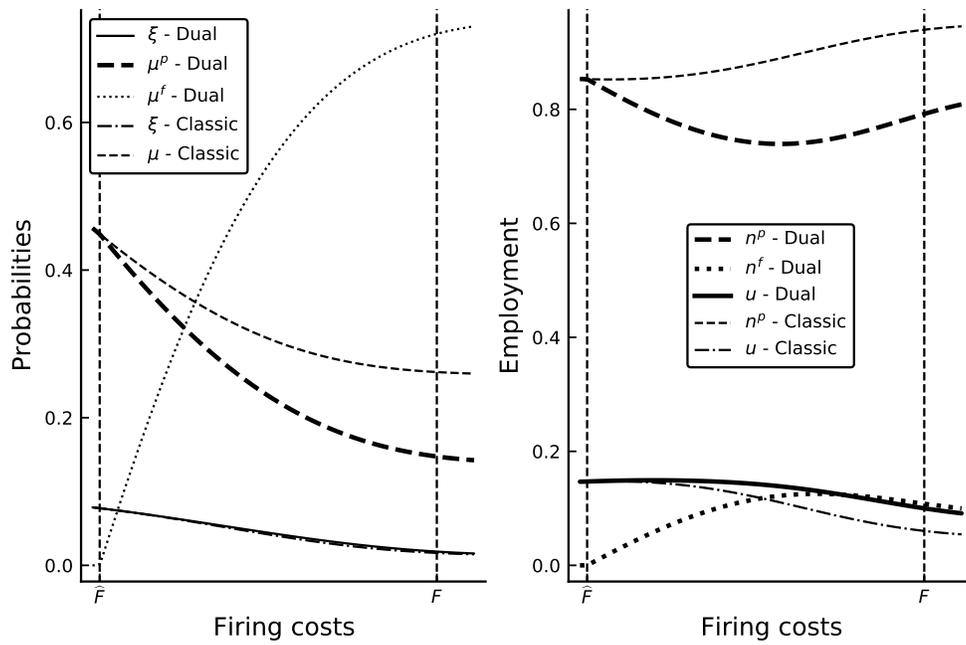


Figure 2.A.10: Steady-state employment values and firing costs

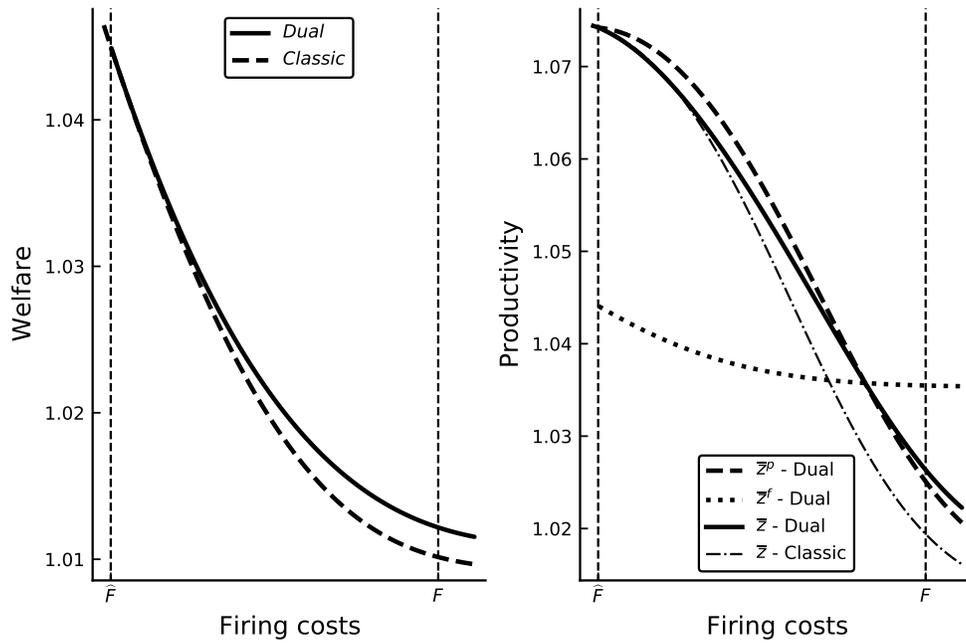


Figure 2.A.11: Social welfare and firing costs

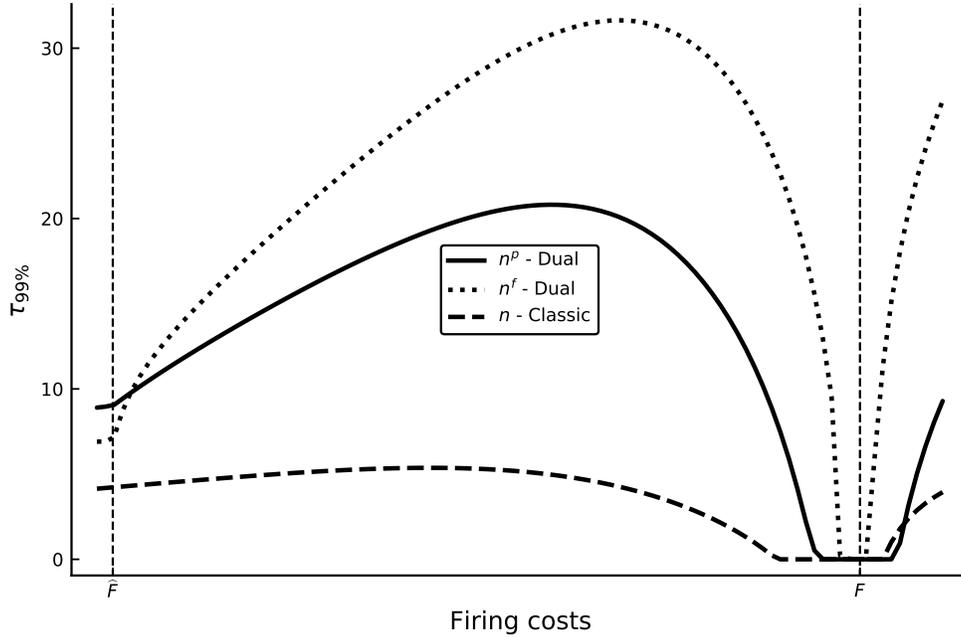


Figure 2.A.12: $\tau_{99\%}$ of different reforms with respect to the post-reform firing costs in months

2.B Proofs

Proposition 1 I denote $\rho^p = 1/(r + s + \lambda)$ and $\rho^f = 1/(r + \delta + \lambda)$. As mentioned above, $\rho^p > \rho^f$.

- Assume that $z^* > z^f$. (2.32) implies that $\rho^p z^* = (\rho^p - \rho^f) z^* + \rho^f z^* = \rho^p z^c + \rho^f (z^* - z^f)$. Since $z^* - z^f > 0$, the latter equality implies $z^* > z^c$.
- Assume that $z^* > z^c$. Again, jointly with algebraic manipulations, (2.32) implies that $\rho^f z^c = -(\rho^p - \rho^f) z^c + (\rho^p - \rho^f) z^* + \rho^f z^f > -(\rho^p - \rho^f) z^c + (\rho^p - \rho^f) z^c + \rho^f z^f > \rho^f z^f$, which entails that $z^c > z^f$.
- Assume that $z^c > z^f$. Algebraic manipulations and (2.32) imply that $(\rho^p - \rho^f) z^* = \rho^p (z^c - z^f) + (\rho^p - \rho^f) z^f > (\rho^p - \rho^f) z^f$, which implies $z^* > z^f$. \square

Proposition 2 Referring to (2.34),

- If open-ended workers are the only ones hired, then $\max [z^f, z^*] \leq z^f$, implying that $z^* \leq z^f$. Referring to proposition 2, the latter inequality entails $z^f \leq z^c$. As a result, $z^* \leq z^f \leq z^c$.

- If job creation is dual, then

$$\begin{cases} 0 < \max [z^f, z^*] \\ z^f < z^* \end{cases}$$

Using proposition 2, the latter system of inequalities boils down to $\max [0, z^f] < z^*$.

For each case, the converse propositions are straightforward using (2.34). \square

Proposition 3

- Considering the case where job creation is dual and there is endogenous destruction of open-ended jobs, We differentiate the different equations.

$$\frac{r + \xi}{r + s + \lambda} dz^p = \frac{\eta\gamma}{1 - \eta} d\theta - (r + s) dF$$

$$\frac{r + \delta}{r + \delta + \lambda} dz^f = \frac{\eta\gamma}{1 - \eta} d\theta$$

$$dz^c = dz^p + (r + s + \lambda) dF$$

$$\begin{aligned} \left(\frac{1}{r + s + \lambda} - \frac{1}{r + \delta + \lambda} \right) dz^* &= \frac{dz^c}{r + s + \lambda} - \frac{dz^f}{r + \delta + \lambda} \\ - \frac{\gamma q'}{(1 - \eta) q^2(\theta)} d\theta &= -(1 - G(z^*)) \left(\frac{1}{r + s + \lambda} - \frac{1}{r + \delta + \lambda} \right) dz^* - \left(1 - G(z^f) \right) \frac{dz^f}{r + \delta + \lambda} \end{aligned}$$

Substituting the expression of dz^p into the definition of dz^c , we get

$$\frac{dz^c}{r + s + \lambda} = \frac{1}{r + \xi} \left(\frac{\eta\gamma}{1 - \eta} d\theta + \lambda G(z^p) dF \right)$$

In turn, this expression for dz^c can be substituted into the definition of dz^* .

$$\left(\frac{1}{r + s + \lambda} - \frac{1}{r + \delta + \lambda} \right) dz^* = \frac{1}{r + \xi} \left(\frac{\eta\gamma}{1 - \eta} d\theta + \lambda G(z^p) dF \right) - \frac{1}{r + \delta + \lambda} dz^f$$

Reintroducing the expression of dz^f , the differentiated job creation condition becomes,

$$-\frac{\gamma q'}{(1-\eta)q^2(\theta)}d\theta = -\frac{1-G(z^*)}{r+\xi} \left[\frac{\eta\gamma}{1-\eta}d\theta + \lambda G(z^p)dF \right] - \frac{G(z^*)-G(z^f)}{r+\delta} \frac{\eta\gamma}{1-\eta}d\theta$$

As a result,

$$\frac{\partial\theta}{\partial F} = -\frac{\frac{1-G(z^*)}{r+\xi}\lambda G(z^p)}{-\frac{\gamma q'}{(1-\eta)q^2(\theta)} + \frac{\eta\gamma}{1-\eta} \left[\frac{1-G(z^*)}{r+\xi} + \frac{G(z^*)-G(z^f)}{r+\delta} \right]} < 0$$

This entails $\frac{\partial z^f}{\partial F} < 0$ and $\frac{\partial z^p}{\partial F} < 0$.

In addition,

$$\begin{aligned} \frac{\partial z^c}{\partial F} &\propto \frac{\eta\gamma}{1-\eta} \frac{\partial\theta}{\partial F} + \lambda G(z^p) \\ \frac{\partial z^c}{\partial F} &\propto -\frac{\gamma q'}{(1-\eta)q^2(\theta)} + \frac{G(z^*)-G(z^f)}{r+\delta} \frac{\eta\gamma}{1-\eta} > 0 \end{aligned}$$

Jointly with the fact that $\frac{\partial z^f}{\partial F} < 0$, We get that $\frac{\partial z^*}{\partial F} > 0$.

- When $z^p \leq 0$, we have that $\frac{\partial\theta}{\partial F} = 0$ and, consequently, $\frac{\partial z^f}{\partial F} = 0$ and $\frac{\partial z^c}{\partial F} = 0$. This leads to $\frac{\partial z^*}{\partial F} = 0$.
- Similar computations can be carried out for the other case, where job creation occurs through open-ended contracts only. The only change lies in the job creation condition.

$$-\frac{\gamma q'}{(1-\eta)q^2(\theta)}d\theta = -\frac{1-G(z^c)}{r+s+\lambda}dz^c$$

Introducing the expression of dz^c , the differentiated job creation condition becomes,

$$-\frac{\gamma q'(\theta)}{(1-\eta)q^2(\theta)}d\theta = -\frac{1-G(z^c)}{r+\xi} \left(\frac{\eta\gamma}{1-\eta}d\theta + \lambda G(z^p)dF \right)$$

As a result,

$$\frac{\partial \theta}{\partial F} = - \frac{\frac{1-G(z^c)}{r+\xi} \lambda G(z^p)}{-\frac{\gamma q'}{(1-\eta)q^2(\theta)} + \frac{\eta\gamma}{1-\eta} \frac{1-G(z^c)}{r+\xi}} < 0$$

and

$$\begin{aligned} \frac{\partial z^c}{\partial F} &\propto \frac{\eta\gamma}{1-\eta} \frac{\partial \theta}{\partial F} + \lambda G(z^p) \\ \frac{\partial z^c}{\partial F} &\propto - \frac{\gamma q'}{(1-\eta)q^2(\theta)} > 0 \end{aligned}$$

$\frac{\partial z^p}{\partial F} < 0$ is still true. \square

Proposition 4 To prove this result, we will rely on the two corner equilibria that are implicitly present in proposition 2.

- In the first case, consider the case where $z^f = z^c = z^* = \hat{z}$, which is the knife-edge case associated with proposition 1. In this case, the equilibrium is summed up by equations (2.34) and (2.25), where θ and z^f are respectively replaced by $\hat{\theta}$ and \hat{z} . Taking into account the fact that $z^f = z^c = z^*$ in the job creation equation, the two latter equations boil down to

$$\begin{aligned} \hat{z} &= \left(1 + \frac{\lambda}{r+\delta}\right) \left(b + \frac{\eta\gamma\hat{\theta}}{1-\eta}\right) - \frac{\lambda}{r+\delta} E_z \\ \frac{\gamma}{(1-\eta)q(\hat{\theta})} &= \int_{\hat{z}}^{+\infty} (1-G(z)) dz \end{aligned}$$

Given the equilibrium values $(\hat{\theta}, \hat{z})$, $z^c = \hat{z}$ along with (2.23) and (2.28) entail that F_1 verifies

$$\hat{z} - b - \lambda \hat{F} + \frac{\lambda}{r+s+\lambda} \int_{\hat{z}-(r+s+\lambda)F_1}^{+\infty} (1-G(z)) dz = \frac{\eta\gamma\hat{\theta}}{1-\eta}$$

Proposition 2 ensures that job creation only occurs through open-ended contracts. Replacing μ^f by zero in (2.38) demonstrates that $n^f = 0$ at the equilibrium.

A marginal increase in firing costs immediately entails an increase in z^c while z^f diminishes according to proposition 3. The initial situation being $z^f = z^c = \hat{z}$, we now face $z^f < \hat{z} < z^c$,

which is equivalent to $z^f < z^*$ as Proposition 1 states. Job creation is now dual, as asserts Proposition 2. Conversely, a marginal decrease in firing costs implies a cut in z^* and z^c as well as an increase in z^f , which results in $z^c < z^f$. The latter is equivalent to $z^* < z^c$ under proposition 2. The resulting equilibrium only involves open-ended contracts.

- In the second case, consider the case where $z^p = 0$. There is no endogenous destruction of open-ended matches. The equilibrium can be summed up by $(\tilde{F}, \theta, z^p, z^c, z^f, z^*)$ verifying equations (2.23), (2.25), (2.28), (2.32) and (2.34) under the additional constraint that $z^p = 0$.

2.C Dynamics

In this section, I describe the dynamics of the equilibrium after a shock to firing costs.

2.C.1 Dual-to-dual and classic-to-dual transitions

The comments made here also apply to the model that includes policy uncertainty.

Let us consider the model starting from the equilibrium defined by $(\theta_0, z_0^p, z_0^c, z_0^f, z_0^*)$ with firing costs F_0 at time $t = 0^-$ and the associated open-ended and fixed-term employment values n_0^p and n_0^f . The former tuple solely consists in forward looking variables. Therefore, assuming that firing costs jump from F_0 to F on time $t = 0$, the equilibrium tuple defined in definition 1 immediately jumps to its new value $(\theta, z^p, z^c, z^f, z^*)$. As for employment, notice that if $z^p > z_0^p$ - which occurs if $F < F_0$ - open-ended matches such that $z_0^p < z < z^p$ split right away. Denoting δ_0 Dirac function in 0, open-ended and fixed-term contracts, equations (2.35)-(2.36) are amended as follows

$$\begin{cases} \dot{n}_t^p &= -\xi n_t^p + \mu^p (1 - n_t^p - n_t^f) - \frac{G(\max\{z_0^p, z^p\}) - G(z_0^p)}{1 - G(z_0^p)} \delta_0 n_t^p \\ \dot{n}_t^f &= -\delta n_t^f + \mu^f (1 - n_t^p - n_t^f) \end{cases}$$

where ξ , μ^p and μ^f are computed as described in section 2.2.4 using the equilibrium tuple $(\theta, z^p, z^c, z^f, z^*)$.

Laplace transforms are particularly useful when it comes to solving systems of differential equations embedding Dirac functions. Denoting N^p and N^f the Laplace transforms of n^p and n^f , the latter system becomes

$$\begin{cases} sN^p(s) - n_0^p &= \frac{\mu^p}{s} - \alpha_0 n_0^p - (\xi + \mu^p) N^p(s) - \mu^p N^f(s) \\ sN^f(s) - n_0^f &= \frac{\mu^f}{s} - (\delta + \mu^f) N^f(s) - \mu^f N^p(s) \end{cases}$$

where $\alpha_0 = \frac{G(\max\{z_0^p, z^p\}) - G(z_0^p)}{1 - G(z_0^p)}$.

The system above being linear in $N^p(s)$ and $N^f(s)$, one may isolate the latter to obtain

$$\begin{aligned} N^p(s) &= \frac{(1 - \alpha_0)n_0^p s^2 + (\mu^p + (\delta + \mu^f)(1 - \alpha_0)n_0^p - \mu^p n_0^f) s + \delta \mu^p}{s(s^2 + (\xi + \delta + \mu^p + \mu^f)s + \xi\delta + \xi\mu^f + \mu^p\delta)} \\ N^f(s) &= \frac{n_0^f s^2 + (\mu^f + (\xi + \mu^p)n_0^f - \mu^f(1 - \alpha_0)n_0^p) s + \xi\mu^f}{s(s^2 + (\xi + \delta + \mu^p + \mu^f)s + \xi\delta + \xi\mu^f + \mu^p\delta)} \end{aligned}$$

The common denominator of these two expressions is a third-degree polynomial with three real roots: 0, α_1 and α_2 defined as

$$\begin{aligned} \alpha_1 &= \frac{1}{2} \left(-(\xi + \delta + \mu^p + \mu^f) + \sqrt{(\xi + \delta + \mu^p + \mu^f)^2 - 4(\xi\delta + \xi\mu^f + \mu^p\delta)} \right) \\ \alpha_2 &= \frac{1}{2} \left(-(\xi + \delta + \mu^p + \mu^f) - \sqrt{(\xi + \delta + \mu^p + \mu^f)^2 - 4(\xi\delta + \xi\mu^f + \mu^p\delta)} \right) \end{aligned}$$

Thus, $N^p(s)$ and $N^f(s)$ verify

$$N^p(s) = \frac{(1 - \alpha_0)n_0^p s^2 + (\mu^p + (\delta + \mu^f)(1 - \alpha_0)n_0^p - \mu^p n_0^f) s + \delta \mu^p}{s(s - \alpha_1)(s - \alpha_2)}$$

$$N^f(s) = \frac{n_0^f s^2 + \left(\mu^f + (\xi + \mu^p) n_0^f - \mu^f (1 - \alpha_0) n_0^p \right) s + \xi \mu^f}{s(s - \alpha_1)(s - \alpha_2)}$$

For $i \in \{p, f\}$, a partial fraction decomposition yields

$$N^i(s) = \frac{n_\infty^i}{s} + \frac{\rho_1^i}{s - \alpha_1} + \frac{\rho_2^i}{s - \alpha_2}$$

where n_∞^i , ρ_1^i and ρ_2^i verify

$$\begin{aligned} n_\infty^p &= \frac{\mu^p \delta}{\mu^p \delta + \xi \delta + \mu^f \xi} \\ n_\infty^f &= \frac{\mu^f \xi}{\mu^p \delta + \xi \delta + \mu^f \xi} \\ \rho_1^i &= -\frac{\alpha_1 A_i + B_i}{\alpha_2 - \alpha_1} \quad \forall i \in \{p, f\} \\ \rho_2^i &= \frac{\alpha_2 A_i + B_i}{\alpha_2 - \alpha_1} \quad \forall i \in \{p, f\} \end{aligned}$$

where

$$\begin{aligned} A_p &= (1 - \alpha_0) n_0^p - n_\infty^p \\ A_f &= n_0^f - n_\infty^f \\ B_p &= \mu^p + \left(\delta + \mu^f \right) (1 - \alpha_0) n_0^p - \mu^p n_0^f + (\alpha_1 + \alpha_2) n_\infty^p \\ B_f &= \mu^f + (\xi + \mu^p) n_0^f - \mu^f (1 - \alpha_0) n_0^p + (\alpha_1 + \alpha_2) n_\infty^f \end{aligned}$$

For all $i \in \{p, f\}$, using the inverse Laplace transform, we get

$$n_t^i = n_\infty^i + \rho_1^i \exp\{-\alpha_1 t\} + \rho_2^i \exp\{-\alpha_2 t\}$$

The classic-to-dual transition obeys the same equations with the only additional condition $n_0^f = 0$.

2.C.2 Dual-to-classic transition

Keeping the same notations as above, with the exception that the possibility to hire through fixed-term contracts is shut down after the reform. The resulting equilibrium is defined by the tuple (z^p, z^c, θ) which verifies equations (2.23), (2.28) and the modified job creation condition

$$\frac{\gamma}{(1-\eta)q(\theta)} = \frac{1}{r+s+\lambda} \int_{z^c}^{+\infty} (1-G(z)) dz \quad (2.C.1)$$

The only remaining transition probabilities on the labor market are the job-finding probability $\mu = p(\theta)(1-G(z^c))$ and the job-destruction probability ξ , which is left unchanged. Thus, the system of equation describing dynamics after the reform on time $t = 0$ is

$$\dot{n}_t^p = -\xi n_t^p + \mu(1 - n_t^p - n_t^f) - \alpha_0 \delta_0(t) n_t^p \quad (2.C.2)$$

$$\dot{n}_t^f = -\delta n_t^f \quad (2.C.3)$$

where α_0 is defined as in the dual-to-dual-reform paragraph.

(2.C.3) can be solved right away

$$n_t^f = n_0^f \exp\{-\delta t\}$$

As for (2.C.2), using Laplace transforms yield

$$sN^p(s) - n_0^p = \frac{\mu}{s} - (\xi + \mu)N^p(s) - \frac{\mu}{s + \delta} n_0^f - \alpha_0 n_0^p$$

id est

$$N^p(s) = \frac{(1 - \alpha_0)n_0^p s^2 + (\mu + (1 - \alpha_0)\delta n_0^p - \mu n_0^f) s + \mu \delta}{s(s + \delta)(s + \xi + \mu)}$$

A partial fraction decomposition yields

$$N(s) = \frac{n_{\infty}^p}{s} + \frac{\rho_1^p}{s + \delta} + \frac{\rho_2^p}{s + \xi + \mu}$$

where

$$\begin{aligned} n_{\infty}^p &= \frac{\mu}{\xi + \mu} \\ \rho_1^p &= \frac{\mu}{\delta - \xi - \mu} n_0^f \\ \rho_2^p &= ((1 - \alpha_0)n_0^p - n_{\infty}^p) - \frac{\mu}{\delta - \xi - \mu} n_0^f \end{aligned}$$

Using the inverse Laplace transform, n_t^p verifies

$$n_t^p = n_{\infty}^p + \rho_1^p \exp\{-\delta t\} + \rho_2^p \exp\{-(\xi + \mu)t\}$$

2.D The model with regulatory uncertainty

The Bellman equations defining the firms' and workers' programs now include the shock in firing costs. Firing costs become a new state variable. When a shock hits the latter, which occurs with probability ϵ , firing costs jumps to either F_1 or F_2 with an equal probability $1/2$ and the present discounted values adjust accordingly. Whenever possible, I simplify notations and substitute dependence in F_i with the corresponding subscripts $i \in \{1, 2\}$.

$$\begin{aligned} rV(F) &= -\gamma + q(\theta(F)) \int \max \left[J_0^p(z, F) - V(F), J^f(F) - V(F), 0 \right] dG(z) \\ &\quad + \epsilon \left(\frac{V_1 + V_2}{2} - V(F) \right) \end{aligned}$$

$$\begin{aligned}
rU(F) &= b + p(\theta(F)) \int \max [W_0^p(z', F) - U(F), W^f(z', F) - U(F), 0] dG(z') \\
&\quad + \epsilon \left(\frac{U_1 + U_2}{2} - U(F) \right) \\
rJ^p(z, F) &= z - w^p(z, F) + s(V - J^p(z, F)) + \lambda \int (\max [J^p(z', F), V(F) - F] - J^p(z, F)) dG(z') \\
&\quad + \epsilon \left(\frac{1}{2} \max [J^p(z, F_1), V_1 - F_1] + \frac{1}{2} \max [J^p(z, F_2), V_2 - F_2] - J^p(z, F) \right) \\
rW^p(z, F) &= w^p(z, F) + \lambda \int (\max [W^p(z', F), U(F)] - W^p(z, F)) dG(z') + s(U(F) - W^p(z, F)) \\
&\quad + \epsilon \left(\frac{1}{2} \max [W^p(z, F_1), U_1] + \frac{1}{2} \max [W^p(z, F_2), U_2] - W^p(z, F) \right) \\
rJ_0^p(z, F) &= z - w_0^p(z, F) + s(V(F) - J_0^p(z)) + \lambda \int (\max [J^p(z', F), V(F) - F] - J_0^p(z, F)) dG(z') \\
&\quad + \epsilon \left(\frac{1}{2} \max [J^p(z, F_1), V_1 - F_1] + \frac{1}{2} \max [J^p(z, F_2), V_2 - F_2] - J_0^p(z, F) \right) \\
rW_0^p(z, F) &= w_0^p(z, F) + \lambda \int (\max [W^p(z', F), U(F)] - W_0^p(z, F)) dG(z') + s(U(F) - W_0^p(z, F)) \\
&\quad + \epsilon \left(\frac{1}{2} \max [W^p(z, F_1), U_1] + \frac{1}{2} \max [W^p(z, F_2), U_2] - W_0^p(z, F) \right) \\
rJ^f(z, F) &= z - w^f(z, F) + \lambda \int (J^f(z', F) - J^f(z, F)) dG(z') + \delta (V(F) - J^f(z, F)) \\
&\quad + \epsilon \left(\frac{1}{2} J^f(z, F_1) + \frac{1}{2} J^f(z, F_2) - J^f(z, F) \right) \\
rW^f(z, F) &= w^f(z, F) + \lambda \int (W^f(z', F) - W^f(z, F)) dG(z') + \delta (U(F) - W^f(z, F)) \\
&\quad + \epsilon \left(\frac{1}{2} W^f(z, F_1) + \frac{1}{2} W^f(z, F_2) - W^f(z, F) \right)
\end{aligned}$$

Free entry implies $V_1 = V_2 = 0$. Taking into account the Nash-bargaining rules (2.1)–(2.3), the job creation condition is

$$\frac{\gamma}{(1-\eta)q(\theta(F))} = \int \max [S_0^p(z', F), S^f(z', F), 0] dG(z')$$

Considering the unemployed's value function, the previous equation and Nash-bargaining rules (2.1)–(2.3) imply

$$(r + \epsilon)U_i = \left(1 + \frac{\epsilon}{r}\right)b + \frac{\eta\gamma}{1 - \eta} \left(\theta_i + \frac{\epsilon}{r} \frac{\theta_1 + \theta_2}{2}\right)$$

Algebraic manipulations along with the Nash-bargaining assumption deliver the following expressions for surpluses

$$\begin{aligned} (r + s + \lambda + \epsilon)S^p(z, F) &= z - (r + \epsilon)U(F) + (r + s + \epsilon)F + \lambda \int \max [S^p(z', F), 0] dG(z') \\ &\quad + \frac{\epsilon}{2} (\max [S^p(z, F_1), 0] + \max [S^p(z, F_2), 0]) \\ &\quad + \epsilon \left(\frac{U_1 + U_2}{2} - \frac{F_1 + F_2}{2} \right) \end{aligned}$$

$$S_0^p(z, F) = S^p(z, F) - F$$

$$\begin{aligned} (r + \delta + \lambda + \epsilon)S^f(z, F) &= z - (r + \epsilon)U(F) + \lambda \int S^f(z', F) dG(z') \\ &\quad + \epsilon \left(\frac{S^f(z, F_1) + S^f(z, F_2)}{2} + \frac{U_1 + U_2}{2} \right) \end{aligned}$$

S^p is increasing in both z and F and has its values in \mathbb{R} . Thus, there exists z_1^p and z_2^p such that $S^p(z_1^p, F_1) = 0$ and $S^p(z_2^p, F_2) = 0$. Notice that $\partial S^p / \partial z$ does not depend on F and verifies

$$\frac{\partial S^p}{\partial z} = \begin{cases} \frac{1}{r+s+\lambda+\epsilon} & \text{if } z \leq z_2^p \\ \frac{1}{r+s+\lambda+\frac{\epsilon}{2}} & \text{if } z_2^p \leq z \leq z_1^p \\ \frac{1}{r+s+\lambda} & \text{if } z \geq z_1^p \end{cases}$$

Using an integration by parts, we know that z_1^p and z_2^p verify

$$\begin{aligned} & z_2^p - (r + \epsilon)U_2 + (r + s + \epsilon)F_2 + \epsilon \left(\frac{U_1 + U_2}{2} - \frac{F_1 + F_2}{2} \right) \\ & + \frac{\lambda}{r + s + \lambda + \frac{\epsilon}{2}} \int_{z_2^p}^{z_1^p} (1 - G(x)) dx + \frac{\lambda}{r + s + \lambda} \int_{z_1^p}^{+\infty} (1 - G(x)) dx = 0 \\ & z_1^p - (r + \epsilon)U_1 + (r + s + \epsilon)F_1 + \epsilon \left(\frac{U_1 + U_2}{2} - \frac{F_1 + F_2}{2} \right) \\ & + \frac{\lambda}{r + s + \lambda} \int_{z_1^p}^{+\infty} (1 - G(x)) dx + \frac{\epsilon}{2} \frac{z_1^p - z_2^p}{r + s + \lambda + \frac{\epsilon}{2}} = 0 \end{aligned}$$

The present discounted value of unemployment U depends on the firing cost through the labor market tightness, which accounts for the i subscript, with $i \in \{1, 2\}$. Their expressions still verify (2.18).

The derivative above yields another expression for S^p .

$$S^p(z, F_2) = \begin{cases} \frac{z - z_2^p}{r + s + \lambda + \epsilon} & \text{if } z \leq z_2^p \\ \frac{z - z_2^p}{r + s + \lambda + \frac{\epsilon}{2}} & \text{if } z_2^p < z < z_1^p \\ \frac{z - z_1^p}{r + s + \lambda} + \frac{z_1^p - z_2^p}{r + s + \lambda + \frac{\epsilon}{2}} & \text{if } z \geq z_1^p \end{cases}$$

$$S^p(z, F_1) = \begin{cases} \frac{z - z_2^p}{r + s + \lambda + \epsilon} + \frac{z_2^p - z_1^p}{r + s + \lambda + \frac{\epsilon}{2}} & \text{if } z \leq z_2^p \\ \frac{z - z_1^p}{r + s + \lambda + \frac{\epsilon}{2}} & \text{if } z_2^p < z < z_1^p \\ \frac{z - z_1^p}{r + s + \lambda} & \text{if } z \geq z_1^p \end{cases}$$

Considering the surplus of fixed-term contracts, $\partial S^f / \partial z$ equals $1 / (r + \delta + \lambda)$. One may define z_i^f such that $S^f(z_i^f, F_i) = 0$. Thus, another definition of S^f is

$$S^f(z, F_i) = \frac{z - z_i^f}{r + \delta + \lambda}$$

where thresholds z_i^f are such that

$$z_i^f = \frac{r + \delta + \lambda}{r + \delta + \epsilon} \left((r + \epsilon)U_i - \frac{\delta}{r + \delta} \epsilon \frac{U_1 + U_2}{2} \right) - \frac{\lambda}{r + \delta} E z$$

In the same manner, one may define z_i^c as $S_0^p(z_i^c, F_i) = 0$. Since for all $z \geq z_2^p$, $\partial S^p / \partial z = 1 / (r + s + \lambda) > 1 / (r + \delta + \lambda) = \partial S^f / \partial z$, there still exists z_i^* such that $S^f(z_i^*, F_i) = S_0^p(z_i^*, F_i)$, for $i \in \{1, 2\}$. I assume that ϵ and the distance between F_1 and F_2 is small enough so that $z_i^* > z_2^p$ for all $i \in \{1, 2\}$. In this case, z_i^* verify

$$\left(\frac{1}{r+s+\lambda} - \frac{1}{r+\lambda+\delta} \right) z_i^* = \frac{z_1^p}{r+s+\lambda} - \frac{z_1^p - z_2^p}{r+s+\lambda + \frac{\epsilon}{2}} 1_{\{i=2\}} + F_i - \frac{z_i^f}{r+\lambda+\delta}$$

As previously, assume that ϵ and the distance between F_1 and F_2 is small enough so that $z_i^c > z_2^p$ for all $i \in \{1, 2\}$, we can rewrite the job creation conditions (2.14), which pinpoint θ_i with $i \in \{1, 2\}$.

$$\frac{\gamma}{(1-\eta)q(\theta_i)} = \frac{1}{r+s+\lambda} \int_{\max[z_i^c, z_i^*]}^{+\infty} (1-G(z)) dz + \frac{1}{r+\delta+\lambda} \int_{z_i^f}^{\max[z_i^f, z_i^*]} (1-G(z)) dz$$

Consequently, the equilibrium can be summed up by a continuous time Markov process over space $\left\{ \left(\theta_i, z_i^p, z_i^c, z_i^f, z_i^* \right) \right\}_{i=1,2}$ with switching probability ϵ and 2x2 transition matrix filled with 1/2. See Appendix 2.C for the study of the corresponding dynamic behavior.

Chapter 3

Fluctuations in a Dual Labor Market

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Abstract

I build a New-Keynesian dynamic stochastic general-equilibrium model with a dual labor market. Firms and workers meet through a matching technology à-la Diamond-Mortensen-Pissarides and face a trade-off between productivity and flexibility at the hiring stage. All else equal, open-ended contracts are more productive than fixed-term contracts, but they embed a firing cost. The share of fixed-term contracts in job creation fluctuates endogenously, which enables to assess the resort to fixed-term contracts along the cycle and its response to different shocks. I estimate the model using a first-order perturbation method and classic Bayesian procedures with macroeconomic data from the Euro area. I find that the share of fixed-term contracts in job creation is counter-cyclical. The agents react to shocks essentially through job creation and the contractual composition of hires. Moreover, a general-equilibrium effect arises ; the substitution between fixed-term and open-ended contracts at the hiring stage influences the job seekers' stock, which in turn impacts job creation. Using my previous estimates and solving the model with a third-order perturbation method, I find that fixed-term employment reacts to negative aggregate demand shocks and uncertainty shocks oppositely. Thus, fixed-term employment could be used to identify uncertainty shocks in future research. As for inflation, changes in firing costs alter its dynamics, but its volatility remains the same as long as open-ended and fixed-term matches do not differ much in productivity all else equal.

JEL Classification: J42, J64, E31, E32, D81

Keywords: Fixed-term contracts, Employment protection, New Keynesian model, Inflation dynamics, Uncertainty

3.1 Introduction

In the 1980s, European governments introduced fixed-term contracts in labor markets otherwise characterized by stringent employment protection legislations. Employment protection changes the way firms compose their staff. In this manner, employment protection impacts the firms' pricing decisions in response to shocks on demand and costs and, thus, impact inflation dynamics. Fixed-term contracts being more flexible than regular contracts, they should be one of firms' preferred tools to deal with shocks, especially if pricing decisions are constrained. As a result, fixed-term employment fluctuations should reflect well firms' changes in expected costs and demand. Fixed-term employment could thus play the role of a short-term macroeconomic indicator if its fluctuations are better understood. The literature has seldom considered fluctuations in dual labor markets and its response to shocks. I try to bridge that gap.

How does a dual labor market respond to most common types of shocks? How does dualism impact inflation dynamics? To address these questions, I estimate a New-Keynesian dynamic stochastic general-equilibrium model with a dual labor market using Euro area data. The New-Keynesian block of the economy remains classic. As for the labor market, I extend the traditional Diamond-Mortensen-Pissarides framework to embed fixed-term and open-ended contracts. Firms post vacancies, unemployed workers search for a job and firm-worker pairs arise following a matching function. New firm-worker pairs differ in quality and optimally choose between going back to search, or carrying on either with an open-ended or a fixed-term contract. While laying off an unprofitable open-ended contract entails the payment of a firing cost, fixed-term contracts split at zero cost and are less productive all else equal. Thus, a trade-off between productivity and flexibility drives the choice between a fixed-term and an open-ended hire. When the quality of the match is high enough, the productivity gains overcome the future payment of firing costs in bad times; the best way to make the most out of the match is hiring through an open-ended contract. Otherwise, the fear of firing costs prevails and a fixed-term contract is preferred.

I estimate the log-linearized model on quarterly data from the Euro area. Overall, the model is able to fit the cyclical features of a dual labor market despite being estimated on classic general macroeconomic time series — Output, nominal interest rates, inflation and employment. One main

contribution is the model ability to account for the fluctuations in contractual composition of hires. It is not the case in the few references studying business cycles and dualism. The model fits well the counter-cyclical of the share of fixed-term contracts in job creation. Solving the estimated model with a third-order perturbation method, I find that fixed-term employment responds oppositely to a negative aggregate demand shock and to a volatility shock on aggregate productivity. This result suggests that fixed-term employment could be used to tell apart uncertainty shocks and negative aggregate demand shocks, which is a well-known difficulty in the literature. My last main contribution involves inflation dynamics. I find that dualism does not impact inflation volatility as long as the *ex ante* productivity wedge between open-ended and fixed-term contracts remains small.

The assumption that fixed-term workers produce less than open-ended workers *ceteris paribus* is fundamental to obtain a dual labor market as equilibrium. If fixed-term and open-ended workers with the same idiosyncratic quality produced the same, hires would involve either fixed-term workers or open-workers only. While fundamental, my assumption substantiates with empirical work. Fixed-term workers are likely to undergo successions of short employment periods and long unemployment spans (Fontaine and Malherbet, 2016). Pissarides (1992) shows that the latter reduce concerned workers' skills. Moreover, fixed-term workers benefit less from on-the-job training². The productivity-flexibility trade-off is highlighted in several papers related to labor market dualism. Caggese and Cuñat (2008) introduces fixed-term contracts, which are less productive than open-ended contracts by assumption, in firms with a decreasing-return-to-scale technology. Firms hire open-ended contracts until the productivity gains are offset by the expected losses from costly separations, and hire fixed-term contracts beyond that point.

Explaining business cycles in a dual labor market requires relevant labor market data. As far as I know, it does not exist on a quarterly basis concerning the Euro area. Thus, I assess the fit of the model using French data from the *Dares*. Beyond the counter-cyclical share of fixed-term hires mentioned above, open-ended job creation and destruction flows are more volatile than their fixed-term counterparts. While open-ended job destruction is counter-cyclical, fixed-term job destruction is pro-cyclical. The short duration of fixed-term contracts explains this counter-intuitive result; as most fixed-term contracts last less than a quarter, demand boosts fuel fixed-term job creation that

²See Arulampalam and Booth (1998); Arulampalam et al. (2004); Albert et al. (2005); Cutuli and Guetto (2012)

expire within the same quarter. My model also replicates the Beveridge curve. Real business cycles with frictional labor markets a-la Mortensen Pissarides mimic the negative correlation between unemployment and vacancies with difficulty. Talking about dynamics, a substitution effect and general-equilibrium effect shape the labor market. Shocks change the contractual composition of job creation — substitution effect —, which in turn impacts the size of the job seekers' pool and influences job creation — general-equilibrium effect.

Firms resort to fixed-term contracts to cope with uncertainty and demand fluctuations (Rémy, 2017). On the one hand, Saint-Paul (1996) explains that fixed-term employment acts as a securing buffer to open-ended workers. In the doldrums, firms lay off fixed-term workers and leave open-ended employment as unchanged as possible to avoid firing costs. Firms restore fixed-term employment during booms. Thus, a negative aggregate demand shock leads to a decrease in fixed-term employment. On the other hand, bolstered uncertainty encourages firms to postpone open-ended hires and opt for fixed-term hires instead³. Fixed-term employment should increase following an increase in uncertainty. My model is consistent with both views ; fixed-term employment decreases after an aggregate demand shock and increases after an uncertainty shock. It suggests that fixed-term employment could be used in future research as a way to identify uncertainty shocks.

My paper relates to three branches of the literature. First, a few papers have tried to measure the cyclical properties of dual labor markets and account for the higher volatility on its fixed-term side. Sala and Silva (2009), Costain et al. (2010) and Sala et al. (2012) are the closest papers in that regard. These papers either assume that job creation only occurs through fixed-term contracts, or that the share of fixed-term contracts in job creation is exogenous. I depart from this approach as I do not rule out contractual substitution effects in job creation, which involves both open-ended and fixed-term contracts. In that regard, I can study the fluctuations in the contractual composition of hires.

Secondly, my paper is close to a few papers in the DSGE literature⁴ that assess the impact of firing costs on macroeconomic variables. The closest paper is Thomas and Zanetti (2009), which builds a model with a Mortensen-Pissarides framework into a traditional New Keynesian framework. Firing

³Bloom (2014) highlights that firm are more reluctant to go for investments requiring fixed costs in uncertain times.

⁴A few seminal papers in the DSGE literature include Smets and Wouters (2007), Christiano et al. (2005), Gertler et al. (2008), Trigari (2009), Blanchard and Galí (2010) and Christiano et al. (2016)

costs protect employed workers. The model is estimated on Euro area data. Thomas and Zanetti (2009) finds that changes in firing costs do not impact inflation volatility. My findings corroborate this result: while a 5-percent cut in firing costs significantly alters the cyclical properties of labor market variables, inflation volatility remain the same. However, the study of inflation components shows that their behavior changes much in response to a change in firing costs. The neutrality of firing costs with respect to inflation volatility rests on the small value of the *ex ante* contractual productivity wedge. Using similar tools as Thomas and Zanetti (2009), Zanetti (2011) finds that firing costs decrease the volatility of output, employment and job flows. Thus, the higher firing costs, the more rigid is the labor force and the more firms adjust prices in response to shocks. I depart from the approach of Thomas and Zanetti (2009) and Zanetti (2011) and introduce fixed-term contracts. My intuition is that fixed-term contracts mitigate the need for stronger price adjustments firing costs alone may encourage.

Thirdly, my paper also relates to the literature explaining the macroeconomic impact of risk. Bloom (2009) shows that uncertainty shocks encourage firms to postpone hiring and investment decisions when they face adjustment costs. A difficulty in this literature is identifying uncertainty shocks. For example, Leduc and Liu (2016) asserts that uncertainty shocks have the same effect as negative aggregate demand shocks: both increase unemployment and decrease inflation⁵. In my model, the different behavior of fixed-term employment in front of negative demand shocks and uncertainty shocks may provide a way to disentangle both types of shocks.

The paper is organized as follows. Section 2 presents the model. Section 3 exposes the calibration and estimation procedure. Section 4 displays the main experiments. Section 5 concludes.

3.2 Model

The model follows a discrete timing and embeds 3 types of agents; the households, the firms and the government. Households can be unemployed or employed through a fixed-term or an open-ended contract. Three types of firms coexist. Perfectly competitive firms produce the final good valued by households for consumption and investment. Final good producers aggregate the differentiated

⁵In the same vein, see also Jurado et al. (2015) and Fasani and Rossi (2018)

goods produced by the retailers. Retailers are in monopolistic competition and transform the homogeneous intermediate good into a differentiated retail good. Intermediate-good firms produce the associated intermediate good and experience perfect competition. Intermediate firms use labor as their only input. Figure 3.2.1 sums up the structure of the model. I now describe the behavior of the different types of agents in more detail.

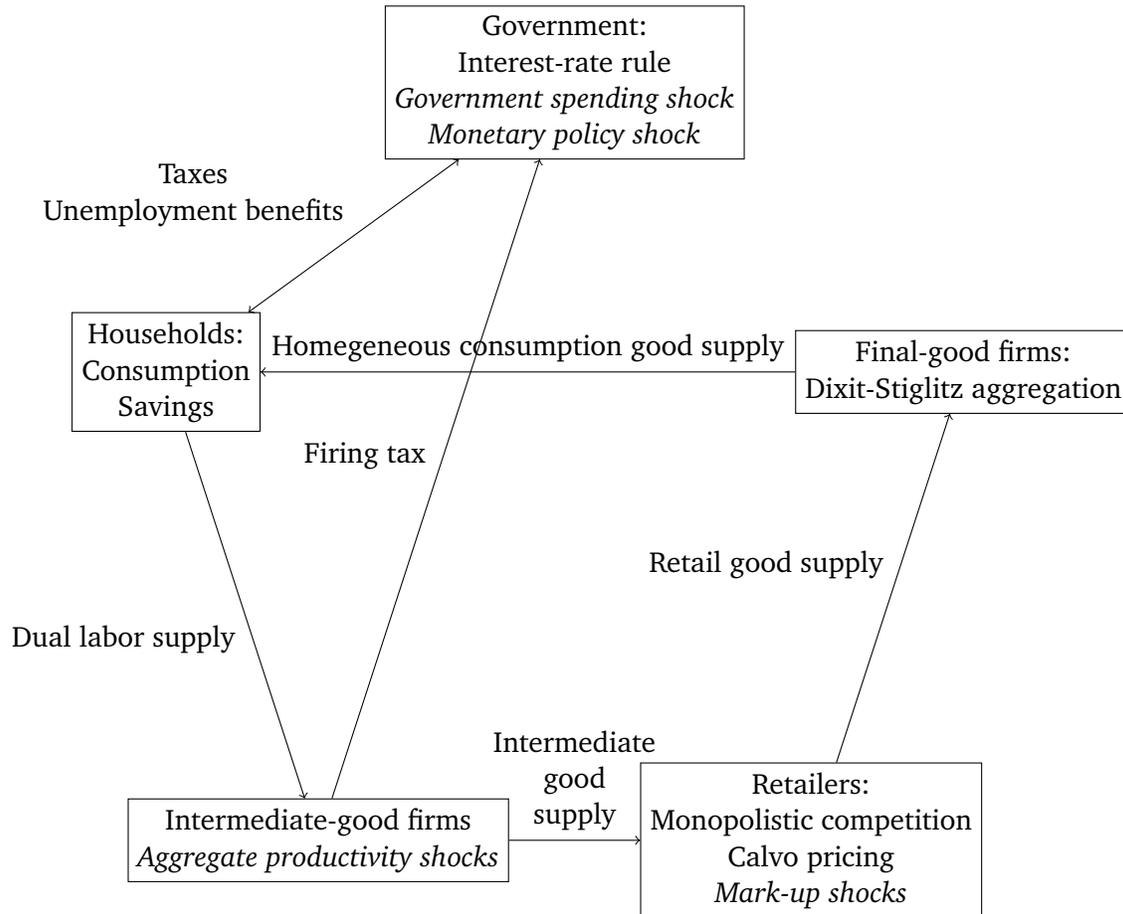


Figure 3.2.1: An overview of the structure of the model

3.2.1 Households

Households are identical and constitute a continuum represented by the interval $(0, 1)$. They can be employed under a fixed-term or an open-ended contract, or unemployed. They earn wages or unemployment benefits accordingly. Households also hold firms, consume the homogeneous good produced by final good firms, save using one-period nominal bonds, earn interests on their savings and pay lump-sum taxes. Hence, I assume that taxes do not distort the choice of households over

consumption and investment. I do not consider the interplay between payroll taxes and labor market dualism.

If households are identical *ex ante*, their different employment histories make them heterogeneous *ex post*. How labor market dualism impacts the consumption and saving behavior of households is beyond the scope of this paper. As Merz (1995) and Andolfatto (1996) first did, I assume that households pool revenues and that capital markets are perfect. Thereby, I rule out the complication heterogeneity brings on. Households share equal consumption and investments. This assumption is not innocuous: unemployed, open-ended and fixed-term workers have different borrowing constraints and Lise (2013) shows that assets shape the search behavior. I leave these issues for future research.

The household's program boils down to

$$\begin{aligned} & \max_{\{c_t, B_{t+1}\}_{t=0}^{+\infty}} \mathbb{E}_0 \sum_{t=0}^{+\infty} \beta^t u(c_t) \\ \text{s.t. } & c_t + \frac{B_{t+1}}{P_t} = R_{t-1} \frac{B_t}{P_t} + \overline{w}_t^p n_t^p + \overline{w}_t^f n_t^f + b u_t + \Pi_t - \tau_t \end{aligned}$$

C_t marks down consumption. B_t is the amount of nominal bond holdings at the beginning of period t , with the associated nominal interest rate R_t between t and $t + 1$. $\overline{w}_t^p, \overline{w}_t^f$ denote the average real wages for open-ended jobs and fixed-term jobs. b denotes the unemployment benefits. n_t^p is the aggregate open-ended employment and n_t^f denotes its fixed-term counterpart. u_t marks down the measure of non-employed households. Firms transfer their profits to households through Π_t , while the government taxes τ_t to finance the payment of unemployment benefits.

The first order conditions with respect to c_t and B_{t+1} lead to the following Euler equation

$$u'(c_t) = \beta \mathbb{E}_t \left[R_t \frac{P_t}{P_{t+1}} u'(c_{t+1}) \right] \quad (3.2.1)$$

As households own firms, firms discount profits of date s from date t with the factor $\beta_{t,s} = \beta^{s-t} u'(c_s) / u'(c_t)$.

3.2.2 Final good firms

Final good firms are identical and compete to produce the good consumed by households. They put together retail goods through a Dixit-Stiglitz technology and produce Y_t .

$$Y_t = \left(\int_0^1 Y_{i,t}^{\frac{\epsilon_t-1}{\epsilon_t}} di \right)^{\frac{\epsilon_t}{\epsilon_t-1}} \quad (3.2.2)$$

where ϵ_t is the elasticity of substitution between retail goods.

The firm takes as given the price of the retail goods $P_{i,t}$ and the price of the final good P_t and maximizes its profits with respect to the components of its input $\{Y_{i,t}\}_{i \in (0,1)}$ under the constraint (3.2.2). The program of the final good firm boils down to

$$\begin{aligned} \max_{\{Y_{i,t}\}_{i \in [0,1]}} \quad & P_t Y_t - \int_0^1 P_{i,t} Y_{i,t} di \\ \text{subject to} \quad & (3.2.2) \end{aligned}$$

The subsequent first order condition provides an expression for the demand of retail good i .

$$Y_{i,t} = \left(\frac{P_{i,t}}{P_t} \right)^{-\epsilon_t} Y_t \quad (3.2.3)$$

3.2.3 Retailers

Retailers buy goods from intermediate firms and sell the obtained production to final good producer. They are in monopolistic competition and lie on the interval $(0, 1)$. Retailers accomplish the one-to-one transformation of the intermediate good into a retail good. Denoting $X_{i,t}$ retailer i 's input in the intermediate good, the production technology writes

$$Y_{i,t} = X_{i,t}$$

As a result, retailers face a real marginal cost that equals the relative price of the intermediate good ϕ_t . I assume that retailers adjust prices as Calvo (1983) describes.

$$P_{i,t} = \begin{cases} P_{i,t-1} & \text{with probability } \psi \\ P_{i,t}^* & \text{with probability } 1 - \psi \end{cases}$$

A fraction ψ of retailers is able to adjust its prices to the optimal value $P_{i,t}^*$, whereas the remaining retailers stick to their former prices. There is no indexation of non-adjusted prices on inflation in this model. The price-setting retailer i at period t has the following program.

$$\begin{aligned} \max_{P_{i,t}^*} \mathbb{E}_t \sum_{T=t}^{+\infty} \beta_{t,T} \psi \left(\frac{P_{i,t}^*}{P_T} - \phi_T \right) Y_{i,T} \\ \text{subject to } Y_{i,T} = \left(\frac{P_{i,t}^*}{P_T} \right)^{-\epsilon_T} Y_T \end{aligned}$$

It leads to the following first order condition.

$$\mathbb{E}_t \sum_{T=t}^{+\infty} \beta_{t,T} \psi \left(\frac{P_{i,t}^*}{P_T} - \mu_T \phi_T \right) = 0 \quad (3.2.4)$$

$\mu_t = \epsilon_t / (\epsilon_t - 1)$ is a mark-up shock such that $\mu_t = \epsilon / (\epsilon - 1) e^{\epsilon_t^\mu}$, with $\epsilon_t^\mu \stackrel{iid}{\sim} \mathcal{N}(0, \widehat{\sigma}_\mu^2)$.

3.2.4 Intermediate good firms and the labor market

Intermediate-good firms use labor as sole input. They can employ one worker or maintain one vacancy. Workers can be unemployed or employed under a fixed-term or an open-ended contract. They are identical. There is no on-the-job search, which implies that only unemployed workers search for a job. When a firm and a worker meet, the idiosyncratic productivity of the match z is revealed. I assume that the idiosyncratic productivity of a match is i.i.d across time and drawn from a distribution with cumulative distribution function G . I reluctantly make this assumption for the sake

of simplicity. With persistent idiosyncratic productivity, the computation of the equilibrium requires keeping track of the productivity distribution of matches as a state variable. Since the literature considering cycles and dual labor market is in early stages, I prefer to leave the distributional issues for future research. Matches also face an aggregate productivity shock A_t with process $\log(A_t) = \rho_A \log(A_{t-1}) + \epsilon_t^A$, where $\epsilon_t^A \stackrel{iid}{\sim} \mathcal{N}(0, \sigma_A^2)$.

The number of firm-worker contacts per period is $m(e, v)$, where e is the number of job-seekers and v is the number of vacancies. A classic measure of the matching activity is the labor market tightness $\theta = v/e$. The matching function m has constant returns to scale, which enables the definition of the firm-worker meeting probability $p(\theta)$ on the job seeker's side and its counterpart $q(\theta)$ on the firm's side.

$$q = \frac{m(e, v)}{v} = m(\theta^{-1}, 1)$$

$$p = \frac{m(e, v)}{e} = m(1, \theta) = \theta q(\theta)$$

p is increasing in labor market tightness, whereas q is decreasing in labor market tightness. Note that the meeting probabilities are not the classic job-finding and vacancy-filling probabilities. A firm-worker meeting does not lead to production if the idiosyncratic productivity is too low.

The timing in the economy is summed up in Figure 3.2.4. At the beginning of the period, agents learn the value of shocks and firms manage their workforce accordingly. They lay off poorly productive workers and post vacancies. Next, new matches are revealed. Workers fired in the current period are able to participate to the present meeting round. Hence, I avoid understating labor market flows as most fixed-term contracts last less than a quarter: fixed-term jobs last 1.5 months on average in France (Milin, 2018). Finally, production is carried out, firms pay for wages and firing costs, households consume, and the period ends.

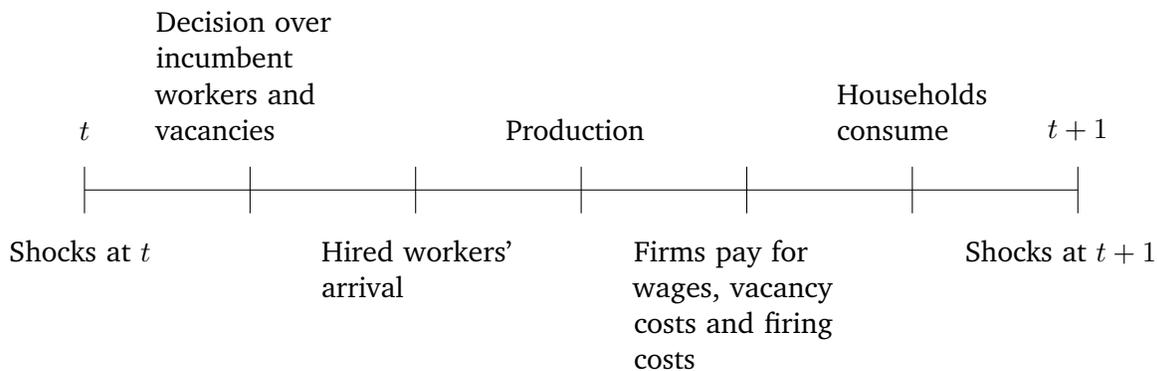


Figure 3.2.2: The timing of the economy

Vacancies When paired with a worker, firms hire through a fixed-term contract or an open-ended contract. They can also return searching for a worker and get the chance to be matched with another one on the next period. Job creation is unconstrained; firms choose the actions that maximize their surpluses. The present discounted value of a vacancy V_t bears witness of these different options:

$$V_t = -\gamma + q(\theta_t) \int \max \left[J_t^{0,p}(z), J_t^f(z), \mathbb{E}_t \beta_{t,t+1} V_{t+1} \right] dG(z) + (1 - q(\theta_t)) \mathbb{E}_t \beta_{t,t+1} V_{t+1} \quad (3.2.5)$$

where γ is the cost of a vacancy, $J_t^{0,p}$ is the firm's surplus with a new open-ended match. I denote J_t^p its counterpart for continuing open-ended matches. J_t^f is the firm's surplus with a fixed-term match. The workers' surpluses are denoted W , while the total surpluses are denoted S .

Surplus sharing I assume that wages are set each period by Nash bargaining. It is not realistic considering the evidence supporting rigidity in wages. In addition, wage flexibility seems inconsistent with the stickiness of retailers' prices. Still, I leave rigid wages for future research. Tractability motivates the use of Nash bargaining. It makes hiring and firing decisions jointly efficient and only dependent on the total surplus of a match. Denoting η the worker's share of the match surplus, the sharing rules write

$$W_t^p(z_t) - U_t = \eta S_t^p(z_t) \quad (3.2.6)$$

$$W_t^{0,p}(z_t) - U_t = \eta S_t^{0,p}(z_t) \quad (3.2.7)$$

$$W_t^f(z_t) - U_t = \eta S_t^f(z_t) \quad (3.2.8)$$

Total surpluses verify

$$S_t^p(z_t) = J_t^p(z_t) - (V_t - F_t) + W_t^p(z_t) - U_t \quad (3.2.9)$$

$$S_t^{0,p}(z_t) = J_t^{0,p}(z_t) - V_t + W_t^{0,p}(z_t) - U_t \quad (3.2.10)$$

$$S_t^f(z_t) = J_t^f(z_t) - V_t + W_t^f(z_t) - U_t \quad (3.2.11)$$

where U_t is the value of unemployment at the beginning of period t . The outside option of workers includes taking part in current period's market trades and earning the unemployment benefit if no beneficial meeting occurred. U_t^0 is the present discounted utility of workers who have not found a job on period t .

$$U_t = p(\theta_t) \int \max(W_t^{0,p}(z), W_t^f(z), U_t^0) dG(z) + (1 - p(\theta_t)) U_t^0 \quad (3.2.12)$$

$$U_t^0 = b + \mathbb{E}_t \beta_{t,t+1} U_{t+1} \quad (3.2.13)$$

In (3.2.9)-(3.2.11), note that the surplus of incumbent open-ended matches includes firing costs, while the one of new open-ended workers does not. In case of disagreement during wage bargaining, a newly paired worker goes back to the pool of job seekers and the firm does not pay firing costs. That way, I do not overstate the role of firing costs.

Now, I describe the open-ended and the fixed-term contracts as well as the associated surpluses.

Open-ended contracts A continuing open-ended contract delivers the wage w_t^p and stipulates a firing tax F . An open-ended match may separate with the exogenous probability s . In this case, the separation bears no cost. Otherwise, the firm chooses whether it keeps or lays off the worker regarding the idiosyncratic productivity of the match. An endogenous separation entails the payment of the firing cost and the opening of a new vacancy. Hence, a firm with an incumbent open-ended worker has the following surplus

$$J_t^p(z_t) = \phi_t A_t z_t - w_t^p(z_t) + \mathbb{E}_t \beta_{t,t+1} \left\{ (1-s) \int \max [J_{t+1}^p(z), V_{t+1} - F] dG(z) + sV_{t+1} \right\} \quad (3.2.14)$$

An incumbent open-ended worker earns a wage and may leave with probability s . If he does not, he faces a productivity shock and the match may split if the latter shock is adverse enough. Laid-off or quitting workers go back to the job seekers' pool immediately and are therefore eligible to participate to firm-worker contacts in the current period. Otherwise, the match goes on.

$$W_t^p(z_t) = w_t^p(z_t) + \mathbb{E}_t \beta_{t,t+1} \left\{ (1-s) \int \max [W_{t+1}^p(z), U_{t+1}] dG(z) + sU_{t+1} \right\} \quad (3.2.15)$$

New open-ended workers have a different wage function $w_t^{0,p}$: their outside option does not include the payment of the firing cost in case of disagreement during the wage bargaining and the possibility to search for a new job in case of disagreement. After one-period, if there is no separation, a wage renegotiation occurs because idiosyncratic productivity changed. The firm pays firing costs if an endogenous split occurs. Otherwise, the firm's continuation value is the expected surplus of an incumbent open-ended contract.

$$J_t^{0,p}(z_t) = \phi_t A_t z_t - w_t^{0,p}(z_t) + \mathbb{E}_t \beta_{t,t+1} (1-s) \left\{ \int_{z_{t+1}^p}^{+\infty} J_{t+1}^p(z) dG(z) - G(z_{t+1}^p) F + sV_{t+1} \right\} \quad (3.2.16)$$

$$W_t^{0,p}(z_t) = w_t^{0,p}(z_t) + \mathbb{E}_t \beta_{t,t+1} \left\{ (1-s) \int \max (W_{t+1}^p(z), U_{t+1}) dG(z) + sU_{t+1} \right\} \quad (3.2.17)$$

In this paper, I consider firing costs instead of severance payments. Indeed, severance payments are pure transfers between firms and workers. They do not impact the joint surplus of a match. As a result, severance payments do not directly shape job destruction decisions. They increase wages, though; on each period, severance payments are part of the workers' outside option in case of a disagreement over negotiated wages. The fact that firms and workers renegotiate wages each period explains why severance payments raise workers' wages. The impact of severance payments can be utterly offset in the bargaining process if there is enough commitment⁶. Without renegotiations, the pre-hiring bargaining of wages can utterly wipe out the impact of severance payments to reach the efficient employment level. On the contrary, firing costs, alter the joint surplus of the match and is still push up wages. They increase wages through the stronger workers' outside option and directly alter job destruction decisions. Firing costs alter labor market outcomes through more channels than severance payments do.

Fixed-term contracts A fixed-term contract stipulates the wage function w_t^f . Fixed-term matches split with the exogenous probability δ . I assume that fixed-term contracts yield a lower productivity than open-ended matches with a factor $\rho < 1$. I discuss this assumption in detail below. Firms value the immediate production net of the wage. As for the continuation value, it simply embeds the possibility of an exogenous separation shock.

$$J_t^f(z_t) = \rho A_t z_t \phi_t - w_t^f(z_t) + \mathbb{E}_t \beta_{t,t+1} \left\{ (1 - \delta) \int J_{t+1}^f(z) dG(z) + \delta V_{t+1} \right\} \quad (3.2.18)$$

Fixed-term workers immediately value their wages. In case of a separation, they can immediately indulge in labor market trades.

$$W_t^f(z_t) = w_t^f(z_t) + \mathbb{E}_t \beta_{t,t+1} \left\{ (1 - \delta) \int W_{t+1}^f(z) dG(z) + \delta U_{t+1} \right\} \quad (3.2.19)$$

Using the different definitions of the firms' and the workers' surpluses, the total surpluses write⁷

⁶Lazear (1990) lays out this idea in more detail.

⁷Detailed calculations are available in Appendix 3.B.1

$$S_t^p(z_t) = A_t z_t \phi_t - b - \frac{\eta \gamma \theta_t}{1 - \eta} + (1 - \mathbb{E}_t \beta_{t,t+1}(1 - s)) F + \mathbb{E}_t \beta_{t,t+1}(1 - s) \int \max(S_{t+1}^p(z), 0) dG(z) \quad (3.2.20)$$

$$S_t^{0,p}(z_t) = S_t^p(z_t) - F \quad (3.2.21)$$

$$S_t^f(z_t) = \rho A_t z_t \phi_t - b - \frac{\eta \gamma \theta_t}{1 - \eta} + \mathbb{E}_t \beta_{t,t+1}(1 - \delta) \int S_{t+1}^f(z) dG(z) \quad (3.2.22)$$

As intended, the surplus of continuing open-ended workers includes firing costs in case of endogenous separations. It increases the continuing open-ended worker's threat point in Nash bargaining and pushes up his wage. The new open-ended workers does not benefit from this effect since a failure in the bargaining process does not entail the payment of F . The total surplus of fixed-term workers shows the productivity gap ρ in the flows and the exogenous termination of the contract in the continuation value. Fixed-term contracts struck by a job destruction shock split regardless the productivity of the match.

Using the firms' surpluses, joint surpluses and the surplus sharing rules, wages verify

$$w_t^p(z_t) = \eta (A_t z_t \phi_t + (1 - E_t \beta_{t,t+1}(1 - s)) F + \gamma \theta_t) + (1 - \eta) b \quad (3.2.23)$$

$$w_t^{0,p}(z_t) = \eta (A_t z_t \phi_t - E_t \beta_{t,t+1}(1 - s) F + \gamma \theta_t) + (1 - \eta) b \quad (3.2.24)$$

$$w_t^f(z_t) = \eta (\rho A_t z_t \phi_t + \gamma \theta_t) + (1 - \eta) b \quad (3.2.25)$$

$$(3.2.26)$$

The new open-ended worker is penalized with higher firing costs to compensate the future wage gains in case of continuation. Moreover, labor market tightness increases the outside option of workers through the higher probability of finding a job, which increases wages.

3.2.5 Job creation and job destruction

I assume there is free entry on vacancy posting.

$$V_t = 0 \tag{3.2.27}$$

The job creation condition stems from the free-entry condition (3.2.27) and the Bellman equation defining the present discounted value of an unfilled vacancy (3.2.5). Using the Nash-sharing rules (3.2.7)-(3.2.8), the job creation condition becomes

$$\frac{\gamma}{(1-\eta)q(\theta_t)} = \int \max [S_t^{0,p}(z), S_t^f(z), 0] dG(z) \tag{3.2.28}$$

The choice between fixed-term and open-ended contracts lies in the comparison of joint surpluses across contracts. Notice that $\partial S_t^{0,p} / \partial z_t = A_t \phi_t > \rho A_t \phi_t = \partial S_t^f / \partial z_t$. Thus, there exists a productivity threshold z_t^* above which open-ended contracts are preferable to fixed-term ones.

$$S_t^{0,p}(z_t^*) = S_t^f(z_t^*) \tag{3.2.29}$$

I also define the threshold z_t^p below which an incumbent open-ended match splits. Similarly, fixed-term contracts become profitable when productivity exceeds z_t^f . I denote z_t^c the analogous threshold for new open-ended contracts.

$$S_t^p(z_t^p) = 0 \tag{3.2.30}$$

$$S_t^f(z_t^f) = 0 \tag{3.2.31}$$

$$S_t^{0,p}(z_t^c) = 0 \tag{3.2.32}$$

Joint surpluses are linear in z_t . I can rewrite them using (3.2.30)-(3.2.31).

$$S_t^p(z) = A_t \phi_t (z - z_t^p) \quad (3.2.33)$$

$$S_t^f(z) = \rho A_t \phi_t (z - z_t^f) \quad (3.2.34)$$

As a result, a new definition of z_t^* stems from (3.2.29), (3.2.33) and (3.2.34).

$$(1 - \rho)z_t^* = z_t^c - \rho z_t^f \quad (3.2.35)$$

Using the expressions of total surpluses (3.2.20)-(3.2.22), the definition of thresholds (3.2.30)-(3.2.32) and integrations by part, productivity thresholds verify

$$\begin{aligned} & A_t z_t^p \phi_t + (1 - \mathbb{E}_t \beta_{t,t+1} (1 - s)) F + \mathbb{E}_t \beta_{t,t+1} (1 - s) A_{t+1} \phi_{t+1} \int_{z_{t+1}^p}^{+\infty} (1 - G(z)) dG(z) \\ &= b + \frac{\eta \gamma \theta_t}{1 - \eta} \end{aligned} \quad (3.2.36)$$

$$A_t \phi_t z_t^c = A_t \phi_t z_t^p + F \quad (3.2.37)$$

$$\rho A_t z_t^f \phi_t + \rho \mathbb{E}_t \beta_{t,t+1} (1 - \delta) A_{t+1} \phi_{t+1} (\mathbb{E} z - z_{t+1}^f) = b + \frac{\eta \gamma \theta_t}{1 - \eta} \quad (3.2.38)$$

Using these thresholds and integrations by part, I rewrite the job creation condition (3.2.28).

$$\frac{\gamma}{(1 - \eta) q(\theta_t) A_t \phi_t} = \int_{\max[z_t^c, z_t^*]}^{+\infty} (1 - G(z)) dz + \rho \int_{z_t^f}^{\max[z_t^c, z_t^*]} (1 - G(z)) dz \quad (3.2.39)$$

The following proposition sums up job creation.

Proposition 5. Given $(z_t^p, z_t^c, z_t^f, z_t^*)$,

- if $z_t^* \leq z_t^f \leq z_t^c$, job creation is carried out through open-ended contracts only. It occurs when $z \geq z_t^c$ as figure 3.2.3 shows.

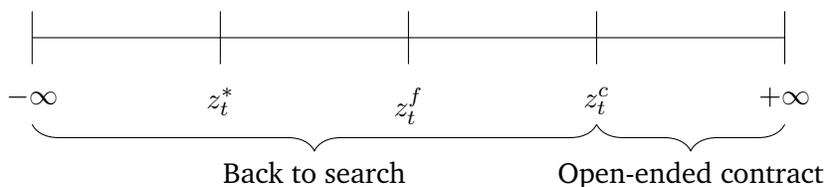


Figure 3.2.3: Open-ended hires only

- Otherwise, necessarily, $z_t^c \leq z_t^f \leq z_t^*$: job creation is carried out through both open-ended contracts and fixed-term contracts. Fixed-term contracts are hired when $z \in (z^f, z^*)$ and open-ended contracts are hired when $z \in (z^*, +\infty)$. Figure 3.2.4 sums it up.

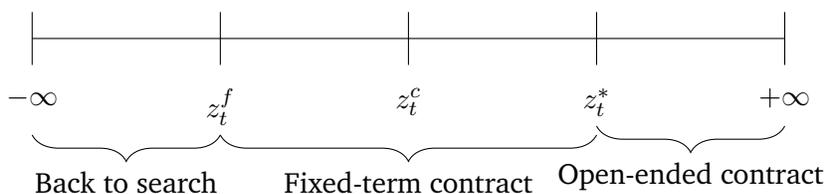


Figure 3.2.4: Dual job creation

Proof. See Appendix 3.A □

Demonstrating proposition 5 follows the same steps as in chapter 2. However, the choice between open-ended contract and a fixed-term contract does not stem from the same mechanisms. Here, the trade-off opposes flexibility and productivity. An open-ended contract delivers a full productivity but may lead to the payment of firing costs if an adverse productivity shock hits. Thus, hiring an open-ended worker is worth it if productivity is high enough to overcome the expected firing costs. A fixed-term contract delivers a lower productivity, but it is shorter and separation costs zero. The option of hiring a fixed-term contract makes agents short-sighted: it pushes up the minimum productivity to hire an open-ended contract and tightens the hiring window for open-ended contracts. Chapter 2 is similar to the present model with two notable exceptions. First, open-ended and fixed-term workers have the same productivity. Secondly, matches face i.i.d productivity shocks, whose occurrence follows a Poisson law. A new match with a high productivity chooses a contract to last as long as possible: it would be a pity to split before any productivity shock hits and to lose the

advantage of a high productivity draw. Thus, on average, an open-ended contract lasts longer than a fixed-term contract and enables to lock up highly productive matches. A new match with a lower initial productivity may not find it optimal to face the risk of paying firing costs in the doldrums to secure current gains. In worst cases, going back to search is the best option. In the middle ground, though, fixed-term contracts are relevant; they enable both production and a quick return to search for a better match.

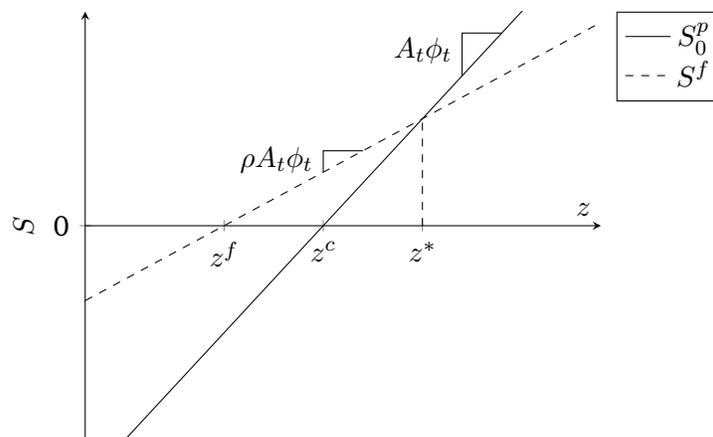


Figure 3.2.5: Joint surpluses and idiosyncratic productivity of matches

In this paper, productivity shocks no longer hit at random according to a memory-less Poisson law, which cuts out the incentive to secure the most productive matches through open-ended contracts. When meeting, a firm and a worker know that the current productivity draw will last one period. They do not hope a high productivity draw to last forever. Thereby, fixed-term contracts lose their role of median solution between producing and searching for more productive matches. One contract would be systematically preferred to the other without the contractual productivity gap because productivities of matches are not persistent. Still, the assumption that fixed-term contracts are *per se* less productive than open-ended ones is not far-fetched. Figure 3.2.5 shows the joint surplus of fixed-term and new open-ended jobs in function of the idiosyncratic productivity and illustrates the importance of the productivity wedge for the shaping of job creation.

Fixed-term positions are mainly filled by low-skilled or inexperienced workers (Fontaine and Malherbet, 2016) and benefit less from on-the-job training (Arulampalam and Booth, 1998; Arulampalam et al., 2004; Albert et al., 2005; Cutuli and Guetto, 2012). Aguirregabiria and Alonso-Borrego

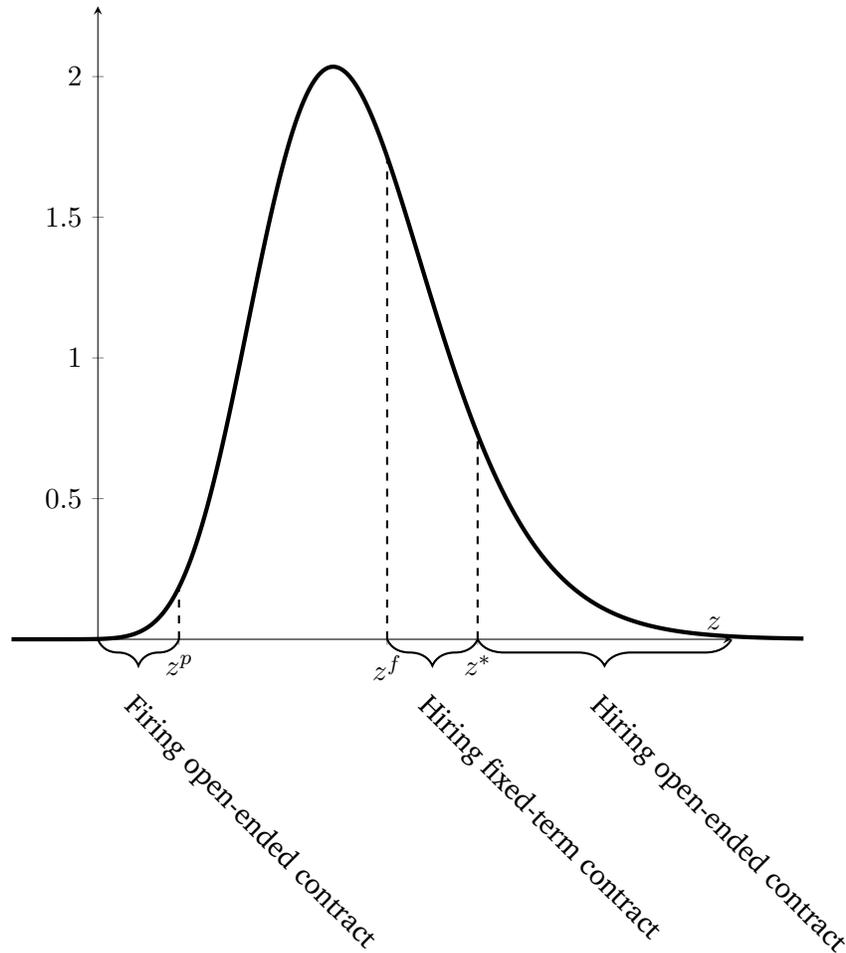


Figure 3.2.6: The probability distribution function of idiosyncratic shocks and the location of thresholds

The displayed pdf belongs to a log-Normal law with zero mean and standard deviation 0.2.

(2014) even estimates that fixed-term workers are 20 % less productive than open-ended workers.

The main departure of my approach with respect to Sala and Silva (2009) and Sala et al. (2012) is the appearance of the threshold z_t^* . The movements in thresholds z_t^p , z_t^c , z_t^f and z_t^* shape the behavior of the labor market and its fluctuations. If job creation involves both fixed-term and open-ended contracts — as will be the case in my calibration — then Figure 3.2.6 sums up the hiring and firing policies and the position of the thresholds if idiosyncratic productivity shocks are drawn from a log-Normal distribution.

3.2.6 Fiscal and monetary policy

The government taxes households to provide for unemployment benefits. The revenues from the firing tax get back to the government. Thus, the budget constraint of the government is

$$\tau_t + (1 - s)G(z_t^p) n_t^p F = bu_t + g_t \quad (3.2.40)$$

where g_t is the government expenditure and follows the AR(1) log-process $\log(g_t) = (1 - \rho_g) \log(\bar{g}) + \rho_g \log(g_{t-1}) + \epsilon_t^g$, $\epsilon_t^g \sim \mathcal{N}(0, \sigma_g^2)$.

The monetary policy is decided in accordance with the interest rate rule

$$\log(R_t/R) = \rho_R \log(R_{t-1}/R) + (1 - \rho_R) \left[\rho_\pi \mathbb{E}_t \log\left(\frac{P_{t+1}}{P_t}\right) + \rho_y \log\left(\frac{y_t}{y}\right) \right] + \epsilon_t^m \quad (3.2.41)$$

where y is the steady-state output and $\epsilon_t^m \stackrel{iid}{\sim} \mathcal{N}(0, \sigma_m^2)$.

Fixed-term contracts are known to behave as buffers in front of workload fluctuations, as Saint-Paul (1996) documented. Thus, the case of indeterminacy in the Taylor rule and the subsequent appearance of sunspot equilibria may prove interesting. For the sake of simplicity, though, I shall restrain the present analysis to the determinate case with $\rho_\pi > 1$ and $\rho_y > 0$ and leave indeterminacy and its consequences on dual labor markets for future research. is .

3.2.7 Aggregate values and the equilibrium

This paragraph sums up the different conditions enabling an utter closing of the model. The employment values sum to the measure of households, namely 1.

$$n_t^p + n_t^f + u_t = 1 \quad (3.2.42)$$

The aggregate stock of job-seekers includes the formerly unemployed households and the new

entrants in the unemployment pool from the current period.

$$e_t = u_{t-1} + \delta n_{t-1}^f + \xi_t n_{t-1}^p \quad (3.2.43)$$

The employment variables drop by the job destruction flow and augment by the job creation flow.

$$n_t^p = (1 - \xi_t) n_{t-1}^p + \mu_t^p v_t \quad (3.2.44)$$

$$n_t^f = (1 - \delta) n_{t-1}^f + \mu_t^f v_t \quad (3.2.45)$$

$\mu_t^p = q(\theta_t)(1 - G(z_t^*))$ and $\mu_t^f = q(\theta_t)(G(z_t^*) - G(z_t^f))$ are the open-ended and fixed-term job-filling rates. $\xi_t = s + (1 - s)G(z_t^p)$ is the the job destruction rate of open-ended contracts.

As for firms, the aggregate demand for final goods is

$$Y_t = c_t + g_t + \gamma v_t \quad (3.2.46)$$

Retailers only face one real marginal cost from intermediate-good firms. Thus, there is a unique equilibrium value for the optimal price-setting program, *id est* $P_{i,t}^* = P_t^*$.

The market clearing condition for intermediate goods states that intermediate goods are produced by incumbent workers or new workers through either open-ended or fixed-term contracts.

$$\begin{aligned} \int_0^1 Y_{i,t} di &= A_t E_z [z \mid z \geq z_t^p] (1 - \xi_t) n_{t-1}^p + \mu_t^p v_t A_t E_z [z \mid z \geq z_t^*] \\ &\quad + \rho A_t E_z [z] (1 - \delta) n_{t-1}^f + \rho \mu_t^f v_t A_t E_z [z \mid z_t^* \geq z \geq z_t^f] \end{aligned}$$

Using the first order condition from the final good firm's program (3.2.3), I get

$$\begin{aligned}
Y_t \Delta_t &= A_t E_z [z \mid z \geq z_t^p] (1 - \xi_t) n_{t-1}^p + \mu_t^p v_t A_t E_z [z \mid z \geq z_t^*] \\
&+ \rho A_t E_z [z] (1 - \delta) n_{t-1}^f + \rho \mu_t^f v_t A_t E_z [z \mid z_t^* \geq z \geq z_t^f]
\end{aligned} \tag{3.2.47}$$

with $\Delta_t = \int_0^1 \left(\frac{P_{i,t}}{P_t}\right)^{-\epsilon_t} di$ measures price dispersion. Yun (1996) demonstrated that the associated law of motion is

$$\Delta_t = (1 - \psi) \left(\frac{P_t^*}{P_t}\right)^{-\epsilon_t} + \psi \left(\frac{P_t}{P_{t-1}}\right)^{\epsilon_t} \Delta_{t-1} \tag{3.2.48}$$

while the price level follows

$$P_t = \left[\psi P_{t-1}^{1-\epsilon_t} + (1 - \psi) (P_t^*)^{1-\epsilon_t} \right]^{\frac{1}{1-\epsilon_t}} \tag{3.2.49}$$

As detailed in Appendix 3.B.3, the log-linearization of the price-level equation (3.2.49) and the price-setting equation (3.2.4) leads to the New-Keynesian Phillips curve.

$$\widehat{\pi}_t = \beta \mathbb{E}_t \widehat{\pi}_{t+1} + \kappa \left(\widehat{\phi}_t + \epsilon_t^\mu \right)$$

where $\kappa = (1 - \beta\psi)(1 - \psi)/\psi$ and ϵ_t^μ is an i.i.d mark-up cost that follows a normal law $\mathcal{N}(0, \widehat{\sigma}_\mu^2)$. The current specification of the New-Keynesian Phillips curve makes identification difficult in the estimation. As a result, I define $\sigma_\mu = \kappa \widehat{\sigma}_\mu$, which enables to rewrite the New-Keynesian Phillips curve.

$$\widehat{\pi}_t = \beta \mathbb{E}_t \widehat{\pi}_{t+1} + \kappa \widehat{\phi}_t + \epsilon_t^\mu$$

where ϵ_t^μ is i.i.d and follows a normal law $\mathcal{N}(0, \sigma_\mu^2)$.

Given the path of exogenous shocks $\{\epsilon_t^A, \epsilon_t^\mu, \epsilon_t^g, \epsilon_t^m\}_{t=0}^{+\infty}$, laws of motions of exogenous shocks

$\{A_t, g_t\}_{t=0}^{+\infty}$ and initial values for the state variables $\{R_{-1}, n_{-1}^p, n_{-1}^f, \Delta_{-1}, P_{-1}\}$, the equilibrium sums up into the set of endogenous variables $\{R_t, c_t, Y_t, n_t^p, n_t^f, u_t, \Delta_t, z_t^p, z_t^c, z_t^f, z_t^*, \theta_t, \phi_t, v_t, P_t, P_t^*\}_{t=0}^{+\infty}$ pinned down by equations (3.2.1), (3.2.4), (3.2.35)-(3.2.38) and (3.2.41)-(3.2.49).

3.3 Calibration and estimation

I bridge the model to the data through two steps. First, I calibrate some parameters calibrated to a typical dual European labor markets. Then, parameters driving shock processes and the nominal rigidity are estimated through a Bayesian technique. Time is measured quarterly.

3.3.1 Calibration

The intended calibration exercise needs to meet two requirements to be relevant heuristically speaking. A natural objective is the faithful reproduction of labor market dualism in the Euro area. Comparability with existing research is another one; labor market dualism has not been combined with a New Keynesian framework already, as far as I know. I shall rely on modeling choices Thomas and Zanetti (2009) make, as it looks at a classic labor market embedding firing costs within the Euro Area.

The central role of the distribution for idiosyncratic productivity shocks in the shaping of hiring and separation decisions falls reluctantly within the need for comparability, in absence of a proper estimation procedure. Consequently, I assume that the standard deviation for these shocks amounts to 0.2 as in Thomas and Zanetti (2009). The discount factor is similarly set to 0.99. The matching function is assumed to be in a Cobb-Douglas form $m(e, v) = me^\sigma v^{1-\sigma}$ with σ set to 0.6, which stands in the middle of the 0.5-0.7 range Burda and Wyplosz (1994) estimated for some European countries. I set the workers' bargaining power to 0.6. Note that the Hosios condition is not verified as unemployment benefits are financed through a tax. The elasticity of demand curves is set to 6. I also assume that the government-spending-to-gdp ratio is 20 % as in Thomas and Zanetti (2009).

β	σ	η	σ_z	ϵ
0.99	0.6	0.6	0.2	6

Table 3.3.1: Initial parameters

I depart from Thomas and Zanetti (2009) in several dimensions. I assume that the vacancy-worker meeting probability from the firm's point of view is 0.7 instead of 0.9. The latter figure replicates flows on the US labor market, which are known to be bigger than the European ones. One important feature of the labor market is its size, since it influences labor market tightness and job-finding rates. Should I consider ILO-defined unemployment *stricto sensu* or include the inactive population? Elsby et al. (2015) and Fontaine et al. (2016) demonstrate the importance of the participation margin to explain unemployment fluctuations respectively in the United States and in France. This is all the more true with precarious employment, which involves people at the blurred frontier between unemployment and inactivity. According to data from Eurostat extending between 2002 and 2017, the participation rate in the Euro Area rate is around 67 %. Thus, I set steady-state employment to 0.67. In the same manner, I target a ratio of fixed-term contracts over total employment of 13 % in accordance with Eurostat estimates from 2006 to 2017.

The contractual composition of creation flows matters much, as it impacts the turnover of the labor force. Targeting the share of fixed-term contracts among new jobs enables to control for the contractual composition of hires. However, an issue arises: the model implicitly assumes that fixed-term and open-ended contracts are substitutes for all tasks in the economy. It is a strong assumption as fixed-term workers could be better suited to some specific tasks, such as one-time tasks. Some industries frequently cope with one-time demand. Thus, targeting the share of fixed-term contracts in job creation should be done with caution, as it mixes fixed-term contracts with diverse degrees of substitutability with respect to open-ended contracts. Ruling out very short fixed-term contracts in the calibration may help to consider fixed-term contracts and open-ended contracts that may substitute. In France, data from *Acos* - *Dares* witness that 83 % of job creations occur through fixed-term contracts and 30 % of these new fixed-term contracts last less than one day. Excluding these contracts leads to a share of fixed-term contracts in jobs creation of 77 %. Unfortunately, I do not have data about the proportion of very short contracts in job creation in other countries.

In Spain, Felgueroso et al. (2017) documents that 90 % of job creations occur through fixed-term contracts. At the other end of the spectrum, Addison et al. (2019) report a 45 % share of fixed-term contracts in German job creation. I target a share of fixed-term contracts in job creation of 70 % to reach a middle ground in the Euro area.

I also set the quarterly separation probability of open-ended matches ξ to 3 % consistently with the magnitude of data from Eurostat. This leads to a steady-state separation probability of fixed-term matches of 20 %, which is equivalent to an average duration of 15 months. 15 months lies above the average duration of fixed-term contracts in the Euro area. In this manner, the volatile character of fixed-term employment is not exaggerated on the job destruction side. Among separations involving open-ended contracts, an essential factor is the probability of paying firing costs. Jolivet et al. (2006) explain that more sclerotic European markets lead to a higher share of voluntary quits, whereas lay-offs tend to be more significant in countries with more flexible labor markets. The French case is described as the most representative of the former phenomenon, with 70 % of separations involving open-ended matches happening through voluntary channels according to Milin (2018). A reasonable value for the Euro Area is thus inferior. As a result, I target a rate of 60 % for the ratio of exogenous separations among total separations for open-ended matches. The resulting value of s is 2.1 %.

The calibration of firing costs constitutes a challenge. The data is scarce, which makes reasonable proposals difficult to spell. It is all the more true since heterogeneity between countries is high, whether it be from a legal or an economic point of view. Moreover, labor court decisions often meddle with firing decisions, bringing their share of uncertainty and hidden costs as Bentolila et al. (2012a) documents. The 0-to-6 OECD indicator for employment protection legislation enables a cursory comparison between Euro area countries.

While Portugal and Italy display the highest employment protection indicators around 2.9, German and Spanish values amount to 2.4. France is close to 2.7 and thus constitutes a middle ground regarding employment protection legislation in the biggest Euro zone countries. Fortunately, Kramarz and Michaud (2010) is one of the scarce studies that estimates firing costs and it considers the French case. The latter assess that individual lay-offs marginally cost 4 months of the median wage, while the marginal cost lay-offs within a collective termination plan represents 12 months

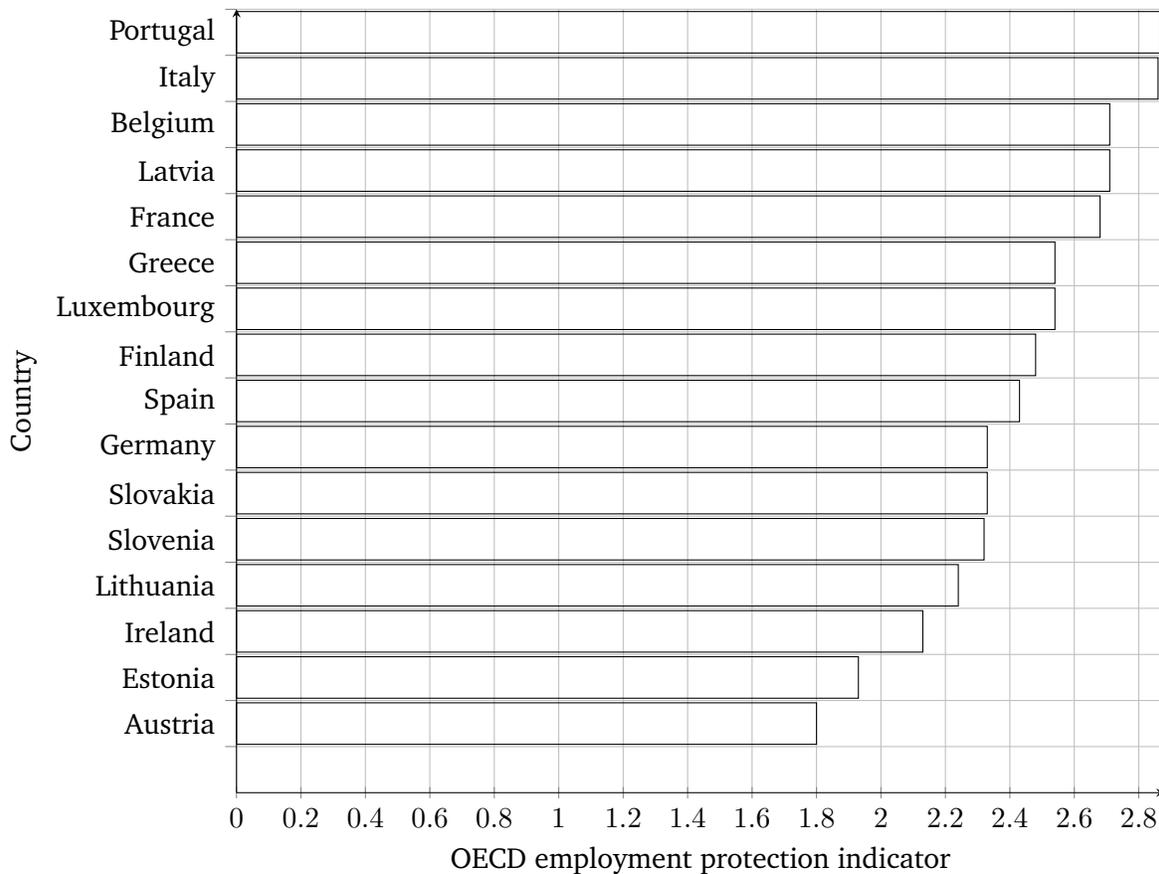


Figure 3.3.1: An overview of employment protection in the Euro area countries in 2019

SOURCE: OECD (2020a)

of the median wage⁸. The former being the most frequent case, I reckon that total firing costs represent 4 months of the open-ended workers' average wage. As Bentolila et al. (2012a) and Cahuc et al. (2016), I assume that red-tape costs actually embodied by F only represent one third of total firing costs for the firm. Thus, I target a ratio of 4/9 for firing costs with respect to the quarterly open-ended workers' average wage for the Euro area

F/\bar{w}^p	$\mu^f / (\mu^p + \mu^f)$	n^f/n	ξ	s/ξ	n	$q(\theta)$
4/9	0.7	0.15	0.03	0.6	0.67	0.7

Table 3.3.2: Targets for a calibration of the labor market in the Euro area

⁸To be accurate, Kramarz and Michaud (2010) assess that firms with more than 50 employees face a marginal cost of 97,727 FF_r (Table 1b), which represents 14 months of the workers' median wage. Consequently, the associated median wage of fired workers is 6,980 FF_r. Thus, Table 2 shows that individual terminations cost 27,389 FF_r, which amounts to 4 months of the fired workers' median wage, while the termination within a collective firing plan marginally costs 81,850 FF_r, which equals 12 months of the median wage.

The last parameters to be pinpointed are F , b , m , ρ and γ . The empirical evidence concerning b is thin. Indeed, the flow value of non-employment is a highly debated issue in labor economics. Hagedorn and Manovskii (2008) advocate a high relative value of non-employment with respect to employment to make the Mortensen-Pissarides model able to faithfully replicate fluctuations in unemployment and vacancies following productivity shocks of a realistic magnitude. The obtained b is coherent with this view. In the same manner, no proper empirical evidence is available to assess the productivity difference between fixed-term contracts and open-ended contracts in European countries, which explains why I prefer leaving it as a free parameter in the calibration. I find a 2 % productivity deficit among fixed-term contracts with respect to open-ended contracts. The vacancy cost represents 1.5 % of the average wage, which is coherent with the available evidence put forward by Kramarz and Michaud (2010).

F	b	s	δ	ρ	m	γ
0.38	0.84	0.02	0.2	0.98	0.44	0.01

Table 3.3.3: Calibrated parameters

3.3.2 Estimation

Labor market parameters being calibrated on the Euro Area, I now estimate the unknown parameters related to shocks and nominal rigidities. I use a Sequential Monte Carlo procedure⁹. Following Thomas and Zanetti (2009), I choose the same time period extending from 1997-Q1 to 2007-Q4 and a similar set of quarterly time series as observables (Y_t, π_t, R_t, n_t) , namely GDP at constant prices, employment, EONIA rates in annual terms and the GDP deflator¹⁰. All involve the 19-country Euro area and are obtained from the ECB Data Warehouse. The demeaned growth rate of the GDP deflator is plugged to inflation π_t . Since R_t corresponds to the nominal interest rates, they correspond to the demeaned quarterly equivalent of EONIA rates. Real GDP and employment are logged and reluctantly linearly detrended. As a matter of fact, the use of any detrending method or filter as well as the comprehension of adequate observable equations to match growth rates in the data is mainly arbitrary and may deliver heterogeneous and mis-specified estimation results.

⁹See Herbst and Schorfheide (2016) pp 100-129 for an extensive treatment of this method.

¹⁰Table 3.C.2 details the series used for estimation

Ferroni (2011) and Canova (2014) roughly propose to simultaneously estimate the parameters of flexible specifications for trends along deep parameters so as to let the model explain the part of the data it is able to account for. However, as Canova and Sala (2009) and Iskrev (2010); Iskrev et al. (2010) testify, identification issues are real in the estimation of DSGE models. The resort to the methods advocated by Ferroni (2011) and Canova (2014) would magnify these problems through the introduction of new parameters. For this reason, I stick to the detrending method employed by Thomas and Zanetti (2009), which remains simple and enables comparisons between my model and their own. In Appendix 3.C.3 Table 3.C.3, I report the estimation results using different filtering methods and observables ranging from 1995Q3 to 2019Q2. Overall, the estimates are pretty robust. Most chosen priors are chosen to be diffuse, reflecting the void of the DSGE literature with respect to dual labor markets. Thus, the priors for autocorrelations of the shock processes are uniform laws on $[0, 1]$, while standard deviations follow inverse gamma distributions with mean 0.5 and standard deviation 4¹¹. As for the Taylor parameters r_π and r_y , the prior needs to be vague and embed the fact that $r_\pi > 1$ and $r_y > 0$. As a result, truncated normal laws with large standard deviations are employed. Druant et al. (2012) assess the average duration of firms' prices in the Euro Area to 10 months, which corresponds to a value of ψ around 0.7. A tight normal law around this value is subsequently chosen.

I run the Sequential Monte Carlo procedure with 500 likelihood-tempering steps, which involve a swarm of 30,000 particles and one Random-Walk-Metropolis-Hastings step each. Table 3.3.4 compound results. I similarly estimate a classic labor market without fixed-term contracts to compare results. All details are available in Appendix 3.D. The results are displayed in Table 3.D.3. Overall, the estimates are pretty similar across both models and estimates are not significantly different. The log marginal density do not significantly differ either, as Table 3.D.2 shows.

Government spending shocks are more volatile and more auto-correlated in the estimated classic model than in its dual counterpart. Government spending is a pure aggregate demand shock that does not impact the production function. Moreover, given the absence of capital, note that the shock on government spending g_t also includes the missing values aggregate demand need to match fluctuations in GDP. Productivity shocks impact production, inflation and employment.

¹¹Standard deviations are expressed in percentage.

Parameter	Prior distribution			Posterior distribution			
	Distr.	Para (1)	Para(2)	Mean	Std. Dev.	5%	95%
ρ_A	Uniform	0.0	1.0	0.7	0.08	0.56	0.83
ρ_g	Uniform	0.0	1.0	0.89	0.04	0.81	0.94
ρ_R	Uniform	0.0	1.0	0.77	0.05	0.68	0.85
ρ_π	Normal	1.5	0.75	2.17	0.62	1.25	3.28
ρ_y	Normal	0.12	0.15	0.29	0.06	0.19	0.4
ψ	Beta	0.7	0.05	0.83	0.03	0.78	0.87
σ_A	IGamma	0.5	4.0	0.31	0.04	0.26	0.37
σ_μ	IGamma	0.5	4.0	0.3	0.03	0.25	0.36
σ_g	IGamma	0.5	4.0	5.59	1.51	3.86	8.41
σ_m	IGamma	0.5	4.0	0.08	0.01	0.07	0.1

Table 3.3.4: Prior and posterior distributions of structural parameters.

Para(1) and Para(2) correspond to mean and standard deviation of the prior distribution if the latter is Normal or Inverse Gamma. Para(1) and Para(2) correspond to lower and upper bound of the prior distribution when the latter is uniform

Thus, productivity shocks alone cannot account for the whole extent of fluctuations in GDP without producing crazy results in terms of interest rate, inflation and employment. Government spending shocks capture the fluctuations in GDP that productivity shocks cannot fully account for. Table 3.D.2 reports that both models have comparable logged marginal data densities. Thus, roughly speaking, the more volatile and persistent government spending shocks are, the more mis-specified aggregate demand is to fit the GDP time series. To this extent, the dual model fits observed fluctuations in GDP better than the classic model. The volatility and persistence of government spending shocks remains high in the dual model, though. The model lacks essential features — capital and investment for example — to properly fit fluctuations in GDP. The estimates of the government spending shock in Thomas and Zanetti (2009) exhibit a similar behavior.

The mark-up shock μ_t is the counterpart of the government spending shock for inflation. Its volatility amounts to one standard deviation of the inflation time series. The auto correlation parameter of productivity shocks is 0.7, lower than usual estimates in the literature. The parameters driving the interest rate rule (3.2.41) are similar to Thomas and Zanetti (2009), with the exception of the weight of output. The Calvo pricing parameter amounts to 0.83, a bit lower than the estimate of Thomas and Zanetti (2009) around 0.9.

3.4 Experiments

3.4.1 Labor market moments

In this paragraph, I assess the ability of the model with respect to the reproduction of labor market moments. The absence of proper series for the computation of the latter in the Euro area represents a significant obstacle. As a result, I use time series from French data as a proxy to account for the main features of the Euro area labor market. I detail the sources in Table 3.C.2. Figure 3.4.1 shows the logged and filtered data along the lines of Hamilton (2018). For this graph only, I do not use linear detrending because the 2008's crisis belongs to the time interval of data; a break of trend occurs for most variables¹². It is not a problem as the qualitative cyclical features I describe below remain when using linear detrending.

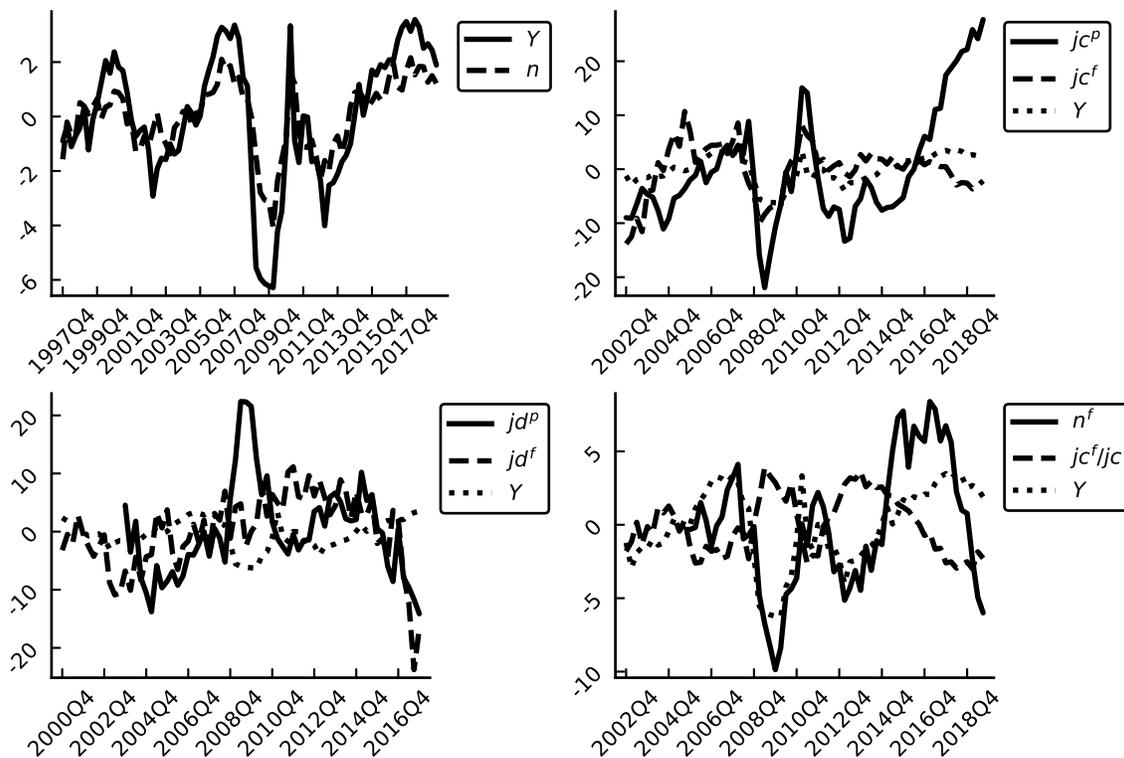


Figure 3.4.1: Fluctuations in labor market values.

Aggregate employment n is pro-cyclical and less volatile than output, as is well known. Fixed-term

¹²See Gorodnichenko and Ng (2010), Ferroni (2011), Lafourcade and de Wind (2012), Canova (2014) and Hamilton (2018) for thorough developments about the consequences of filtering data

employment n^f is also pro-cyclical and displays a volatility larger than aggregate employment. On the flows side, job creation and job destruction of open-ended contracts seems more volatile than their fixed-term counterparts. While open-ended job creation jc^p and fixed-term job creation jc^f are both pro-cyclical as one would expect, job destruction flows show opposite behaviors across contract types. Open-ended job destruction is counter-cyclical whereas fixed-term job destruction is pro-cyclical. In favorable times, as demand increases, firms hire fixed-term workers. Fixed-term contracts are short ; most of them last less than a quarter. Thus, an increase in fixed-term job creation immediately generates an increase in fixed-term job destruction. The share of fixed-term contracts in job creation seems counter-cyclical jc^f/jc . Open-ended job creation jc^p and fixed-term job creation jc^f are pro-cyclical. Open-ended job creation is more volatile than fixed-term job creation.

Variables	Data		Model	
	Std. Dev.	$Cor(Y, \cdot)$	Std. Dev.	$Cor(Y, \cdot)$
Y	1.16	1.0	0.79	1.0
π	0.32	0.15	0.31	0.01
R	0.33	0.29	0.18	0.38
n	0.73	0.93	0.87	0.85
jc^p	7.19	0.65	12.16	0.45
jc^f	4.97	0.52	3.89	0.21
jc^f/jc	1.29	-0.4	2.89	-0.47
n^f	1.87	0.18	2.0	0.1
jd^p	5.7	-0.43	7.05	-0.54
jd^f	2.84	0.39	2.0	0.24
v	10.32	0.61	7.29	0.41

Table 3.4.1: Actual and simulated correlations with output of different variables

Is the model able to reproduce cross-correlations and volatility of these labor market time series? I compute the model-induced cross-correlations using simulations. For each of the 30,000 particles of the SMC algorithm, I compute the correlations over 200-period chains of shocks with a 100-period burn-in time. Then, I derive a weighted average of cross covariances using the particle-specific weights generated by the SMC procedure. Then, I compare the simulated moments to those of the time series displayed in Figure 3.4.1, which are linearly detrended between 1997-Q1 and 2007-Q4. I also consider vacancies v , inflation π and EONIA interest rates R . Table 3.4.1 compounds the

results. Overall, the model reproduces well the standard deviations and correlation with output of the considered time series. The model retrieves the pro-cyclicality of job creation flows. On the job destruction side, the model reproduces the pro-cyclicality of the fixed-term job destruction rate and the counter-cyclicality of the open-ended job destruction. It also mimics the higher volatility of flows on the open-ended side of the labor market with respect to its fixed-term counterparts. Compared to Sala and Silva (2009) and Sala et al. (2012), my main contribution is replicating the volatility and counter-cyclicality of the share of fixed-term workers in job creation jc^f/jc . Sala and Silva (2009) and Sala et al. (2012) assume that it is exogenously set by law.

Cole and Rogerson (1999) showed that replicating the Beveridge curve in real business cycles models with a frictional labor market is challenging. The actual negative correlation between unemployment and vacancies is difficult to replicate without making productivity implausibly volatile. In the original Diamond-Mortensen-Pissarides model, a positive productivity shock increases the surplus of matches and encourages the posting of vacancies. It pushes up labor market tightness and workers benefit from a higher job-finding probability that bolsters their threat point in Nash-bargaining. Wages end up increasing and fuel job destruction. Therefore, the positive effect of the productivity shock on wages significantly weakens the movements of job creation and vacancies, making the Beveridge curve flatter or even positively sloped. Ljungqvist and Sargent (2017) explain that the endeavors to obtain sufficiently strong responses of unemployment to productivity shocks consist in reducing the fundamental surplus of the match. The so-called fundamental surplus is the share of the surplus that can be allocated to job creation. The literature teem with implementations of wage rigidity, high utility of unemployment or firing costs; all boil down to reducing the fundamental surplus of new matches. What are the dimensions impacting the fundamental surplus in my model? The utility flow associated with unemployment is calibrated at a high value. Moreover, firing costs discourage open-ended job destruction. Both reduce the fundamental surplus. Fixed-term contracts ambiguously impact the fundamental surplus. On the one hand, it makes production possible for low values of idiosyncratic productivity for which firms and workers would get back to searching if only open-ended contracts were available. On the other hand, for a given idiosyncratic productivity, the new fixed-term contracts produce less. Numerically speaking, the simulated correlation between unemployment and vacancies amounts to -0.4 , which fits the data well.

My model suffers from a widespread problem in the DSGE literature: it is unable to generate enough persistence in cross-correlations and covariances. Figures 3.C.2 and 3.C.2 bear witness of this issue. Introducing wage rigidity and persistent idiosyncratic shocks could help. I leave it for future research.

3.4.2 Impulse Response Functions

The computation of impulse response functions highlights several interesting features of the model. First of all, a substitution effect between fixed-term and open-ended contracts emerges, with long-run consequences on employment whether it be fixed-term or open-ended and a strong influence on impact. Secondly, a general-equilibrium effect appears. Indeed, shocks imply changes in the size of the job seekers' pool, which, in turn, has important implication for job creation flows. Finally, the common source of both effects being the evolution of (z^p, z^f, z^*, θ) , the two effects interact through time depending on the persistence of the considered shock.

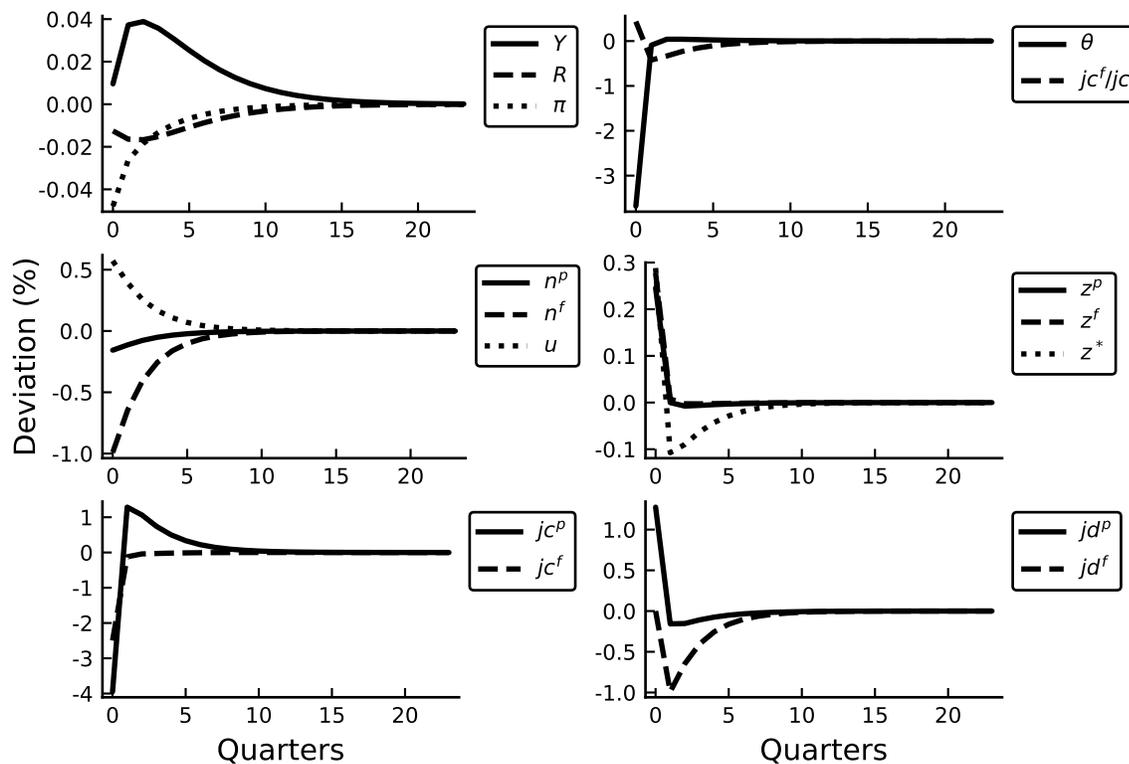


Figure 3.4.2: IRF of main variables to a one-standard-deviation productivity shock

Productivity shocks Figure 3.4.2 displays the reaction of main variables to a productivity shock. An increase in labor productivity cuts real marginal costs. Inflation decreases and the central bank reduces nominal interest rates to encourage consumption. The support to demand is insufficient to prevent a decrease in employment. Unemployment increases while vacancies reduce, delineating a downward-sloping Beveridge curve and a decrease in labor market tightness. These results are classic with New Keynesian DSGE models. The downward sloping Beveridge curve is a traditional feature of Mortensen Pissarides models.

The behavior of flows constitutes an important feature of labor markets. The enhanced productivity makes agents more demanding to carry on production or to start a new match: z^p and z^f increase. The forces at stake when it comes to the evolution of z^* are more complex. On one hand, the agents seek to benefit from productivity gains in full, which bolsters the attractiveness of open-ended workers. On the other hand, firms are more demanding in terms of productivity when hiring a new open-ended worker. The choice between a fixed-term and an open-ended contract at the hiring stage also reflects the compromise between the fear of future rigidity and the appetite for immediate production gains. The transitory nature of the productivity shock makes productivity gains insufficient to encourage open-ended job creation. Overall, open-ended and fixed-term job creation immediately decrease. The behavior of thresholds, job creation and job destruction revert after the impact. A general equilibrium effect accounts for it. Just after the shock, aggregate job destruction increases and job creation shrinks, which inflates the job seekers' pool for the next periods. This mechanically increases the subsequent job creation flows. Open-ended employment unambiguously shrinks under the joint diminution in job creation and increase in job destruction. As for fixed-term employment, job creation shrinks and job destruction occurs at a constant exogenous rate. Consequently, fixed-term employment decreases.

Government spending shocks Figure 3.4.3 shows the impulse response functions of main variables after a shock in government spending. As usual in the literature, a sudden increase in government spending enhances output. Real marginal costs increase and the central bank increases the nominal interest rate to prevent the spread of inflation. The labor market tightness increases as firms post more vacancies to cope with the magnified demand of consumption goods. As a

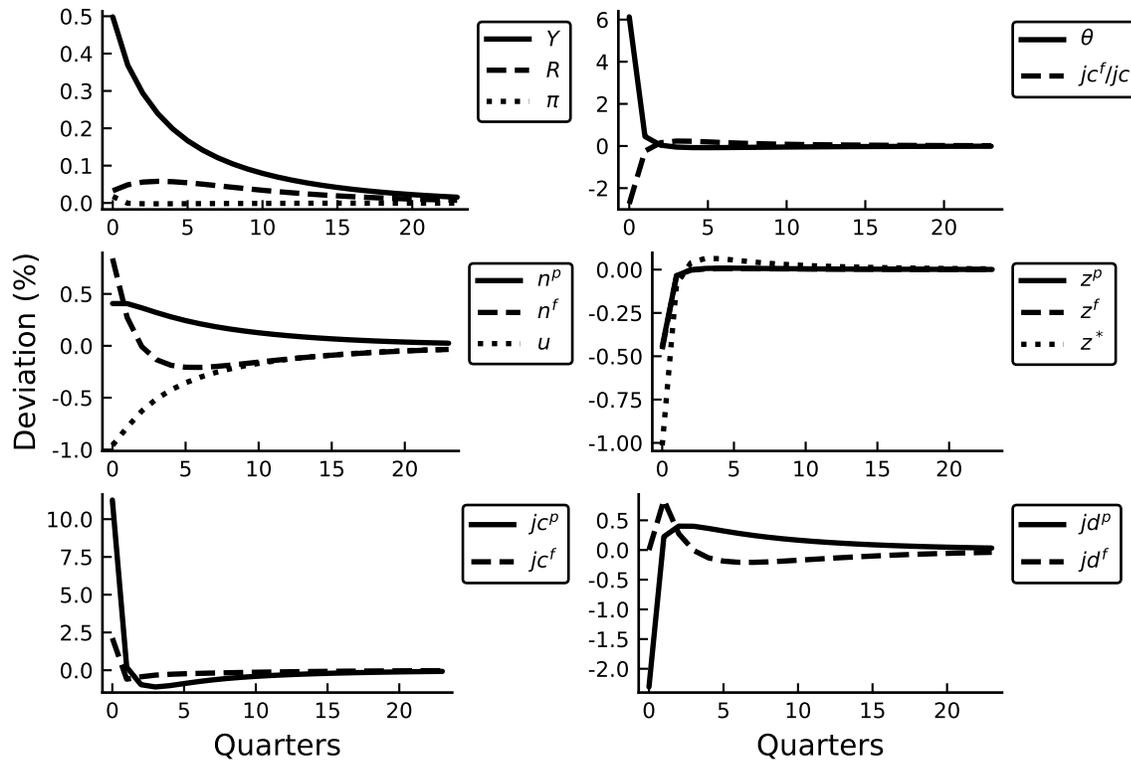


Figure 3.4.3: IRF of main variables to a one-standard-deviation shock in government spending shock

result, on impact, job destruction decreases and job creation increases. Interestingly, firms cope with the surplus of demand through an enlarged share of open-ended contracts in job creation. The shock is persistent enough for the future expected losses associated with firing costs to be overcome by lifelong productivity gains. The general-equilibrium effect described in the preceding sections weighs in anew. Indeed, the shrink in the stock of job seekers exerts a downward pressure on job creations, which decrease below their steady-state values. While the transitional path of open-ended employment remains above its steady-state value, fixed-term employment goes below its equilibrium level. As a matter of fact, fixed-term employment experiments a higher turnover, and is therefore highly impacted by fixed-term fluctuations in its associated job creation. This is all the more true since destruction rates of fixed-term jobs are constant.

Monetary policy shock Figure 3.4.4 shows the impulse response functions of main variables after a shock in the monetary policy. A monetary policy shock pushes up interest rates, which discourages consumption and subsequently depresses output. Real marginal costs and inflation decrease. The

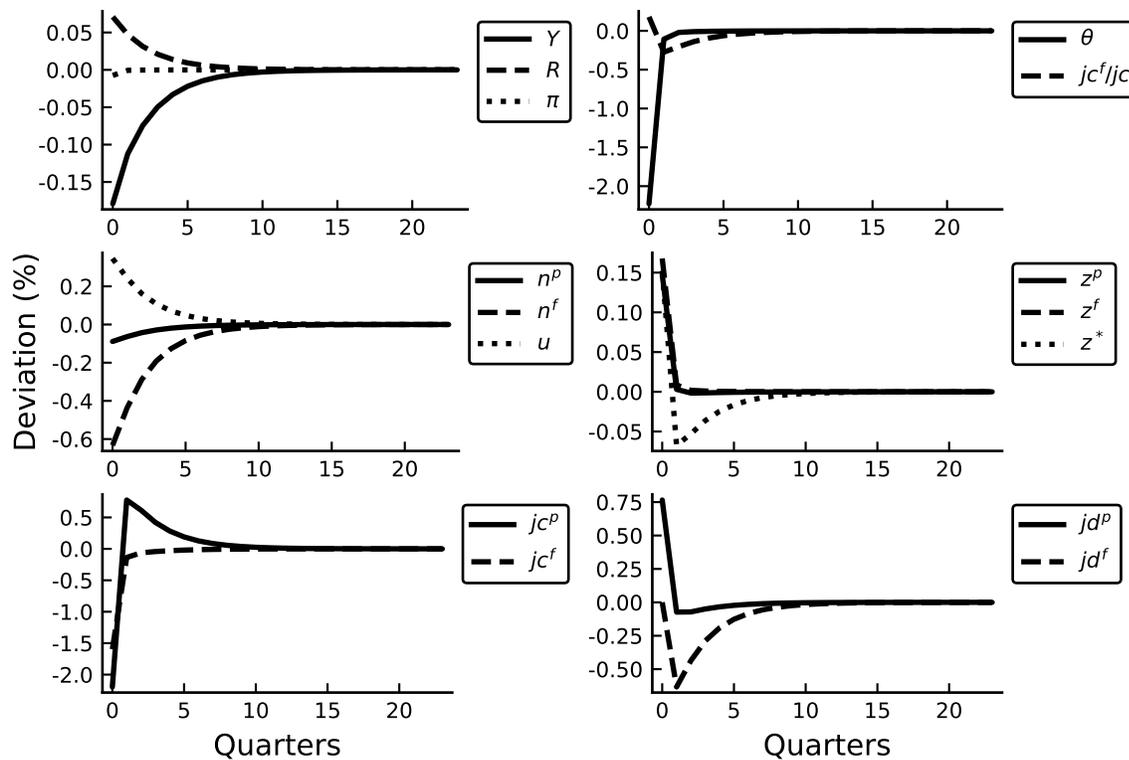


Figure 3.4.4: IRF of main variables to a one-standard-deviation in the monetary policy shock

marginal gross revenue from labor decreases and intermediate firms are overall more demanding in terms of productivity to compensate the loss in profits ; z^p , z^f and z^* increase. Thus, on impact, job creation shrinks and open-ended job destruction flow enlarges. In turn, the formerly open-ended employees join the ranks of the job seekers', which enhances job creation. Moreover, firms tend to switch to open-ended contracts on behalf of fixed-term ones at the hiring stage in order to temper the immediate loss in revenue due to prices; z^* decreases. These two effects combined explain the observed rebound in open-ended job creation.

As a result, viewed from the labor market, the monetary policy shock represents the negative of the government spending shock. The economic schemes at stake are the same. There is however a nuance. The effects of the monetary policy shock on the interest rate vanish much faster and the oscillations between the substitution effect and the general-equilibrium effect develop in a rougher way. This observation is also relevant when one considers the cost-push shock. The IRF of the latter will not be described, as it involves the same mechanisms as the other IRFs.

Volatility shocks As surveys report, uncertainty in demand makes firms willing to resort to fixed-term employment (Rémy, 2017). What is the impact of uncertainty in my model? Solving the model with a first-order perturbation method¹³ is convenient to estimate the model within a reasonable time span. However, it rules out risk as a driving force in policy functions.

To catch a glimpse of the impact of uncertainty, I strike a bargain between time feasibility and the introduction of risk. I keep the estimates obtained from the first-order perturbation method, introduce stochastic volatility and solve the model using a third-order perturbation method. The third order is the lowest one where policy functions involve innovations in stochastic volatility. This approach is far from ideal as it implicitly assumes that introducing stochastic volatility does not change the parameters estimates. It is not the case. The third-order perturbation method along the introduction of stochastic volatilities includes new terms in the response of states to shocks, which, in turn, should change the estimates. Ideally, I should estimate again the model with the third-order perturbation method.

Figure 3.4.5 shows the impulse response functions of macroeconomic and labor market variables to a one-standard-deviation volatility shock to productivity starting from the stochastic steady state.

The seminal paper Bloom (2009) highlights the impact of uncertainty on investment and hiring. A larger uncertainty motivates a pause in the hiring and investment decisions that involve fixed costs. In my framework, according to this mechanism, increasing uncertainty leads to postponing open-ended job destruction and open-ended job creation. It encourages substitution towards fixed-term hires and the share of fixed-term contracts in job creation increases. Following Bloom (2009), I estimate a VAR to corroborate this intuition with CAC40 and its volatility, the share of fixed-term contracts in job creation and total employment. The underpinning assumption is that shocks firstly hit stock markets, then the composition of hires and finally total employment. Including prices and other labor market variables would be better, but the short length of my quarterly time series do not allow me to do so. Figure 3.C.5 shows the impulse response functions to a one standard-deviation volatility shock. I find that the share of fixed-term contracts in hires increases while total employment decreases. An adverse demand shock — embodied by a negative government spending shock —

¹³Perturbation methods consist in approaching the behavior of variables around the steady-state using Taylor expansions along a correction parameter. A third-order perturbation method uses monomials up to degree three. Judd (1998) describes it in more detail.

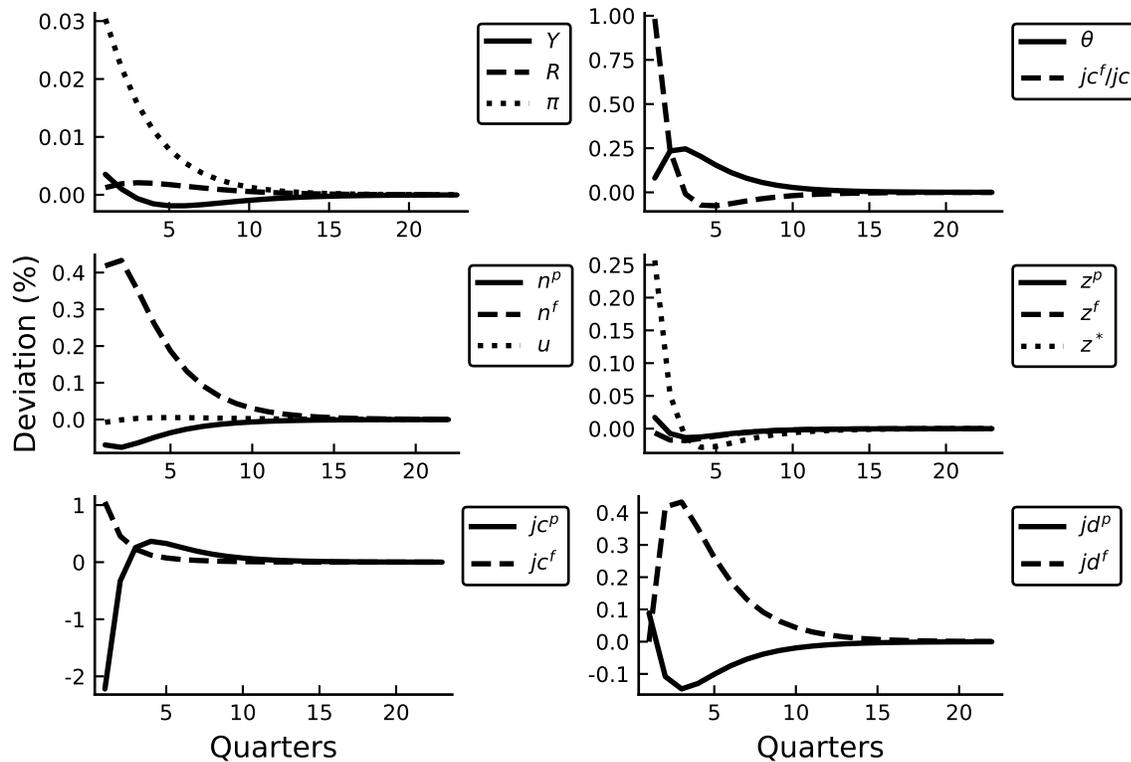


Figure 3.4.5: IRF of main variables to a one-standard deviation volatility shock to productivity.

leads to the same response of the share of fixed-term contracts in job creation. However, in contrast with an adverse demand shock, fixed-term employment increases. Saint-Paul (1996) explains that fixed-term employment act as a protective buffer for open-ended workers; in the doldrums, firms get rid of fixed-term workers and leave open-ended employment as untouched as possible. It is consistent with the response of the model.

As a result, in a dual labor market, an uncertainty shock and an adverse demand shock have different implications. It is a relevant result as the literature over macroeconomic risk argues that uncertainty shocks are difficult to distinguish from negative aggregate demand shocks (Leduc and Liu, 2016). Fluctuations in fixed-term employment may help to identify uncertainty shocks and demand shocks separately. My model is a naive representation of a dual labor market and cannot pretend to do it seriously, but it should be considered in future research.

3.4.3 Reforms in employment protection legislation

In this paragraph, I examine the macroeconomic effects of a reform on employment protection legislation, which is summed up in firing costs here.

Steady-state analysis The steady-state labor market can be summed up by the thresholds and the labor market tightness $(z^p, z^c, z^f, z^*, \theta)$. Equations (3.2.35)-(3.2.39) pinpoint the steady-state equilibrium in the labor market. Figure 3.4.6 illustrates it. (3.2.36) defines job destruction for open-ended matches. It defines a positive relationship between the open-ended job destruction threshold z^p and labor market tightness θ ; a higher labor market tightness increases wages and encourages job destruction. I denote JD^p the corresponding locus. For the same reason, a higher labor market tightness reduces the surplus of new matches. As a result, the profitability threshold z^f and substitution threshold z^* increase with labor market tightness. I denote JP and JC^p the corresponding loci. The job creation condition (3.2.39) defines a negative relationship between the open-ended job destruction threshold z^p and the labor market tightness θ . Indeed, as labor market tightness increases, wages increase and agents demand a higher productivity when hiring. The expected surplus of a vacancy must increase to compensate firms for higher wages. The higher labor market tightness pushes up the profitability threshold z^f ; the hiring region tightens and the expected gain from a vacancy decreases. The only manner to enhance the expected benefit from vacancies is to encourage substitution towards open-ended workers that are more productive; the substitution threshold z^* must decrease, and so does the open-ended profitability threshold z^c and the open-ended job destruction threshold z^p . I denote (JC) the associated locus.

I consider a steady-state decrease in firing costs. Let me first keep the labor market tightness θ constant as a thought experiment. A cut in firing costs encourages job destruction; the threshold for open-ended job destruction z^p increases and the JD^p curve moves up to $(JD^p)'$. Are open-ended jobs more profitable overall? On the one hand, reduced firing costs directly encourage job creation as separations are cheaper. On the other hand, enhanced job destruction rate pushes up the probability of paying the firing cost in the future, which indirectly depletes open-ended job profitability. The former effect prevails and the profitability threshold z^c decreases. Reduced firing costs leave the profitability of fixed-term contracts unaffected: z^f does not change and the JP locus does not move.

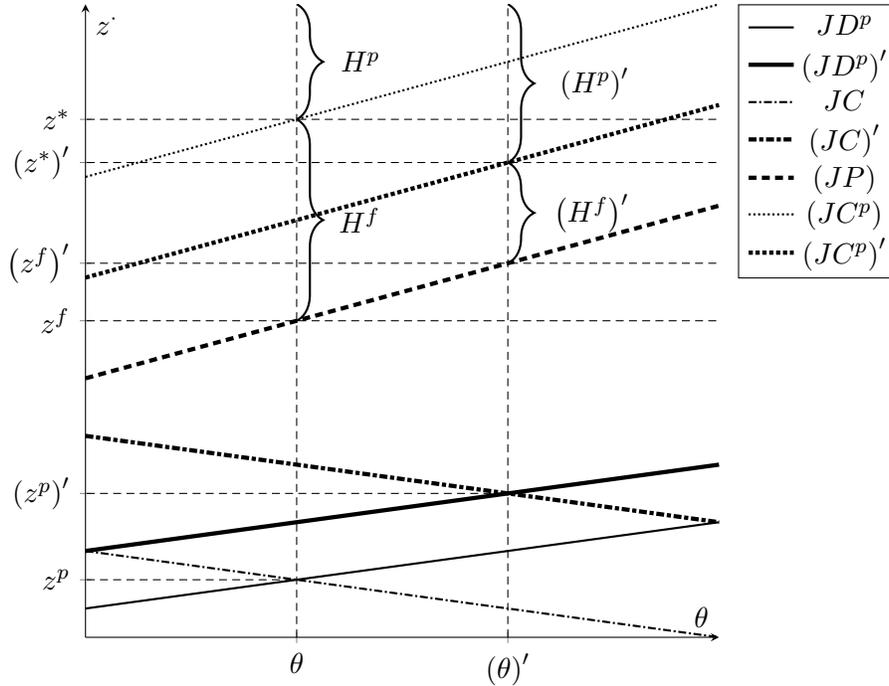


Figure 3.4.6: A decrease in F and the steady-state equilibrium.

The prime index the equilibrium values after the change in firing costs. H^p denote the hiring region of open-ended contracts.

As a result, z^* increases and the JC^p curve moves up to $(JC)'$. The hiring region of open-ended contracts H^p widens.

I kept labor market tightness constant in the reasoning above. Now, I loosen up this assumption. The wider hiring region of open-ended contracts increases the expected gain from a vacancy. Open-ended contracts replace highly productive fixed-term contracts in the neighborhood of z^* . As open-ended contracts are more productive than fixed-term ones for a given idiosyncratic quality of the match, the substitution benefits the match. Thus, firms post more vacancies and labor market tightness increases. This indirectly reflects back on the thresholds. The ensuing increase in wages supports the initial increases in job destruction, while it mitigates the higher profitability of open-ended contracts and reduces the profitability of fixed-term contracts; z^f increases. Proposition 6 mathematically proves the results mentioned above.

Proposition 6. *Considering the steady-state equilibrium, the comparative statics with respect to firing costs boil down to: $\frac{\partial \theta}{\partial F} < 0$, $\frac{\partial z^p}{\partial F} < 0$, $\frac{\partial z^c}{\partial F} > 0$, $\frac{\partial z^f}{\partial F} < 0$, $\frac{\partial z^*}{\partial F} > 0$. Thus, an increase in firing costs tightens the hiring region of open-ended contracts.*

Proof. See Appendix 3.A. □

Overall, the higher labor market tightness and the broadened hiring region of open-ended contracts enhance open-ended job creation. The joint increase in open-ended job destruction makes the response of open-ended employment unclear. As for fixed-term job creation, the tightened hiring region and the higher labor market tightness lead to an ambiguous response. Thus, the change in fixed-term employment is ambiguous. Here, I retrieve the classic result of the inconclusive impact of firing costs on aggregate employment. Numerically speaking, a 5 % decrease in firing costs significantly increases open-ended employment and decreases fixed-term employment. The lack of persistence in the idiosyncratic productivity of matches explains the high sensitivity of the steady state with respect to firing costs.

Variables	Data		Baseline		Reduced firing costs	
	Std. Dev.	$Cor(Y, \cdot)$	Std. Dev.	$Cor(Y, \cdot)$	Std. Dev.	$Cor(Y, \cdot)$
Y	1.16	1.0	0.79	1.0	0.79	1.0
π	0.32	0.15	0.31	0.01	0.31	0.03
R	0.33	0.29	0.18	0.38	0.18	0.37
n	0.73	0.93	0.87	0.85	0.9	0.85
jc^p	7.19	0.65	12.16	0.45	9.61	0.34
jc^f	4.97	0.52	3.89	0.21	15.64	0.14
$\mu^f / (\mu^f + \mu^p)$	1.29	-0.4	2.89	-0.47	9.95	-0.04
n^f	1.87	0.18	2.0	0.1	8.89	0.03
jd^p	5.7	-0.43	7.05	-0.54	10.18	-0.51
jd^f	2.84	0.39	2.0	0.24	8.89	0.14
v	10.32	0.61	7.29	0.41	12.08	0.35

Table 3.4.2: Labor market moments and institutions.

Table 3.4.2 shows that the cyclicality of variables has not changed much. The only exception is the share of fixed-term contracts in job creation, which was counter-cyclical and is now acyclical. Talking

about volatility, open-ended job destruction is more volatile as the cut in firing costs hinders its movements less. Note that the volatility of flows on the fixed-term side soars, whereas the volatility of job creation decreased on the open-ended side of the labor market. The tightened hiring region of fixed-term workers strengthens the sensitivity of the related labor market moments. Surprisingly, the change in the composition of flows and employment does not impact inflation and employment volatility and cyclical.

What happens to inflation dynamics? Using the job creation condition (3.2.39) to isolate $\widehat{\phi}_t$, the New-Keynesian Phillips curve becomes

$$\widehat{\pi}_t = hc_t + \Pi_t^f + subs_t^p - \frac{\kappa}{1 - \beta\rho_A} \widehat{A}_t + \epsilon_t^\mu$$

The hiring cost component hc is bound to the cost of vacancy posting.

$$hc_t = \kappa\sigma \sum_{T=t}^{+\infty} \beta^{T-t} \mathbb{E}_t \widehat{\theta}_T$$

The fixed-term hiring component Π^f represents the profitability of hiring fixed-term contracts only.

$$\Pi_t^f = \frac{(1-\eta)}{\gamma} \frac{\epsilon-1}{\epsilon} \kappa (\mu^f + \mu^p) \rho z^f \sum_{T=t}^{+\infty} \beta^{T-t} \mathbb{E}_t z_T^f$$

The substitution component $subs^p$ relates to the profitability of substituting fixed-term contracts towards open-ended hiring.

$$subs_t^p = \frac{(1-\eta)}{\gamma} \frac{\epsilon-1}{\epsilon} \kappa \mu^p z^* \sum_{T=t}^{+\infty} \beta^{T-t} \mathbb{E}_t z_T^*$$

The variance of inflation verifies

$$\text{var}(\hat{\pi}) = \text{var}(hc) + \text{var}(\Pi^f) + \text{var}(subs^p) + \frac{\kappa^2}{(1 - \beta\rho_A)^2} \frac{\sigma_A^2}{1 - \rho_A^2} + \sigma_\mu^2 + covs$$

Covariances	Baseline	Reduced firing costs
$\text{var}(\pi)$	1.53	1.55
$\text{var}(hc)$	0.4	0.98
$2cov(hc, \Pi^f)$	-0.68	-1.64
$\text{var}(\Pi^f)$	0.29	0.69
$\text{var}(subs^p)$	$1.6 \cdot 10^{-4}$	$4.3 \cdot 10^{-4}$

Table 3.4.3: Firing costs and inflation volatility

Table 3.4.3 reports the variances of inflation and its relevant components in annual terms. As the small value of $\text{var}(subs^p)$ bears witness of, the substitution motive towards open-ended contracts plays a minor role. It is all the more true as the contractual productivity wedge $(1 - \rho)$ is tiny. Being able to substitute contracts without facing strong differences in production abilities *ex ante* matters to inflation dynamics. In the present case, the contractual composition of flows and employment can be altered in depth without influencing inflation dynamics. Meanwhile, reduced firing costs push up the profitability threshold z^f to a region where it affects fewer new matches, as Figure 3.2.6 suggests. Movements in the substitution threshold z^* do not alter much the expected surplus of a vacancy as ρ is close to one. Thus, the same percentage fluctuations in labor market tightness and, thus, hiring costs, require larger adjustments in the profitability threshold z^f . The steady-state value $z^f(\mu^p + \mu^f)$ does not move much. As a result, reduced firing costs push up the variance of the fixed-term hiring component Π^f . For the same reasons, the same percentage fluctuations in the profitability threshold z^f require larger adjustments in hiring costs ; the volatility of labor market tightness increases and so does the volatility of the hiring cost component hc . The higher volatility of the hiring cost component and the fixed-term profitability component is compensated

by the stronger negative co-variance of the labor market tightness and the profitability threshold. When the labor market tightness increases after a transitory shock, the expected cost of a vacancy increases. Consequently, the expected value of a vacancy must increase. A first possible response is to increase the profitability threshold to have more productive new hires, but fewer of them. A second solution is to decrease the profitability threshold to have less productive new hires, but more of them. In my calibration, the second solution prevails, which makes the labor market tightness and the profitability threshold negatively correlated. The enhanced volatility in the hiring cost component and the fixed-term hiring component mechanically increase the magnitude of their co-variance. Overall, in theoretical terms, the dual character of the labor market does not impact inflation dynamics as long as fixed-term contracts and open-ended contracts do not embed wide productivity wedges. Numerically speaking, I tried to check robustness with respect to ρ . As I highlight above, this parameter enable dualism to arise as an equilibrium. Small changes to ρ are enough to lose dualism. Introducing some persistence in the idiosyncratic productivity of matches would help reducing the sensitivity of the model with respect to this parameter.

3.5 Conclusion

In this paper, I have described and estimated a tractable New-Keynesian model with a dual labor market. The estimated model replicates well the main moments of a typical European dual labor market and shows that fixed-term employment could help identify uncertainty shocks from negative aggregate demand shocks. Moreover, changes in firing costs do not impact inflation volatility as long as the *ex ante* contractual productivity wedge remains small.

A few points merit further discussion, though. Tractability comes at a high cost. The assumption that fixed-term jobs produce less than open-ended ones all else equal enable a dual equilibrium to arise, but the resulting model is very sensitive to the parameter embodying this productivity wedge. Assuming that the quality of matches undergoes i.i.d shocks every period explains this lack of robustness. Moreover, ruling out heterogeneity enables to easily delineate the mechanisms at stake, but it leads to an incomplete investigation of inflation dynamics. Inflation dynamics seem unaffected by change in firing costs as long as fixed-term and open-ended workers substitute well. Accounting

for firm-worker heterogeneity and rigidity in wages would make the model more realistic. I plan to work out these extensions in future research.

Appendix

3.A Proofs

Proof Proposition 5 The behavior of the thresholds is characterized by the following proposition

Lemma 1. *These assertions are equivalent*

1. $z_t^* > z_t^f$
2. $z_t^* > z_t^c$
3. $z_t^c > z_t^f$

Proof. • Assume that $z_t^* > z_t^f$. The definition of z_t^* (3.2.35) implies that $z_t^* = (1 - \rho) z_t^* + \rho z_t^* = z_t^c + \rho (z_t^* - z_t^f)$. Since $z_t^* - z_t^f > 0$, the latter equality implies $z_t^* > z_t^c$.

• Assume that $z_t^* > z_t^c$. Again, jointly with algebraic manipulations, (3.2.35) implies that $\rho z_t^c = -(1 - \rho) z_t^c + (1 - \rho) z_t^* + \rho z_t^f > -(1 - \rho) z_t^c + (1 - \rho) z_t^c + \rho z_t^f > \rho z_t^f$, which entails that $z_t^c > z_t^f$.

• Assume that $z_t^c > z_t^f$. Algebraic manipulations and (3.2.35) imply that $(1 - \rho) z_t^* = z_t^c - z_t^f + (1 - \rho) z_t^f > (1 - \rho) z_t^f$, which implies $z_t^* > z_t^f$. \square

\square

Referring to the job creation condition (3.2.39),

- If open-ended workers are the only ones hired, then $\max [z^f, z^*] \leq z^f$, implying that $z^* \leq z^f$. Referring to Lemma 1, the latter inequality entails $z^f \leq z^c$. As a result, $z^* \leq z^f \leq z^c$.

- If job creation is dual, then

$$\begin{cases} 0 < \max [z^f, z^*] \\ z^f < z^* \end{cases}$$

Using Lemma 1, the latter system of inequalities boils down to $\max [0, z^f] < z^*$.

For each case, the converse propositions are straightforward using (3.2.39). \square

Proof Proposition 6 Differentiating (3.2.36)-(3.2.37), I get.

$$\begin{aligned} (1 - \beta(1 - \xi)) \phi \frac{\partial z^p}{\partial F} &= -(1 - \beta(1 - s)) + \frac{\eta\gamma}{1 - \eta} \frac{\partial \theta}{\partial F} \\ \phi \frac{\partial z^c}{\partial F} &= \phi \frac{\partial z^p}{\partial F} + 1 \end{aligned}$$

Combining both equation leads to

$$\phi \frac{\partial z^c}{\partial F} = \frac{\beta(1 - s)G(z^p)}{1 - \beta(1 - \xi)} + \frac{1}{1 - \beta(1 - \xi)} \frac{\eta\gamma}{1 - \eta} \frac{\partial \theta}{\partial F}$$

Differentiating (3.2.35) and (3.2.38) leads to

$$\begin{aligned} (1 - \rho) \phi \frac{\partial z^*}{\partial F} &= \phi \frac{\partial z^c}{\partial F} - \rho \phi \frac{\partial z^f}{\partial F} \\ \rho(1 - \beta(1 - \delta)) \phi \frac{\partial z^f}{\partial F} &= \frac{\eta\gamma}{1 - \eta} \frac{\partial \theta}{\partial F} \end{aligned}$$

Using these equations in the differentiated (3.2.39), I get

$$\begin{aligned}
-\frac{\gamma q'}{(1-\eta)q^2} \frac{\partial \theta}{\partial F} &= -(1-G(z^*)) (1-\rho) \phi \frac{\partial z^*}{\partial F} - \left(1-G(z^f)\right) \rho \phi \frac{\partial z^f}{\partial F} \\
&= -(1-G(z^*)) \phi \frac{\partial z^c}{\partial F} - \rho \left(G(z^*) - G(z^f)\right) \phi \frac{\partial z^f}{\partial F} \\
&= -(1-G(z^*)) \frac{\beta(1-s)G(z^p)}{1-\beta(1-\xi)} - \left(\frac{1-G(z^*)}{1-\beta(1-\xi)} + \frac{G(z^*) - G(z^f)}{1-\beta(1-\delta)}\right) \frac{\eta\gamma}{1-\eta} \frac{\partial \theta}{\partial F}
\end{aligned}$$

Isolating $\frac{\partial \theta}{\partial F}$ yields

$$\frac{\partial \theta}{\partial F} = -\frac{(1-G(z^*)) \frac{\beta(1-s)G(z^p)}{1-\beta(1-\xi)}}{-\frac{\gamma q'}{(1-\eta)q^2} + \left(\frac{1-G(z^*)}{1-\beta(1-\xi)} + \frac{G(z^*) - G(z^f)}{1-\beta(1-\delta)}\right) \frac{\eta\gamma}{1-\eta}} < 0$$

Knowing the sign of $\frac{\partial \theta}{\partial F}$ leads to

$$\begin{aligned}
\frac{\partial z^p}{\partial F} &< 0 \\
\frac{\partial z^f}{\partial F} &< 0 \\
\frac{\partial z^c}{\partial F} &\propto -\frac{\gamma q'}{(1-\eta)q^2} + \frac{G(z^*) - G(z^f)}{1-\beta(1-\delta)} \frac{\eta\gamma}{1-\eta} > 0 \\
\frac{\partial z^*}{\partial F} &> 0
\end{aligned}$$

3.B Detailed Calculations

3.B.1 Nash-bargaining joint surpluses

Using the different definitions of surpluses with the free-entry condition -namely equations (3.2.14), (3.2.15), (3.2.27) and (3.2.9) - I get

$$\begin{aligned}
S_t^p(z_t) &= z_t - U_t + \mathbb{E}_t \beta_{t,t+1} U_{t+1} + (1 - \mathbb{E}_t \beta_{t,t+1} (1 - s)) F \\
&\quad + \mathbb{E}_t \beta_{t,t+1} (1 - s) \int \max(S_{t+1}^p(z), 0) dG(z)
\end{aligned} \tag{3.B.1}$$

Meanwhile, the definition of U_t (3.2.12) yields

$$U_t = p(\theta_t) \int \max(W_t^{0,p}(z) - U_t^0, W_t^f(z) - U_t^0, 0) dG(z) + U_t^0 \tag{3.B.2}$$

Nash-sharing rules (3.2.7) imply that

$$U_t = p(\theta_t) \frac{\eta}{1 - \eta} \int \max(J_t^{0,p}(z), J_t^f(z), \mathbb{E}_t \beta_{t,t+1} V_{t+1}) dG(z) + (1 - p(\theta_t)) U_t^0 \tag{3.B.3}$$

But the definition of V_t (3.2.5) and the free entry condition (3.2.27) imply that

$$\int \max(J_t^{0,p}(z), J_t^f(z), \mathbb{E}_t \beta_{t,t+1} V_{t+1}) dG(z) = \frac{\gamma}{q(\theta_t)} \tag{3.B.4}$$

Since $p(\theta_t) = \theta_t q(\theta_t)$, the definition of U_t boils down to

$$U_t = \frac{\eta \gamma \theta_t}{1 - \eta} + U_t^0 \tag{3.B.5}$$

Consequently, using (3.2.13) the outside value of an incumbent worker is

$$U_t = b + \frac{\eta \gamma \theta_t}{1 - \eta} + \mathbb{E}_t \beta_{t,t+1} U_{t+1} \tag{3.B.6}$$

Reintroducing (3.B.6) into (3.2.20) leads to the following expression for the surplus of continuing

permanent contracts

$$\begin{aligned}
S_t^p(z_t) &= A_t z_t \phi_t - b - \frac{\eta \gamma \theta_t}{1 - \eta} + (1 - \mathbb{E}_t \beta_{t,t+1} (1 - s)) F \\
&\quad + \mathbb{E}_t \beta_{t,t+1} (1 - s) \int \max(S_{t+1}^p(z), 0) dG(z)
\end{aligned} \tag{3.B.7}$$

Following the same steps, I find that

$$S_t^{0,p}(z_t) = S_t^p(z_t) - F \tag{3.B.8}$$

As for temporary contracts, equations (3.2.18), (3.2.19) and (3.2.27) boil down to

$$S_t^f(z_t) = \rho A_t z_t \phi_t - U_t + \mathbb{E}_t \beta_{t,t+1} \left\{ (1 - \delta) \int S_{t+1}^f(z) dG(z) + U_{t+1} \right\} \tag{3.B.9}$$

Using (3.B.6), the surplus of incumbent fixed-term contracts is

$$S_t^f(z_t) = \rho A_t z_t \phi_t - b - \frac{\eta \gamma \theta_t}{1 - \eta} + \mathbb{E}_t \beta_{t,t+1} (1 - \delta) \left\{ \int S_{t+1}^f(z) dG(z) \right\} \tag{3.B.10}$$

3.B.2 Steady-state equations

Given parameters $\beta, \sigma, \eta, \sigma_z, \epsilon, F, b, \delta, \rho, m, \gamma$, we need to derive the steady-state values of $R, c, Y, n^p, n^f, u, \Delta, z^p, z^c, z^f, z^*, \theta, \phi, v, \pi, A, g$. Some of them can be directly computed through the following equations

$$R = 1/\beta$$

$$\phi = \frac{\epsilon - 1}{\epsilon}$$

$$P = P^* = \Delta = 1$$

$$A = 1$$

Given (z^p, θ) , many variables can be derived in a tractable way.

$$q = m\theta^{-\sigma}$$

$$p = \theta q$$

$$U = b + \frac{\eta\gamma\theta}{1 - \eta}$$

$$z^c = z^p + \frac{F}{\phi}$$

$$z^f = \frac{U - \rho\phi(1 - \delta)\beta\mathbb{E}z}{\rho\phi(1 - \beta(1 - \delta))}$$

$$z^* = \frac{z^c - \rho z^f}{1 - \rho}$$

$$\xi = s + (1 - s)G(z^p)$$

$$\mu^p = p(1 - G(z^*))$$

$$\mu^f = p\left(G(z^*) - G(z^f)\right)$$

Then, one can circumscribe (z^p, θ) by solving the following system numerically.

$$\begin{aligned} \phi z^p + (1 - \beta(1 - s))F + (1 - s)\beta\phi \int_{z^p}^{+\infty} (1 - G(z)) dz &= U \\ \frac{\gamma}{(1 - \eta)\phi q} &= \int_{z^*}^{+\infty} (1 - G(z)) dz + \rho \int_{z^f}^{z_t^*} (1 - G(z)) dz \end{aligned}$$

Solving the following linear system yields (n^p, n^f, u, e) .

$$\begin{aligned}
n^p + n^f + u &= 1 \\
e &= u + \delta n^f + \xi n^p \\
n^p &= (1 - \xi) n^p + \mu^p e \\
n^f &= (1 - \delta) n^f + \mu^f e
\end{aligned}$$

The resulting expressions are

$$\begin{aligned}
n^p &= \frac{\delta \mu^p}{\xi(1 - \delta)\mu^f + \delta(1 - \xi)\mu^p + \xi\delta} \\
n^f &= \frac{\xi \mu^f}{\xi(1 - \delta)\mu^f + \delta(1 - \xi)\mu^p + \xi\delta} \\
u &= 1 - n^p - n^f \\
e &= u + \xi n^p + \delta n^f
\end{aligned}$$

Now, the steady-state values v , Y , g and c can be obtained.

$$\begin{aligned}
v &= \theta e \\
Y &= (1 - \xi) \mathbb{E}_z [z \mid z \geq z^p] n^p + \mu^p \mathbb{E}_z [z \mid z \geq z^*] e \\
&\quad + \rho(1 - \delta) \mathbb{E}_z [z] n^f + \rho \mu^f \mathbb{E}_z [z \mid z^* \geq z \geq z^f] e \\
g &= Y \left(\frac{g}{Y} \right) \\
c &= Y - g - \gamma v
\end{aligned}$$

3.B.3 Log-linearization

The Euler equation can be log-linearized starting from

$$\widehat{c}_t = \widehat{E}_t \widehat{c}_{t+1} - \left[-\frac{cu''}{u} \right]^{-1} \left(\widehat{R}_t - \widehat{E}_t \widehat{\pi}_{t+1} \right) \quad (3.B.11)$$

where $\pi_t = P_t/P_{t-1}$ denotes inflation.

The definition of price level dynamics (3.2.49) can be log-linearized as

$$\widehat{\pi}_t = (1 - \psi) \left(\widehat{P}_t^* - \widehat{P}_{t-1} \right) \quad (3.B.12)$$

The retailers' price-setting equation (3.2.4) becomes

$$\widehat{P}_t^* = (1 - \beta\psi) \mathbb{E}_t \sum_{k=0}^{+\infty} (\beta\psi)^k \left(\widehat{P}_{t+k} + \widehat{\mu}_{t+k} + \widehat{\phi}_{t+k} \right) \quad (3.B.13)$$

Subtracting \widehat{P}_{t-1} on each side of this equation, we get

$$\widehat{P}_t^* - \widehat{P}_{t-1} = (1 - \beta\psi) \mathbb{E}_t \sum_{k=0}^{+\infty} (\beta\psi)^k \left(\widehat{P}_{t+k} - \widehat{P}_{t-1} + \widehat{\mu}_{t+k} + \widehat{\phi}_{t+k} \right) \quad (3.B.14)$$

$$= \widehat{\pi}_t + (1 - \beta\psi) (\mu_t + \phi_t) + (1 - \beta\psi) \mathbb{E}_t \sum_{k=1}^{+\infty} (\beta\psi)^k \left(\widehat{P}_{t+k} - \widehat{P}_t + \widehat{\mu}_{t+k} + \widehat{\phi}_{t+k} \right) \quad (3.B.15)$$

$$= \widehat{\pi}_t + (1 - \beta\psi) \left(\widehat{\phi}_t + \widehat{\mu}_t \right) + \beta\psi \left(\mathbb{E}_t \widehat{P}_{t+1}^* - \widehat{P}_t \right) \quad (3.B.16)$$

Using the definition of mark-up shocks ϵ_t^μ and using (3.B.12), I get

$$\widehat{\pi}_t = \beta \mathbb{E}_t \widehat{\pi}_{t+1} + \kappa \left(\widehat{\phi}_t + \epsilon_t^\mu \right) \quad (3.B.17)$$

where $\kappa = (1 - \beta\psi)(1 - \psi)/\psi$.

The log-linearization of exogenous processes yields

$$\begin{aligned}\widehat{A}_t &= \rho_A \widehat{A}_{t-1} + \epsilon_t^A \\ \widehat{g}_t &= \rho_g \widehat{g}_{t-1} + \epsilon_t^g\end{aligned}$$

The other log-linearizations of equations (3.2.36)-(3.2.38), (3.2.35) and (3.2.41)-(3.2.47) yield

$$\begin{aligned}& A\phi z^p \left(\widehat{A}_t + \widehat{z}_t^p + \widehat{\phi}_t \right) + \beta(1-s) \left(A\phi \int_{z^p}^{+\infty} (1-G(z)) dz - F \right) (c_t - \mathbb{E}_t \widehat{c}_{t+1}) \\ & + \beta(1-s) A\phi \left(\int_{z^p}^{+\infty} (1-G(z)) dz \left(\mathbb{E}_t \widehat{A}_{t+1} + \mathbb{E}_t \widehat{\phi}_{t+1} \right) - (1-G(z^p)) z^p \mathbb{E}_t \widehat{z}_{t+1}^p \right) \\ & - \frac{\eta\gamma\theta}{1-\eta} \widehat{\theta}_t = 0 \\ & \rho A\phi z^f \left(\widehat{A}_t + \widehat{z}_t^f + \widehat{\phi}_t \right) + \rho\beta(1-\delta) A\phi \left(\mathbb{E}z - z^f \right) \left(\mathbb{E}_t \widehat{A}_{t+1} + \mathbb{E}_t \widehat{\phi}_{t+1} + \widehat{c}_t - \mathbb{E}_t \widehat{c}_{t+1} \right) \\ & - \rho\beta(1-\delta) A\phi z^f \mathbb{E}_t \widehat{z}_{t+1}^f - \frac{\eta\gamma\theta}{1-\eta} \widehat{\theta}_t = 0 \\ & (1-\rho) z^* \widehat{z}_t^* - z^p \widehat{z}_t^p + \frac{F}{A\phi} \left(\widehat{A}_t + \widehat{\phi}_t \right) + \rho z^f \widehat{z}_t^f = 0 \\ & \frac{\gamma}{(1-\eta)\phi q(\theta)} \left(-\widehat{A}_t - \widehat{\phi}_t + \sigma\widehat{\theta}_t \right) + (1-\rho)(1-G(z^*)) z^* \widehat{z}_t^* + \rho \left(1-G(z^f) \right) z^f \widehat{z}_t^f = 0 \\ & \widehat{R}_t = \rho_R \widehat{R}_{t-1} + (1-\rho_R) \left[\rho_\pi \mathbb{E}_t \widehat{\pi}_{t+1} + \rho_y \widehat{Y}_t \right] + \epsilon_t^m \\ & \widehat{v}_t = \widehat{\theta}_t - \frac{(1-\xi^p)\theta n^p}{v} \widehat{n}_{t-1}^p - \frac{(1-\delta)\theta n^f}{v} \widehat{n}_{t-1}^f + \frac{(1-s)\theta g(z^p) z^p n^p}{v} \widehat{z}_t^p \\ & \widehat{n}_t^p = (1-\xi) \widehat{n}_{t-1}^p - (1-s) z^p g(z^p) \widehat{z}_t^p + \frac{(1-G(z^*))q(\theta)v}{n^p} \left(\widehat{v}_t - \sigma\widehat{\theta}_t \right) - \frac{z^* g(z^*) q(\theta)v}{n^p} \widehat{z}_t^* \\ & \widehat{n}_t^f = (1-\delta) \widehat{n}_{t-1}^f + \frac{(G(z^*) - G(z^f))q(\theta)v}{n^f} \left(\widehat{v}_t - \sigma\widehat{\theta}_t \right) + \frac{q(\theta)v}{n^f} \left(z^* g(z^*) \widehat{z}_t^* - z^f g(z^f) \widehat{z}_t^f \right) \\ & \widehat{Y}_t = \frac{c}{Y} \widehat{c}_t + \frac{g}{Y} \widehat{g}_t + \frac{\gamma v}{Y} \widehat{v}_t \\ & \widehat{Y}_t = \widehat{A}_t + \frac{(1-s) \left(\int_{z^p}^{+\infty} z g(z) dz \right) n^p}{Y} \widehat{n}_{t-1}^p + \frac{\rho(1-\delta) \mathbb{E}z n^f}{Y} \widehat{n}_{t-1}^f - \frac{(1-s)n^p (z^p)^2 g(z^p)}{Y} \widehat{z}_t^p \\ & - (1-\rho) (z^*)^2 g(z^*) \frac{vq(\theta)}{Y} \widehat{z}_t^* - \rho (z^f)^2 g(z^f) \frac{vq(\theta)}{Y} \widehat{z}_t^f \\ & + \left(\int_{z^*}^{+\infty} z g(z) dz + \rho \int_{z^f}^{z^*} z g(z) dz \right) \frac{vq(\theta)}{Y} \left(\widehat{v}_t - \sigma\widehat{\theta}_t \right)\end{aligned}$$

3.C Estimation

3.C.1 Calibration

I carry out the calibration using known parameters and steady-state targets. A first block of steady-state values and parameters is tractable.

$$\begin{aligned}\phi &= \frac{\epsilon - 1}{\epsilon} \\ u &= 1 - n \\ n^f &= n \left(\frac{n^f}{n} \right) \\ n^p &= n - n^f \\ s &= \xi \left(\frac{s}{\xi} \right) \\ \delta &= \frac{\left(1 - \left(\frac{n^f}{n} \right) \right) \left(\frac{\mu^f}{\mu^p + \mu^f} \right)}{\left(\frac{n^f}{n} \right) \left(1 - \left(\frac{\mu^f}{\mu^p + \mu^f} \right) \right)} \xi \\ e &= u + \delta n^f + \xi n^p \\ \mu^p &= \frac{\xi n^p}{e} \\ \mu^f &= \frac{\delta n^f}{e}\end{aligned}$$

Knowing ξ , s and σ^z , it is possible to numerically solve for z^p using the fact that $\xi = s + (1 - s)G(z^p)$.

Then, the following system in (\bar{w}^p, U, F) — where $U = b + \frac{\eta\gamma\theta}{1-\eta}$ — is tractable.

$$\bar{w}^p = \eta\phi\mathbb{E}[z \mid z \geq z^p] + \eta(1 - \beta(1 - s))F + (1 - \eta)U$$

$$\phi z^p + (1 - \beta(1 - s)) F + (1 - s)\beta\phi \int_{z^p}^{+\infty} (1 - G(z)) dz = U$$

$$F = \rho^F \bar{w}^p$$

Combining these three expressions, I get

$$F = \frac{\rho^F \phi}{1 - \rho^F(1 - \beta(1 - s))} \left(\eta \mathbb{E}[z \mid z \geq z^p] + (1 - \eta) \left(z^p + \beta(1 - s) \int_{z^p}^{+\infty} (1 - G(z)) dz \right) \right)$$

$$U = \phi z^p + (1 - \beta(1 - s)) F + (1 - s)\beta\phi \int_{z^p}^{+\infty} (1 - G(z)) dz$$

It is possible to compute z^c .

$$z^c = z^p + \frac{F}{\phi}$$

A non-linear system in (z^f, z^*, ρ) can then be solved numerically.

$$\rho z^f \phi + \rho \mathbb{E}_t \beta (1 - \delta) \phi (\mathbb{E} z - z^f) = U$$

$$(1 - \rho) z^* = z^c - \rho z^f$$

$$\frac{\mu^f}{\mu^p + \mu^f} = \frac{G(z^*) - G(z^f)}{1 - G(z^f)}$$

Then, one can derive (θ, γ, b, m) .

$$p = \frac{\mu^p}{1 - G(z^*)}$$

$$\theta = \frac{p}{q}$$

$$\gamma = (1 - \eta)\phi q \left(\int_{z^*}^{+\infty} (1 - G(z)) dz + \rho \int_{z^f}^{z^*} (1 - G(z)) dz \right)$$

$$b = U - \frac{\eta\gamma\theta}{1 - \eta}$$

$$m = q\theta^\sigma$$

The parameters $(F, b, s, \delta, \rho, m, \gamma)$ are all determined at this point

3.C.2 Data

Observable	Time range	Unique Identifier
GDP at constant prices	1995:Q1 - 2019:Q3	MNA.Q.Y.I8.W2.S1.S1.B.B1GQ._Z._Z._Z.EUR.LR.N
GDP deflator	1995:Q2 - 2019:Q2	MNA.Q.Y.I8.W2.S1.S1.B.B1GQ._Z._Z._Z.IX.D.N
Nominal interest rates	1994:Q1 - 2019:Q3	FM.M.U2.EUR.4F.MM.EONIA.HSTA
Employment	1995:Q1 - 2019:Q3	ENA.Q.Y.I8.W2.S1.S1._Z.EMP._Z._T._Z.PS._Z.N

Table 3.C.1: Times series used for estimation

All these time series are drawn from the ECB Data Warehouse

Observable	Symbol	Time range	Source	Unique Identifier
Open-ended job creations	jc^p	2000:Q1 - 2019:Q3	Across	Across Stat 296
Fixed-term job creations	jc^f	2000:Q1 - 2019:Q3	Across	Across Stat 296
Share of fixed- term contracts in job creation	$\mu^f / (\mu^p + \mu^f)$	2000:Q1 - 2019:Q3	Across	Across Stat 296
Share of fixed- term employ- ment	n^f	2003:Q1 - 2019:Q3	Insee	010605905
Endogenous open-ended job destruction	jd^p	2001:Q1 - 2017:Q4	DARES	DMMO - EMMO
Fixed-term job destruction	jd^f	1998:Q1 - 2017:Q4	DARES	DMMO - EMMO
Vacancies	v	1989:Q1 - 2019:Q2	OECD	LMJVTTNVFRQ647S

Table 3.C.2: Labor market times series

3.C.3 Additional graphs and tables

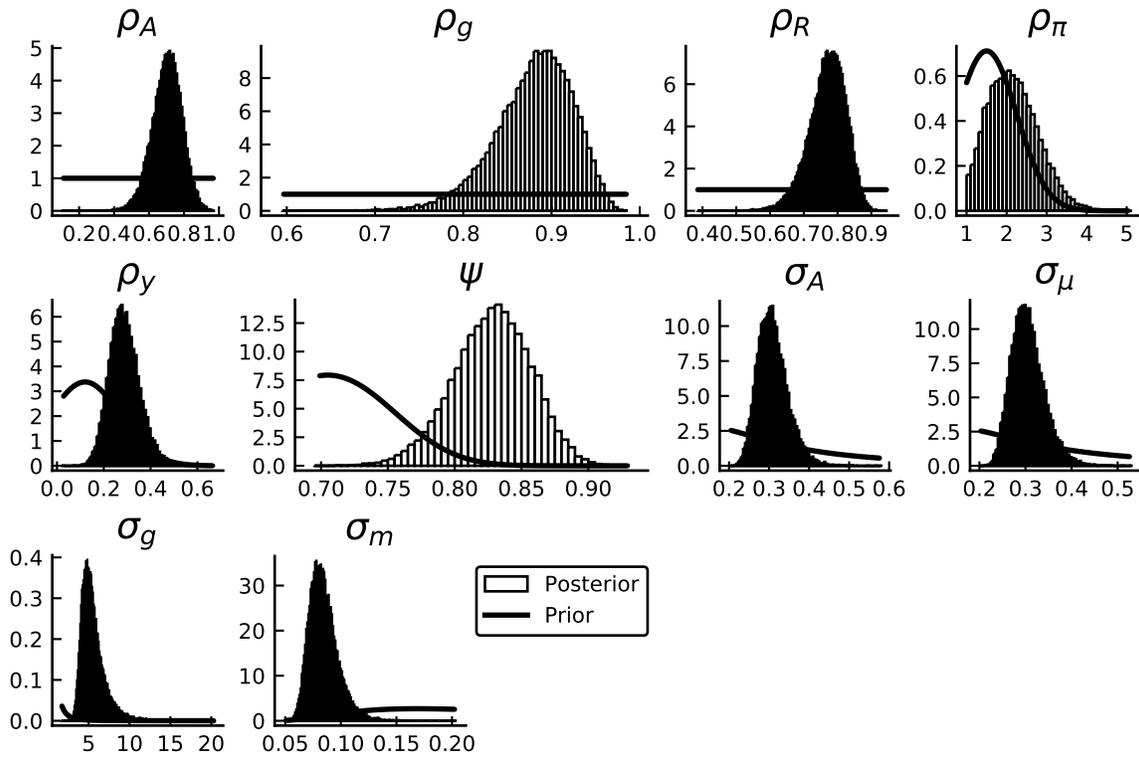


Figure 3.C.1: Prior and posterior distributions

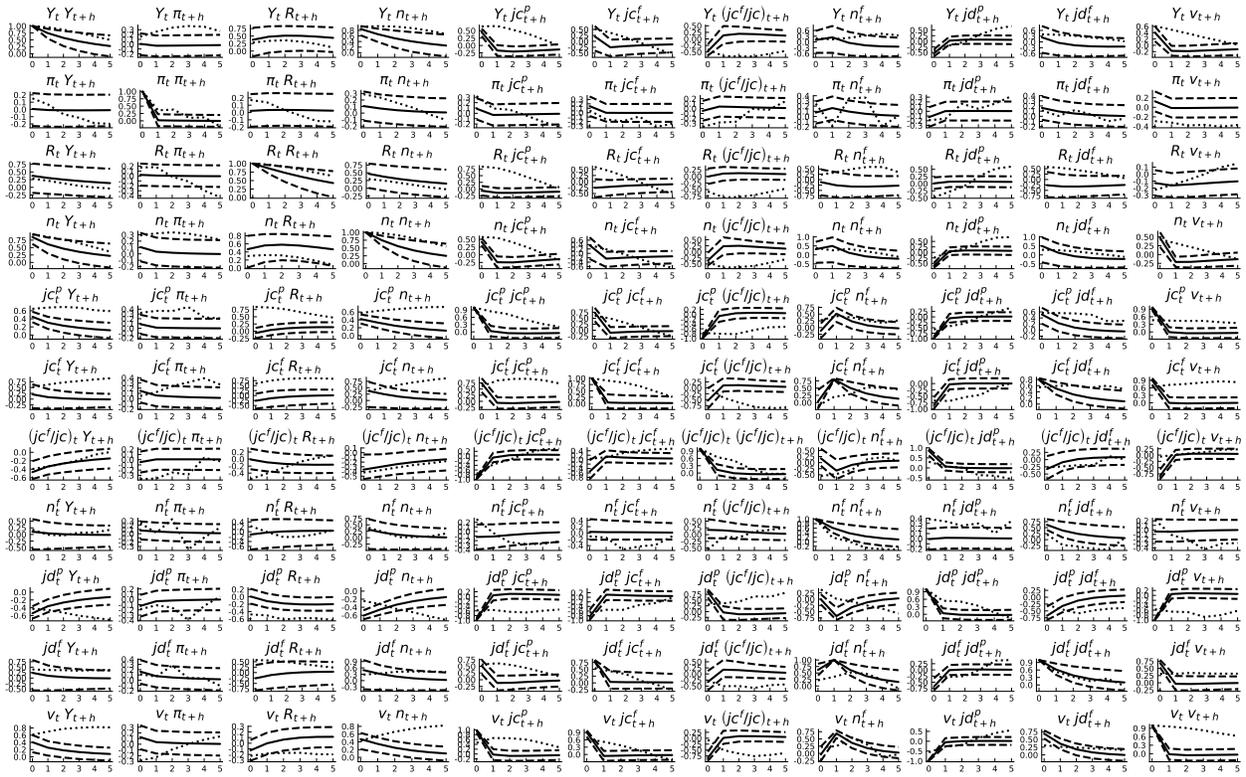


Figure 3.C.2: Simulated and data cross-correlations

The x-axis is the lag h and the y-axis is the correlation between the variable x_t and the variable x_{t+h} . The solid line is the simulated value, the dashed line is the 95% confidence interval around the latter and the dotted line is the value from the data.

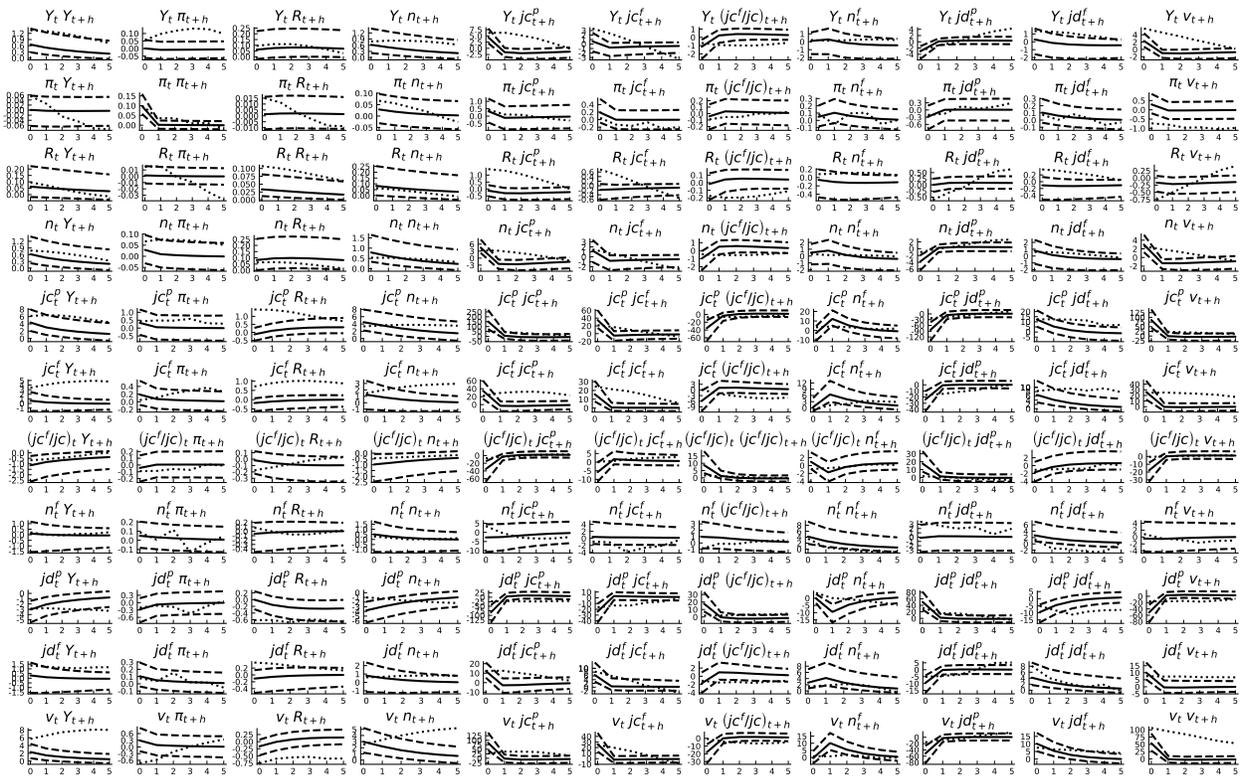


Figure 3.C.3: Simulated and data cross-covariances

The x-axis is the lag h and the y-axis is the covariance between the variable x_t and the variable x_{t+h} . The solid line is the simulated value, the dashed line is the 95 % confidence interval around the latter and the dotted line is the value from the data.

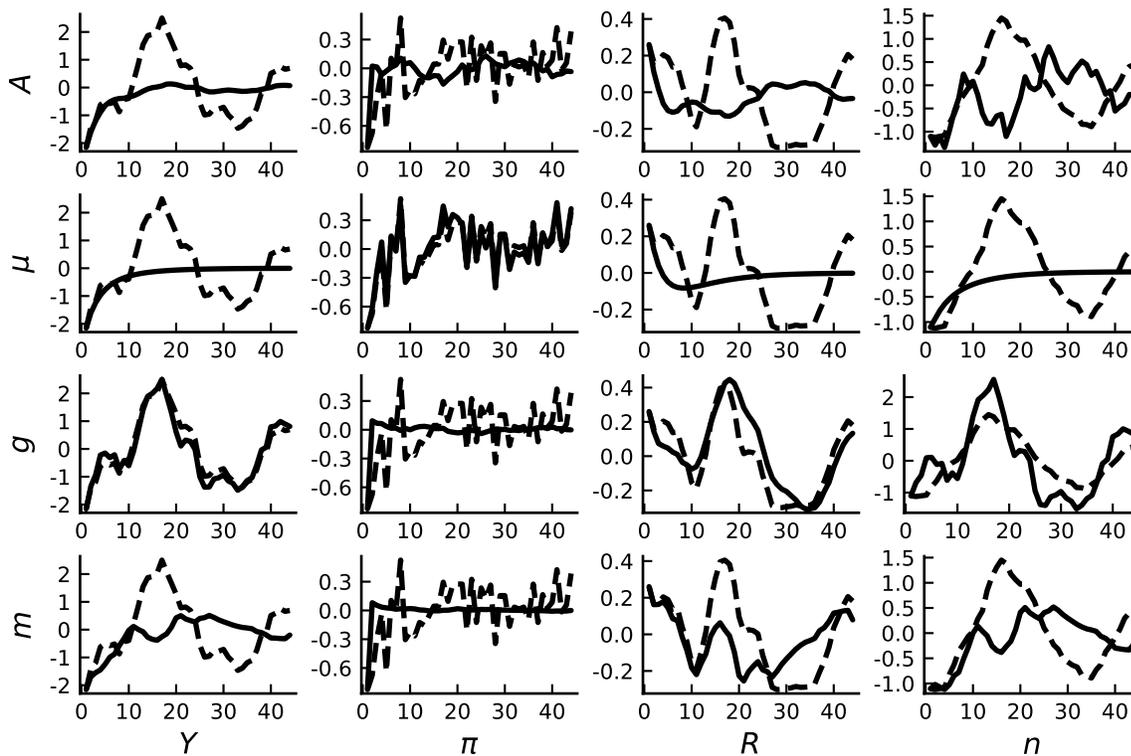


Figure 3.C.4: Historical decomposition of observable variables with respect to shocks

X-axes represent time in quarters, y-axes represent per-cent deviation in the considered variable. Each column is associated with an observable variable, each row relates to a shock. A plot set at the intersection of row i and column j represents the model-induced counter-factual history of variable j if shock i is the only allowed. The plain line is the counter-factual history of variable j ; the dashed line is the actual one.

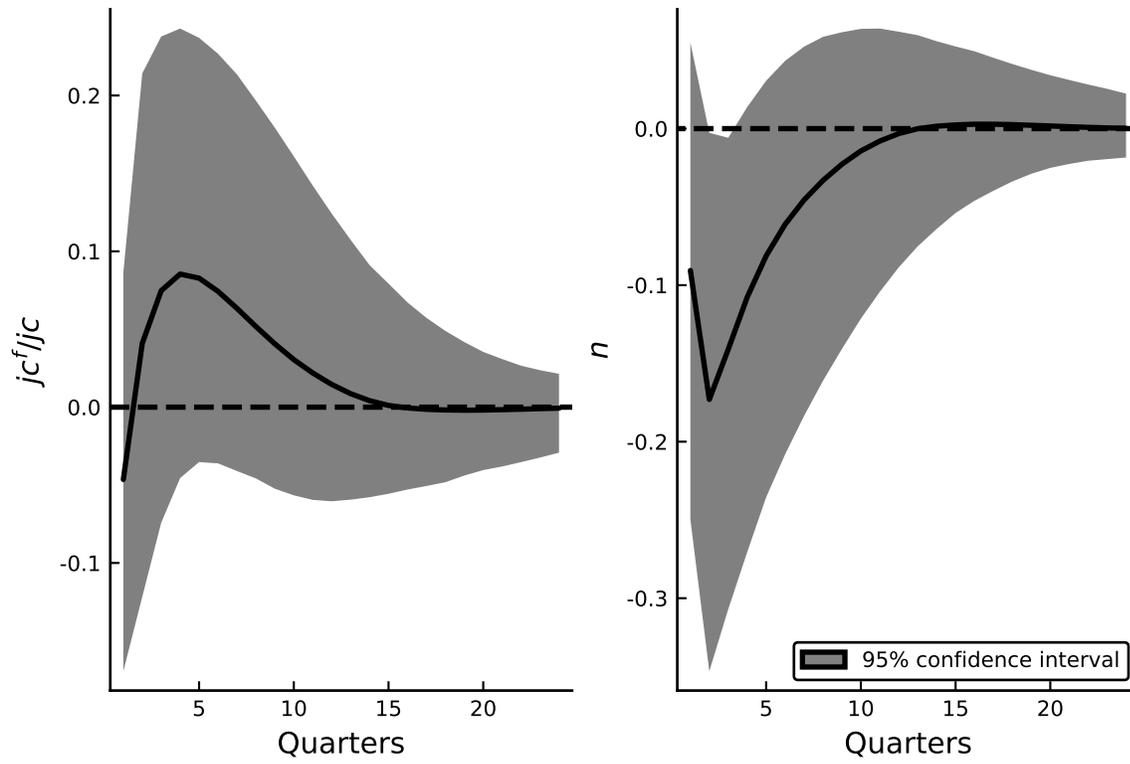


Figure 3.C.5: IRF to a one-standard deviation volatility shock — VAR estimation.

Parameters	Hamilton		Linear trend		First difference		Hodrick-Prescott	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
ρ_A	0.52	0.11	0.69	0.08	0.29	0.27	0.62	0.09
ρ_g	0.86	0.05	0.88	0.04	0.78	0.08	0.86	0.05
ρ_R	0.79	0.04	0.77	0.05	0.79	0.08	0.7	0.05
ρ_π	2.02	0.59	2.06	0.54	1.87	0.74	1.99	0.51
ρ_y	0.25	0.05	0.29	0.06	0.46	0.12	0.43	0.06
ψ	0.84	0.03	0.83	0.03	0.71	0.06	0.8	0.03
σ_A	0.79	0.11	0.31	0.03	0.32	0.04	0.29	0.03
σ_μ	0.23	0.03	0.3	0.03	0.28	0.04	0.3	0.03
σ_g	7.67	1.74	5.61	1.36	3.04	0.87	5.13	1.17
σ_m	0.06	0.01	0.08	0.01	0.09	0.02	0.06	0.01

Table 3.C.3: Estimations with Hamilton, linear-trend, first-difference and Hodrick-Prescott filters

3.D Classic Model

3.D.1 Equilibrium equations

$$\begin{aligned}
u'(c_t) &= \beta R_t \mathbb{E}_t \left[\frac{P_t}{P_{t+1}} u'(c_{t+1}) \right] \\
A_t z_t^p \phi_t + (1 - \mathbb{E}_t \beta_{t,t+1} (1 - s)) F + \mathbb{E}_t \beta_{t,t+1} (1 - s) A_{t+1} \phi_{t+1} &= \int_{z_{t+1}^p}^{+\infty} (1 - G(z)) dG(z) \\
&= b + \frac{\eta \gamma \theta_t}{1 - \eta} \\
z_t^c &= z_t^p + \frac{F_t}{A_t \phi_t} \\
\frac{\gamma}{(1 - \eta) A_t \phi_t q(\theta_t)} &= \int_{z_t^c}^{+\infty} [1 - G(z)] dz \\
n_t^p &= (1 - \xi_t) n_{t-1}^p + \mu_t^p e_t \\
v_t &= \theta_t (1 - (1 - \xi_t) n_{t-1}^p)
\end{aligned}$$

$$Y_t = c_t + g_t + \gamma v_t$$

$$Y_t \Delta_t = A_t E_z [z \mid z \geq z_t^p] (1 - \xi_t) n_{t-1}^p + (1 - G(z_t^c)) q(\theta_t) v_t A_t E_z [z \mid z \geq z_t^c]$$

$$\mathbb{E}_t \sum_{T=t}^{+\infty} \beta_{t,T} \psi^{T-t} P_T^\epsilon Y_T \left(\frac{P_{i,t}^*}{P_T} - \mu \phi_T \right) = 0$$

$$\log(R_t/R) = \rho_R \log(R_{t-1}/R) + (1 - \rho_R) \left[\rho_\pi \mathbb{E}_t \log\left(\frac{P_{t+1}}{P_t}\right) + \rho_y \log\left(\frac{y_t}{y}\right) \right] + \epsilon_t^m$$

$$\log(A_t/A) = \rho^A \log(A_{t-1}/A) + \epsilon_t^A$$

$$\log(g_t/g) = \rho^g \log(g_{t-1}/g) + \epsilon_t^g$$

3.D.2 Log-linearization

$$\widehat{c}_t = \widehat{E_t c_{t+1}} - \left[-\frac{cu''}{u} \right]^{-1} \left(\widehat{R}_t - \widehat{E_t \pi_{t+1}} \right)$$

$$A \phi z^p \left(\widehat{A}_t + \widehat{z}_t^p + \widehat{\phi}_t \right) + \beta(1-s) \left(A \phi \int_{z^p}^{+\infty} (1-G(z)) dz - F \right) (c_t - \mathbb{E}_t \widehat{c_{t+1}}) \\ + \beta(1-s) A \phi \left(\int_{z^p}^{+\infty} (1-G(z)) dz \left(\mathbb{E}_t \widehat{A_{t+1}} + \mathbb{E}_t \widehat{\phi_{t+1}} \right) - (1-G(z^p)) z^p \mathbb{E}_t \widehat{z_{t+1}^p} \right)$$

$$- \frac{\eta \gamma \theta}{1-\eta} \widehat{\theta}_t = 0$$

$$z^c \widehat{z}_t^c = z^p \widehat{z}_t^p - \frac{F}{A \phi} \left(\widehat{A}_t + \widehat{\phi}_t \right)$$

$$\frac{\gamma}{(1-\eta) \phi q(\theta)} \left(-\widehat{A}_t - \widehat{\phi}_t + \sigma \widehat{\theta}_t \right) + (1-G(z^c)) z^c \widehat{z}_t^c = 0$$

$$\widehat{n}_t^p = (1-\xi) \widehat{n}_{t-1}^p - (1-s) z^p g(z^p) \widehat{z}_t^p + \frac{(1-G(z^c)) q(\theta) v}{n^p} \left(\widehat{v}_t - \sigma \widehat{\theta}_t \right) - \frac{z^c g(z^c) q(\theta) v}{n^p} \widehat{z}_t^c$$

$$\widehat{v}_t = \widehat{\theta}_t - \frac{(1-\xi) \theta n^p}{v} \widehat{n}_{t-1}^p + \frac{(1-s) \theta g(z^p) z^p n^p}{v} \widehat{z}_t^p$$

$$\widehat{Y}_t = \frac{c}{Y} \widehat{c}_t + \frac{g}{Y} \widehat{g}_t + \frac{\gamma v}{Y} \widehat{v}_t$$

$$\widehat{Y}_t = \widehat{A}_t + \frac{(1-s) \left(\int_{z^p}^{+\infty} z g(z) dz \right) n^p}{Y} \widehat{n}_{t-1}^p - \frac{(1-s) n^p (z^p)^2 g(z^p)}{Y} \widehat{z}_t^p$$

$$- (z^c)^2 g(z^c) \frac{v q(\theta)}{Y} \widehat{z}_t^c + \left(\int_{z^c}^{+\infty} z g(z) dz \right) \frac{v q(\theta)}{Y} \left(\widehat{v}_t - \sigma \widehat{\theta}_t \right)$$

$$\widehat{\pi}_t = \beta \mathbb{E}_t \widehat{\pi_{t+1}} + \frac{(1-\beta \psi)(1-\psi)}{\psi} \widehat{\phi}_t + \epsilon_t^\mu$$

$$\widehat{R}_t = \rho_R \widehat{R}_{t-1} + (1-\rho_R) \left[\rho_\pi \mathbb{E}_t \widehat{\pi_{t+1}} + \rho_y \widehat{Y}_t \right] + \epsilon_t^m$$

$$\widehat{A}_t = \rho_A \widehat{A}_{t-1} + \epsilon_t^A$$

$$\widehat{g}_t = \rho_g \widehat{g}_{t-1} + \epsilon_t^g$$

3.D.3 Estimation

Parameter	Prior distribution			Posterior distribution			
	Distr.	Para (1)	Para(2)	Mean	Std. Dev.	5%	95%
ρ_A	Uniform	0.0	1.0	0.71	0.09	0.55	0.86
ρ_g	Uniform	0.0	1.0	0.95	0.03	0.9	0.99
ρ_R	Uniform	0.0	1.0	0.7	0.06	0.59	0.8
ρ_π	Normal	1.5	0.75	2.22	0.64	1.25	3.34
ρ_y	Normal	0.12	0.15	0.11	0.07	0.02	0.25
ψ	Beta	0.7	0.05	0.78	0.05	0.7	0.85
σ_A	IGamma	0.5	4.0	0.33	0.04	0.27	0.4
σ_μ	IGamma	0.5	4.0	0.28	0.03	0.23	0.34
σ_g	IGamma	0.5	4.0	9.04	5.73	4.26	18.1
σ_m	IGamma	0.5	4.0	0.08	0.01	0.06	0.11

Table 3.D.1: Prior and posterior distributions of structural parameters.

Para(1) and Para(2) correspond to mean and standard deviation of the prior distribution if the latter is Normal or Inverse Gamma. Para(1) and Para(2) correspond to lower and upper bound of the prior distribution when the latter is uniform

Model	$\log(p(Y_{1:T}))$	Std. Dev.
Dual	-27.4	1.1
Classic	-25.7	1.0

Table 3.D.2: Posterior Odds

Chapter 4

Job creation in a dual labor market: a constructivist approach

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Abstract

In this paper, I review matching models of dual labor markets from a theoretical point of view and describe the consequences of the most common sets of assumptions on job creation. I assert that two poles arise in the literature depending on the modeling of fixed-term contracts. Some papers assume that fixed-term contracts are flexible in the sense that firm-worker matches may costlessly separate any time. Others assume that a fixed-term match is rigid and cannot split before reaching its stipulated termination date, regardless the undergone shocks. Modeling fixed-term contracts as utterly flexible tends to make fixed-term contracts the only vehicle of job creation, while open-ended contracts only appear as converted expiring fixed-term contracts. This counter-factual result encourages the use of *ad hoc* hiring rules that ensure that job creation involves both contracts. On the contrary, modeling fixed-term contracts as rigid makes fixed-term contracts less attractive and leaves more room for job creation to involve open-ended contracts. Substitution effects between contracts can be considered in these frameworks. I build up a model with rigid fixed-term contracts and heterogeneous productivity of matches assumption by assumption and find major robustness issues. Introducing the convertibility of fixed-term contracts into open-ended ones flips over the ranking of contracts at the hiring stage with respect to productivity. Enabling matches to optimize the average duration of fixed-term contracts leads to highly counter-factual results: the shortest and the least productive fixed-term matches have the highest probabilities to be converted to open-ended contracts. The highlighted robustness issues and counter-factual predictions contaminate recent papers studying labor market dualism and heterogeneity in workload fluctuations.

JEL Classification: J40, J41

Keywords: matching models, fixed-term contracts, firing costs, robustness

Introduction

In Western Europe, fixed-term employment has considerably expanded over the last decades. Fixed-term contracts are now pervasive in job creation flows. As the celebrated paper Shimer (2012) shows, job creation flows mostly account for unemployment fluctuations. Understanding why agents prefer hiring through one type of contract is thus essential. A few papers tried to theorize the contractual choice at the hiring stage using matching models. Surprisingly, though, if papers have reviewed this literature, none has assessed the commonly used assumptions and their consequences over job creation. I try to bridge that gap.

I find that two main modeling strategies arise. Some papers model fixed-term contracts as highly flexible; firm-worker matches may split at zero cost any time. On the contrary, other papers assume that fixed-term contracts are rigid; separations cannot occur before reaching the stipulated end date. Matching models with flexible fixed-term contracts tend to predict job creation flows with fixed-term contracts only, which is counter-factual. As a result, some papers introduce *ad hoc* hiring rules with a settled share of open-ended contracts in job creation. Matching models with rigid fixed-term contracts, on the contrary, generally leave room for both open-ended and fixed-term contracts in job creation. However, I show that models with rigid fixed-term contracts lack robustness when it comes to the ranking of contracts in job creation. Overall, my results suggest that a matching model with realistic implications would strike a balance between flexible and rigid fixed-term contracts, avoiding both *ad hoc* hiring rules and robustness issues rigid fixed-term contracts bring along.

Why do flexible and rigid fixed-term contracts shape job creation differently? As the modeling of open-ended contracts displays little variability across papers, the differences stem from the modeling of fixed-term contracts. To be more specific, assumptions impact the surplus of fixed-term matches, which in turn shapes the way job creation resorts to open-ended and fixed-term contracts. Flexible fixed-term contracts deliver a higher surplus than rigid fixed-term contracts, as rigid fixed-term contracts may force some matches to stay together after an adverse productivity shock, for example. Thus, in uncertain environments, job creation would naturally favor flexible fixed-term contracts to rigid fixed-term contracts.

I propose a constructivist thought experiment to delineate the consequences of both rigid and

flexible fixed-term contracts on job creation. This approach enables to circumscribe how each assumption shapes job creation, building a model brick by brick. I consider a classic continuous-time framework à-la Mortensen and Pissarides (1994), where one-job firms and workers meet according to a matching function. New firm-worker pairs are heterogeneous in productivity and undergo adverse productivity shocks that occur at a given rate. Firms and workers negotiate wages through Nash bargaining; hiring decisions only depend on the joint surplus of the match. Open-ended contracts stipulate a firing cost. If fixed-term contracts are flexible, there is no reason to consider open-ended contracts at the hiring stage. Open-ended contracts may only arise as converted expired fixed-term contracts. A way to impose both fixed-term and open-ended contracts in job creation is to direct a given share of new firm-worker pair to each type of contract, as some papers do in the literature. If fixed-term contracts are rigid, the ranking of open-ended and fixed-term contracts in job creation is now unclear. A fixed-term match cannot separate after an adverse productivity shock, whereas an open-ended match may be able to do so at some cost.

My approach also shows how robustness issues arise in models with rigid fixed-term contracts. Assume first that fixed-term contracts cannot be converted into open-ended contracts and that their average duration is fixed. New firm-worker pairs that draw a high productivity want to make the most out of it and a fixed-term contracts may be too short in that regard; the contract may reach its stipulated end before the production opportunity has come to an end. In this case, open-ended contracts are more relevant. The productivity draw needs to be high enough to compensate the match for future firing costs. If the drawn productivity is not high enough to compensate future firing costs, a fixed-term contract is a good option as it enables quickly going back to searching for high productivity draws and generates some positive surplus for a while. Open-ended contracts lock up highly productive matches, whereas fixed-term contracts are good a compromise for intermediate productivities.

Now, assume that fixed-term matches may be converted into open-ended matches once expired if it is profitable to do so. Fixed-term contracts are now better than open-ended contracts to deal with high productivity draws. If an adverse productivity shock occurs before the fixed-term contract reaches its termination date, it is not converted. Otherwise, the contract is converted into an open-ended contract. If firing costs are not too high, fixed-term contracts are not relevant for intermediate

productivities. It is better to pay firing costs and split immediately than bearing with a depressed productivity up to the end date of the contract. As a result, making expired fixed-term matches convertible into open-ended ones reverses the ranking of contracts in job creation. Most productive matches end up in fixed-term contracts, while open-ended contracts cover less productive matches. This new ranking of contracts in job creation leads to a counter-factual result if any new match can maximize the joint surplus of a fixed-term match with respect to its average duration. As the optimal average duration increases with the productivity of the match, the least productive fixed-term matches are the most likely to be converted into open-ended contracts.

Many papers review the literature. The closest paper is Dolado et al. (2002), which presents models and stylized facts of labor market dualism. Beyond including new papers, I focus on matching models, whereas the scope of Dolado et al. (2002) is wider. Boeri (2011) describes the evolution of labor market institutions over time and reviews the empirical literature assessing the impact of employment protection on unemployment. It also builds a theoretical model to assess the impact of labor market institutions on unemployment. Bentolila et al. (2019) depicts theoretical and empirical insights about the impact of employment protection on dual labor markets.

The first section reviews the literature of matching models of dual labor markets. The second section builds a variety of matching models with rigid fixed-term contracts and highlights some robustness issues. The third section concludes.

4.1 Literature review

In this section, I review the literature dealing with labor market dualism using matching models. Note that there are also models describing labor demand when firms face adjustment costs². I first delineate two polar categories of papers with respect to the modeling of fixed-term contracts. Then, I review the papers and their approaches towards job creation in a dual labor market.

²See Nickell (1978, 1979, 1986); Bentolila and Bertola (1990); Bertola (1992); Saint-Paul (1996); Risager and Sørensen (1997); Wasmer (1999); Dolado et al. (2002); Caggese and Cuñat (2008)

4.1.1 Flexible or rigid fixed-term contracts?

Considering papers with both fixed-term and open-ended contracts, the chosen specifications to model open-ended contracts look alike. In general, open-ended contracts stipulate a firing cost that needs to be paid in case of a split. Some academics also include a cost-less separation channel in their models. Papers mostly differ on the fixed-term side of the labor market. In that regard, most models can be classified in two main categories: models with rigid fixed-term contracts and models with flexible fixed-term contracts.

Rigid fixed-term contracts cannot split before the stipulated expiry date is reached, or it is expensive to do so. Flexible fixed-term contracts, on the contrary, can be terminated any time at no cost. What does the actual law say about it? In France, a fixed-term worker may leave his position for an open-ended contract without compensating the firm. Otherwise, regardless gross misconducts or exceptional situations, the unilateral end of a fixed-term contract before its due date is costly to the requester. Concerted terminations are possible and entail no transactions, though.

Both the rigid and flexible approaches to the modeling of fixed-term contracts are relevant. On the one hand, the fact that most fixed-term contracts reach their expiry date in the data supports the idea that fixed-term contracts are rigid; concerted terminations seldom occur. In France, Milin (2018) mentions that only 2 % of fixed-term contracts splitted before their stipulated termination date in 2017. On the other hand, firms and workers negotiate wages through Nash bargaining in most models. It makes hiring and firing decisions efficient for both the firm and the worker. In this case, as all separations are mutually beneficial, assuming that fixed-term matches may split at zero cost any time is consistent with the legal possibility of concerted termination.

The flexible and rigid approaches towards fixed-term-contracts lead to different trade-offs at the hiring stage. In a basic environment with stochastic productivity and random search, flexible fixed-term contracts dominate open-ended contracts in terms of surplus. Indeed, a fixed-term match facing an adverse productivity shock may costlessly split if the contract is flexible, whereas splitting an open-ended match incurs a firing cost. Thus, in a framework with flexible fixed-term contracts, firm-worker pairs always opt for fixed-term contracts at the hiring stage if they are free to do so. Without additional constraints, job creation only occurs through fixed-term contracts. Costain et al.

(2010) is a polar example of unconstrained job creation with flexible fixed-term contracts. In what follows, I also review papers with constrained job creation.

At the other end of the spectrum, rigid fixed-term contracts blur the ranking of contracts in job creation. In a model with random search and stochastic productivity, rigid fixed-term contracts are no longer systematically delivering a higher total surplus than open-ended contracts. After an adverse productivity shock, a fixed-term match cannot split and must endure a low surplus for a while. Thus, in very bad times, open-ended contracts could be better; splitting at some cost may be better than bearing a fixed-term match with a depressed productivity. As Cahuc et al. (2016, 2019) and Rion (2019, 2020) show, rigid fixed-term contracts lead to coexisting fixed-term and open-ended contracts at the hiring stage. While flexible fixed-term contracts lead to a counter-factual unconstrained job creation through fixed-term contracts only, rigid fixed-term contracts enable job creation to occur through both fixed-term and open-ended contracts. Rigid fixed-term contracts enable the study of substitution effects between hiring fixed-term contracts and open-ended contracts. This nice feature of models with rigid fixed-term contracts comes at the cost of robustness issues as I demonstrate below. More specifically, in models with heterogeneous productivity, the ranking of contracts in job creation dramatically changes when expiring fixed-term matches can be converted into open-ended matches.

4.1.2 Flexible fixed-term contracts

I now review models with flexible fixed-term contracts. I distinguish what I call unconstrained and constrained job creation. Unconstrained job creation consists in choosing the contract that maximizes the joint surplus of the new match. Constrained job creation, on the contrary, makes the choice of the contract inconsistent with the highest joint surplus.

Costain et al. (2010) also builds a continuous-time framework with random search and matches face aggregate and idiosyncratic productivity shocks. Aggregate shocks follow a discrete Markov process while idiosyncratic productivity shocks are i.i.d. Open-ended contracts stipulate a firing cost, whereas fixed-term ones can be terminated any time. Fixed-term contracts reach their stipulated end date at a given exogenous rate and may be converted into open-ended contracts at that moment if

it is profitable. As discussed above, job creation is not constrained and, thus, only occurs through fixed-term contracts. Sala et al. (2012) roughly adopts a similar approach in a discrete-time model where idiosyncratic productivities of matches are i.i.d across periods. Job creation obeys the same mechanisms.

Blanchard and Landier (2002) builds a continuous-time model. Firms may immediately hire workers and new matches start at a given productivity under an *entry-level* contract with firing costs. The new matches then face i.i.d productivity shocks with a given arrival rate. The first productivity shock leads either to a split with firing costs or a conversion into a *regular* contract. Regular contracts also involve firing costs, but these firing costs only turn up in the bargaining of wages; regular contracts undergo no productivity shocks and costlessly split at an exogenous rate. When the firing costs of entry-level contracts are lower than the firing costs of regular contracts, dualism arises. In this case, using my terminology, entry-level contracts are flexible fixed-term contracts while regular contracts are open-ended contracts. The stronger bargaining position of regular workers lures firms away from converting entry-level jobs. As a result, firms intensively resort to entry-level contracts.

Many papers with flexible fixed-term contracts impose constraints on job creation. A wide-spread constraint is that an exogenous and settled share of new jobs is directed to each contract. In this manner, the model is able to replicate the presence of both fixed-term and open-ended contracts at the hiring stage, whereas there would be only fixed-term contracts in an unconstrained framework. Cahuc and Postel-Vinay (2002) builds a discrete-time model with this hiring rule. Firms and workers meet through a random-search process and matches are heterogeneous in productivities. Matches face i.i.d productivity shocks each period. Fixed-term contracts last one period and may be converted into open-ended contracts if it is profitable to do so. Open-ended contracts involve firing costs. In such a framework, new firm-worker pairs would systematically opt for fixed-term contracts; open-ended contracts would only emerge as converted fixed-term contracts without the hiring rule. Bentolila et al. (2012a) uses the same job creation rule as Cahuc and Postel-Vinay (2002), whereas fixed-term contracts are rigid in its framework. Créchet (2018) assumes that a given share of created jobs may end up in open-ended contracts only, while the other created jobs may freely choose between open-ended and fixed-term contracts. Sala and Silva (2009) constraints job creation in a different way. The paper is very close to Sala et al. (2012) described above. The only difference is

that fixed-term matches are less productive than open-ended contracts all else equal. The authors assume that job creation only occurs through fixed-term contracts and open-ended jobs stem from converted fixed-term contracts. Yet, as Rion (2020) show in a comparable framework, unconstrained job creation either involves both fixed-term and open-ended jobs, or open-ended jobs only.

How is it possible to endogenously obtain both fixed-term and open-ended contracts in job creation with flexible fixed-term contracts? Intuitively, introducing some mechanisms that lower the surplus of fixed-term contracts in specific cases should work. Cao et al. (2010) introduces on-the-job search, for example. The model is standard in many aspects; time is discrete, search is random, matches are heterogeneous in productivity which is i.i.d across periods. Fixed-term contracts last one period and may be converted into open-ended contracts at expiry. Firms and workers negotiate wages through Nash bargaining. Without any additional assumption, fixed-term contracts would always dominate open-ended contracts in terms of joint surplus. Here, the departing assumption is that workers can search on the job if they pay a search cost. The opportunity cost of searching is higher for workers with high wages, whereas on-the-job search strengthens the outside option of workers that are paid less. Firing costs makes fixed-term wages lower than open-ended wages all else equal. As a result, fixed-term workers have more incentive to search on-the-job than open-ended workers. Consequently, highly productive new firm-worker pairs tend to enter into an open-ended contract to prevent on-the-job search and benefit from their high productivity draw, while less productive matches have less to lose if the worker searches on the job and ends up leaving.

Giving up on random search enables to get both contracts naturally involved in job creation. Berton and Garibaldi (2012) opt for a continuous-time model with directed search. Workers are heterogeneous in their immediate utility of unemployment. Matches are subject to productivity shocks that occur at a given Poisson rate. Open-ended contract stipulate a firing cost, whereas fixed-term contracts may split any time for free. Wages are all the same, regardless the type of contract, and only depend on productivity. The resulting equilibrium leaves room for both contracts in job creation. From the worker's point of view, fixed-term contracts deliver a higher job-finding rate and a short time earning some wage, whereas open-ended contracts are more difficult to reach but offer long-lasting earnings. Typically, workers with low flow unemployment utility tend to go for fixed-term contracts, while workers with high unemployment-utility flow are ready to wait

longer for an open-ended contract. On the firm's side, open-ended contracts grant firms with a high job-filling rate and a low flexibility, whereas fixed-term contracts yield a low job-filling rate and a high flexibility.

4.1.3 Rigid fixed-term contracts

In this section, I review papers with rigid fixed-term contracts. Again, I distinguish constrained and unconstrained job creation.

The closest paper to the thought experiment I propose in introduction is the model of chapter 2 (Rion, 2019). Firms and workers meet according to matching function in a continuous-time framework. Firm-worker pairs are heterogeneous in productivity and receive i.i.d shocks in productivity at a given rate. Open-ended contracts stipulate a firing cost while fixed-term contracts split following an exogenous termination rate. A fixed-term match cannot split before a termination shock hits regardless its productivity. Note that fixed-term matches cannot be converted into open-ended ones when expiring. Job creation is unconstrained; a new-firm worker pair draw a productivity from a given distribution and optimizes the choice of the contract accordingly. Most productive draws end up in open-ended contracts; fixed-term contracts may be too short to take full advantage of the initial high productivity draw. When the productivity is not high enough to consider paying firing costs in the future, fixed-term contract are a good fit. Firms and workers can go back to search for good matches before long and benefit from a positive surplus. As I show below, Rion (2019) is not robust. Making fixed-term matches convertible into open-ended matches dramatically changes the contractual layout of job creation.

In the same vein of models with heterogeneous productivities, the model of chapter 3 (Rion, 2020) is a discrete-time model and is very similar to Rion (2019). A few departures arise as productivities of matches are i.i.d across periods and fixed-term matches are less productive than open-ended ones all else equal. Agents strike a balance between productivity and flexibility. Most productive matches end up in open-ended matches; the agents are ready to pay firing costs in order to avoid the *ad hoc* productivity loss a fixed-term contract would incur. When the initial productivity draw is lower, matches favor fixed-term contracts. Again, the contractual framework of job creation would change

much if expiring fixed-term matches were convertible.

Other models focus on heterogeneity in workload fluctuations. Cahuc et al. (2016, 2019) build a continuous-time model where firms and workers randomly meet according to a matching function. Matches face adverse productivity shocks that occur at heterogeneous rates. Open-ended contracts stipulate a firing cost. Firm-worker pair can optimize the duration of the contract and cannot split before its stipulated end. Fixed-term matches can be converted into an open-ended contract once expired. The optimal duration of fixed-term contracts decreases with the arrival rate of adverse productivity shocks; the more frequent the shocks, the shorter fixed-term contracts. The riskiest contracts end up in fixed-term contracts. On the contrary, open-ended contracts cover low-risk matches. The least risky fixed-term matches spared by adverse productivity shocks are worth converting into open-ended matches.

In some papers with rigid fixed-term contracts, job creation is constrained. Bentolila et al. (2012a) builds a continuous-time random-matching model. Matches undergo i.i.d productivity shocks that occur at a given rate and start at a settled high productivity. Open-ended matches renegotiate wages through Nash-bargaining each time a productivity shock occurs, whereas fixed-term matches keep the initially negotiated wages up to expiry, which occurs at a given rate. Expiring fixed-term matches can be converted into open-ended matches. The paper focuses on the role labor courts play in open-ended job destruction and its impact on the labor market. If an open-ended match faces an adverse enough shock, the firm sends an advance notice to the worker and the match splits after the firing permission is issued, which takes time. Firing permission is issued at a given Poisson rate. Once it has arrived, the firm is bound to pay a firing cost. Between the notification and the firing permission issuance, the match delivers the lowest possible productivity and the worker is paid the average wage in the economy. Job creation is constrained; new-matches are directed towards each type of contract with a given probability. If job creation was unconstrained, since new matches deliver all the same productivity, new firm-worker pairs would simply opt for the type of contract that delivers the highest joint surplus. As a result, job creation would always occur through either open-ended or fixed-term contracts.

4.2 Rigid fixed-term contracts: a constructivist approach

The following sections build assumption by assumption various models with rigid fixed-term contracts to delineate robustness issues and the assumptions responsible for them. The first subsection describes the common core of these models. The second subsection focuses on models with heterogeneous processes of workload fluctuations. The last subsection describes models with heterogeneous productivities and the robustness issues that arise in models with rigid fixed-term contracts.

4.2.1 Initial assumptions

In this subsection, I build a basic model as a starting point. I shall extend this model over various dimensions and see the way job creation changes in the next subsections. I am particularly interested in the contractual composition of created jobs and the ranking of contract types in job creation.

Time is continuous. Firms as well as workers are identical *ex ante*. Firms post vacancies to attract workers and may employ one worker. I assume that the number of new matches per unit of time follows a function with constant returns to scale and the number of vacancies and job seekers as inputs. Meeting rates only depend on the labor market tightness θ , which is the ratio of the number of vacancies and job seekers. Firms meet unemployed workers with probability $q(\theta)$, while unemployed workers face a probability $p(\theta) \equiv \theta q(\theta)$ of finding a vacancy. A firm-worker pair produces y per unit of time, whether it be under an open-ended or a fixed-term contract. Matched firms and workers face a shock that makes their associations unproductive with probability λ per unit of time. This sudden drop in productivity may stem from a demand drop as well as a failure from the firm, the worker or the match itself.

Newly matched firms and workers maximize their expected joint surplus using either fixed-term or open-ended contracts.

Open-ended jobs stipulate a wage and may end through two channels: one involving firing costs and one which does not. The adverse productivity shock involves a split with firing costs F . The firing cost is a red-tape, dead-weight cost. It is not a firm-worker transfer such as a severance payment. In

real life, open-ended matches may also end without entailing the payment of a firing cost (quits and retirement for example). I denote s the probability of cost-less separations per unit of time.

Fixed-term contracts stipulate a duration and a wage. For now, I assume that the duration of fixed-term contracts is fixed in expectation. I model it through a memory-less job destruction rate δ . In other words, the duration of fixed-term contracts is δ^{-1} in expectations and follows an exponential law with parameter δ . One may think it is unrealistic, as fixed-term contracts specify a duration and not a probabilistic job destruction rate. A Poisson process for fixed-term job destruction does not change conclusions qualitatively speaking, while it makes expressions more tractable and elegant than definite durations. Note that a productivity shock does not end a fixed-term contract in contrast with open-ended contracts. The firm has to pay the initially negotiated wage up to the end of the contract.

At this point, the trade-off is shaped. The new firm-worker pairs choose between a long open-ended contract with a costly separation in case of an adverse productivity shock, and a short fixed-term contract with a cost-less separation and potentially unproductive times.

I assume that the hiring decisions are jointly efficient to rule out incentive compatibility constraints and other theoretical difficulties related to firm-worker asymmetry. Newly matched firms and workers choose the contract that maximizes their expected joint surplus; the wage is then pinned down according to a Nash-bargaining rule. Note that the wage is set once for all and does not change until the match splits. I shall relax this assumption later in the paper.

I also assume that the vacancy-posting activity brings no profit to firms. Otherwise, as there are no barrier to entry, new comers would compete until profits are washed out. This so-called free-entry condition is classic in the literature (Mortensen and Pissarides, 1994). I denote V the present discounted value of a vacancy.

$$V = 0 \tag{4.2.1}$$

I denote J^p and W^p the firm's and worker's expected surpluses from an open-ended contract with

wage w . J^f and W^f are their fixed-term counterparts. I denote S^p and S^f the joint surpluses from an open-ended contract and a fixed-term contract. The joint surpluses do not depend on the wage as it is a simple transfer between the firm and the worker. U is the present discounted utility from unemployment. The joint surpluses verify

$$S^p = J^p - V + W^p - U$$

$$S^f = J^f - V + W^f - U$$

The joint surplus associated with open-ended contracts does not include firing costs. A disagreement over the negotiation of wages does not incur the payment of firing costs for the firm. Firing costs do not belong to the firms' outside option while agents negotiate wages.

A firm employing a worker under an open-ended contract with wage w earns $(y - w)$ per unit of time. These flows stop if the match splits, whether it be with or without firing costs. An open-ended match splits without firing costs with probability s . An adverse productivity shock strikes with probability λ and involves the payment of firing costs F . As for the worker, he earns w per unit of time until the match ends.

$$rJ^p = y - w + s(V - J^p) + \lambda(V - F - J^p)$$

$$rW^p = w + (s + \lambda)(U - W^p)$$

I assumed that open-ended matches split when an adverse productivity shock hits. It has to be consistent to do so, though; separations need to be jointly efficient. It implies that the firm-worker pair renegotiates a wage w after the adverse productivity shock. The joint surplus associated with continuing the match must be negative for the separation to be jointly efficient. Under which conditions is it the case? I denote J^c and W^c the surpluses of a firm and a worker carrying on the match after an adverse productivity shock.

$$rJ^c = -w + s(V - J^c)$$

$$rW^c = w + s(U - W^c)$$

The associated joint surplus S^c is defined by

$$S^c = J^c - (V - F) + W^c - U$$

In contrast with the surplus of a new open-ended match, the surplus of a continuing match includes the firing cost. If the firm and the worker cannot agree on a new wage, splitting now involves paying the firing cost; the firm-worker pair formed a while ago at that point.

A little algebra provides an expression for S^c .

$$S^c = F - \frac{rU}{r + s}$$

The following assumption needs to hold for the surplus of a continuing open-ended match to be negative.

Assumption 1. $F < rU/(r + s)$

If the firing cost is too high, it may be better to carry the burden of a zero productivity until a cost-free separation shock hits instead of immediately paying the firing cost.

A fixed-term contract reaches its end with probability δ per unit of time. The match faces an adverse productivity shock with probability λ , in which case the productivity of the match reaches zero. It bears no consequence on the worker, who earns the initially negotiated wage up to a job destruction shock.

$$rJ^f(y, w) = y - w + \lambda(J^f(0, w) - J^f(y, w)) + \delta(V - J^f(y, w))$$

$$rW^f(w) = w + \delta(U - W^f(w))$$

Using the free-entry condition (4.2.1) and the expressions of surpluses above, a little algebra leads to the following joint surpluses.

$$S^p = \frac{y - \lambda F - rU}{r + s + \lambda}$$

$$S^f = \frac{y}{r + \delta + \lambda} - \frac{rU}{r + \delta}$$

4.2.2 Heterogeneous workload fluctuations

In this section, I extend the basic framework with heterogeneous arrival rates of adverse productivity shocks λ . I also assume that new firm-worker pairs optimize the fixed-term job destruction rate δ . Then, I broaden the model to make possible conversion of expired fixed-term contracts into open-ended ones. Appendix 4.A.1 includes all the proofs of the following propositions.

Basic framework

As in Cahuc et al. (2016) and Cahuc et al. (2019), I assume first that jobs are heterogeneous in the arrival rate of adverse productivity shocks. Cahuc et al. (2016) assumes that firms pay a sunk cost to draw a shock arrival rate λ from a distribution G and then maintain a vacancy. Once the match splits, the firm has to pay to draw a new value of the shock arrival rate λ . For the sake of simplicity, I assume that a job-specific arrival rate of productivity shocks λ is drawn from distribution G when a firm-worker pair forms. Another difference with Cahuc et al. (2016) is that durations follow an exponential law instead of being fixed. In the current model, agents optimize the expected duration

of fixed-term jobs instead of the duration itself. Qualitatively speaking, it keeps job creation as in Cahuc et al. (2016) and eases the following exposition of robustness issues. With these assumptions, the value of a vacancy verifies

$$rV = -\gamma + q(\theta)(1 - \eta) \int \max [S^p(\lambda), S_o^f(\lambda), 0] dG(\lambda)$$

where γ is the maintaining cost of the vacancy, η is the worker's share of the joint surplus and $S_o^f(\lambda)$ is the optimized joint surplus of fixed-term contracts with shock arrival rate λ .

$$S_o^f(\lambda) = \max_{\delta \geq 0} S^f(\lambda, \delta)$$

Joint surpluses now depend on the arrival rate of productivity shocks λ .

Considering open-ended jobs, I assume that there are no cost-less separations to stick to the framework of Cahuc et al. (2016): for now, $s = 0$. I consider the case $s > 0$ later in this section. Thus, the joint surplus of an open-ended job with an arrival rate of adverse productivity shocks λ boils down to

$$S^p(\lambda) = \frac{y - \lambda F - rU}{r + \lambda}$$

Proposition 7 describes the behavior of S^p .

Proposition 7. *S^p is continuous and decreasing. Moreover, $S^p(0) = y/r - U > 0$ and $\lim_{\lambda \rightarrow +\infty} S^p(\lambda) = -F < 0$. Thus, there exists a unique λ^p such that $S^p(\lambda^p) = 0$.*

The higher the probability of adverse productivity shocks, the less relevant open-ended contracts are. As λ increases, open-ended contracts shorten, which brings forward firing costs.

In addition to the arrival rate of productivity shocks, the surplus associated with fixed-term contracts

also depends on the fixed-term job destruction rate δ .

Proposition 8. *The function $\delta \mapsto S^f(\delta, \lambda)$ reaches a maximum at $\delta^*(\lambda)$ such that*

$$\delta^*(\lambda) = \lambda \left(\sqrt{\frac{y}{rU}} - 1 \right)^{-1} - r$$

Moreover, $\delta^*(0) = -r < 0$ and $\lim_{\lambda \rightarrow +\infty} \delta^*(\lambda) = +\infty$. δ^* being continuous, there exists a unique $\underline{\lambda}$ such that $\delta^*(\underline{\lambda}) = 0$.

δ^* increases with the shock arrival rate λ . The more frequently adverse productivity shocks strike, the less the optimal fixed-term contract lasts in expectation. The optimal duration finds a middle ground between too short contracts that are still productive when they expire and too long contracts that lock down the agents in unproductive matches for some time. Figure 4.2.2 displays δ^* in function of λ .

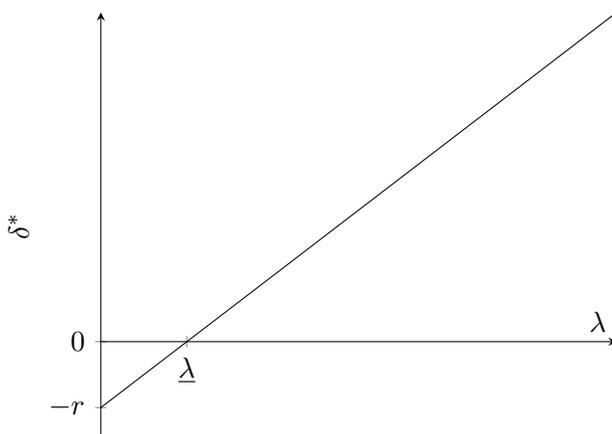


Figure 4.2.1: Optimal duration and arrival rate of adverse productivity shocks

Proposition 9 delineates the optimized surplus S_o^f for fixed-term contracts.

Proposition 9. *S_o^f is continuous and decreasing. Moreover, $S_o^f(0) = y/r - U$ and $\lim_{\lambda \rightarrow +\infty} S_o^f(\lambda) = 0$. Thus, $S_o^f > 0$.*

Describing job creation boils down to comparing joint surpluses for both types of contracts. Proposition 10 sums it up.

Proposition 10. *There exists λ^* such that $S^f(\lambda^*) = S^p(\lambda^*)$ and job creation takes place through*

open-ended contracts for matches with $\lambda \leq \lambda^*$, and through fixed-term contracts otherwise. Figure 4.2.2 sums up job creation.

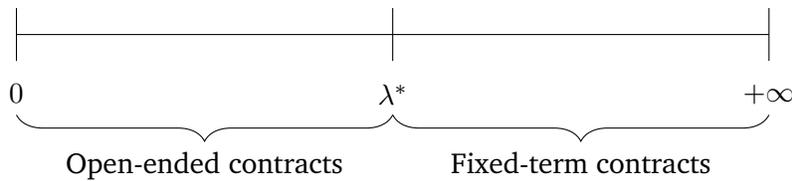


Figure 4.2.2: Arrival rate of productivity shocks and job creation

Proposition 10 describes an intuitive scenario for job creation. Matches that face a high risk of becoming unproductive quickly are better off signing a fixed-term contract. At the other end of the spectrum, matches with low arrival rates of adverse productivity shocks prefer endorsing an open-ended contract. Figure 4.2.2 displays joint surpluses and the associated thresholds.

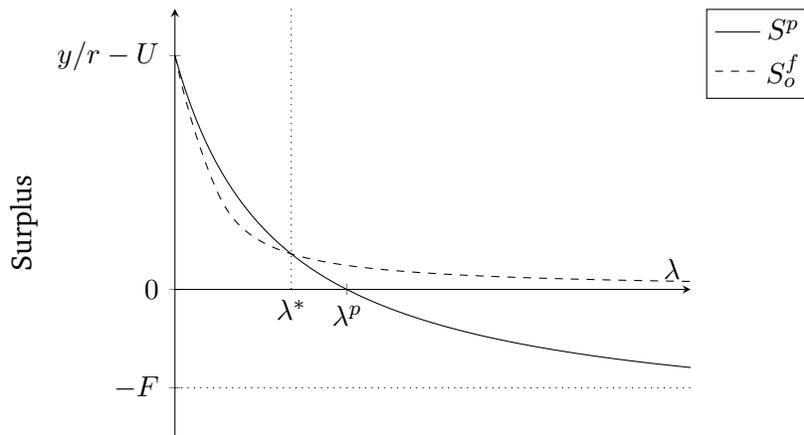


Figure 4.2.3: Surpluses and arrival rate of adverse productivity shocks

The ranking of contracts may change as soon as cost-less separations occur in open-ended matches, *id est* when $s > 0$. Without adverse productivity shocks, the longest the contract, the better it is; an open-ended contract may split with probability s whereas a fixed-term contract can be endless. Thus, fixed-term contracts are better than open-ended ones as the probability of adverse productivity shocks tends towards zero. Overall, cost-less separations of open-ended matches and job-to-job transitions impact job creation a lot. As far as I know, the literature has not tackled this issue yet in a dual labor market framework.

Conversion of fixed-term contracts into open-ended contracts

Now, I assume that expiring fixed-term contracts are converted into open-ended ones if it is profitable to do so. If I keep the model as it is right now, open-ended contracts and fixed-term contracts are not distinct; open-ended contracts are converted fixed-term contracts with zero duration. Thus, there is no room left for job creation through open-ended contracts. To avoid this trivial situation, I assume that each creation or conversion incurs a cost c to the firm. The surplus of open-ended matches with a probability of an adverse shock λ now writes

$$S^p(\lambda) = \frac{y - \lambda F - rU}{r + \lambda} - c$$

The following proposition describes its behavior.

Proposition 11. *S^p is continuous and strictly decreasing in λ . Moreover, $S^p(0) = \frac{y}{r} - U - c$ and $\lim_{\lambda \rightarrow +\infty} S^p(\lambda) = -F - c$. Hence, there exists a unique λ^p such that $S^p(\lambda^p) = 0$.*

As for fixed-term contracts, they are worth converting if no adverse productivity shock has struck before the termination shock. The conversion of fixed-term contracts into open-ended contracts entails the renegotiation of the wage according to a Nash-sharing rule. Thus, the conversion decision is efficient for both the firm and the worker. The joint surplus from a fixed-term contract with destruction probability δ and an adverse shock probability λ is

$$S^f(\lambda, \delta) = \frac{y + \delta S^p(\lambda)^+}{r + \delta + \lambda} - \frac{rU}{r + \delta} - c \quad (4.2.2)$$

Proposition 12. *The function $\delta \mapsto S^f(\delta, \lambda)$ reaches a maximum at $\delta^*(\lambda)$ such that*

$$\delta^*(\lambda) = \begin{cases} \lambda \left(\sqrt{\frac{\lambda(F+c) + r(U+c)}{rU}} - 1 \right)^{-1} - r & \text{if } \lambda \leq \lambda^p \\ \lambda \left(\sqrt{\frac{y}{rU}} - 1 \right)^{-1} - r & \text{otherwise} \end{cases}$$

δ^* is increasing in λ and there exists a unique $\underline{\lambda}$ such that $\delta^*(\underline{\lambda}) = 0$.

Figure 4.2.2 displays the optimal job destruction rate δ^* . For all $\lambda > \lambda^p$, δ^* is the same as in the previous case without convertible fixed-term contracts. It makes sense as the associated fixed term jobs will not be converted into open-ended contracts; it is not profitable to do so. On the contrary, if $\lambda \leq \lambda^p$, the conversion to an open-ended contract takes place if no adverse productivity shock occurs before the fixed-term contract expires. In this case, the optimal job destruction rate exceeds its no-convertibility counterpart, the dashed line on the graph. Why are short fixed-term contracts less attractive when they are convertible? Short contracts lose flexibility with respect to the no-convertibility case. They are more likely converted into open-ended contracts, which brings in contracting and firing costs. Long fixed-term contract, on the contrary, postpone these costs, which makes them more appealing.

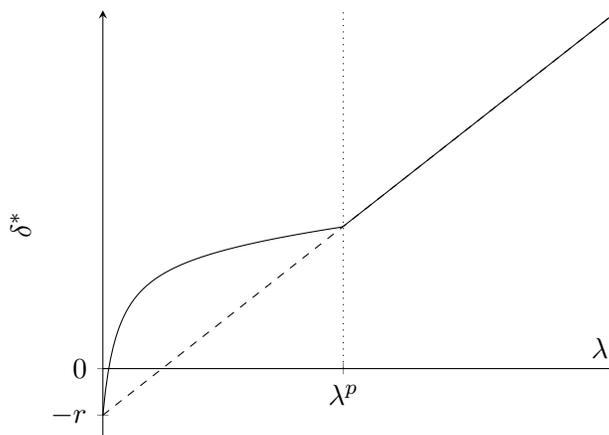


Figure 4.2.4: Optimal duration and arrival rate of adverse productivity shocks

The solid line is the curve of the optimal fixed-term job destruction rate δ^* when fixed-term contracts are convertible; the dashed line when they are not.

The following proposition details the behavior of the optimized joint surplus of fixed-term jobs

$$S_o^f(\lambda) = \max_{\delta \geq 0} S^f(\lambda, \delta).$$

Proposition 13. S_o^f is continuous and decreases with λ from $S_o^f(0) = y/r - U - c$ to $\lim_{\lambda \rightarrow +\infty} S_o^f(\lambda) = -c$. Hence, there exists a unique $\bar{\lambda}$ such that $S_o^f(\bar{\lambda}) = 0$.

Job creation occurs as the following proposition depicts.

Proposition 14. There exists a unique λ^* such that $S^f(\lambda^*) = S^p(\lambda^*)$.

- If $S_o^f(\lambda^p) \leq 0$, then $\bar{\lambda} \leq \lambda^p \leq \lambda^*$ and job creation only occurs through open-ended contracts and for matches such that $\lambda \in [0, \lambda^p]$

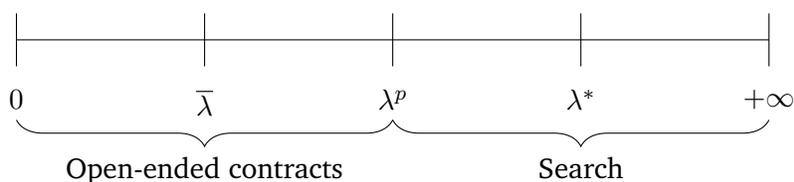


Figure 4.2.5: Arrival rate of productivity shocks and job creation: the case $S_o^f(\lambda^p) \leq 0$

- If $S_o^f(\lambda^p) > 0$, then $\lambda^* < \lambda^p < \bar{\lambda}$. Job creation occurs through open-ended contracts when $\lambda < \lambda^*$, and through fixed-term contracts when $\lambda^* < \lambda < \bar{\lambda}$.

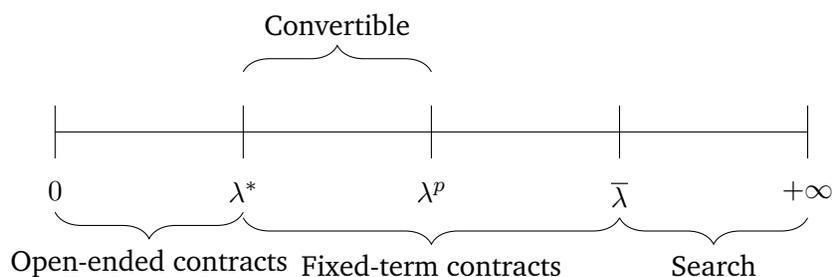


Figure 4.2.6: Arrival rate of productivity shocks and job creation: the case $S_o^f(\lambda^p) > 0$

The convertibility of fixed-term contracts does not change the overall ranking of contracts with respect to the arrival rate of adverse productivity shocks. Low arrival rates of adverse productivity shocks lead to hires under open-ended contracts. Least spared matches opt for fixed-term contracts. The only change boils down to the future of fixed-term contracts. Fixed-term contracts with a low arrival rate of adverse productivity shocks end up being converted if they remain productive up to expiry. Figures 4.2.5 and 4.2.6 show the joint surpluses in the two cases Proposition 14 outline.

The next section shows that the model with heterogeneous arrival rates of adverse productivity shocks may lead to counter-factual results if the productivity of new matches is no longer fixed. More specifically, regardless the arrival rate of productivity shocks, the shortest fixed-term contracts are the most likely to be converted into open-ended contracts when the productivity of matches is heterogeneous.

4.2.3 Heterogeneous productivities: the rise of robustness issues

In this section, I introduce heterogeneous productivities starting from the baseline model described above. I show that the convertibility of fixed-term contracts into open-ended contracts dramatically changes the ranking of contracts in job creation. Without convertibility, most productive matches operate under open-ended contracts, whereas fixed-term contracts encompass intermediate productivities. When fixed-term contracts are convertible, on the contrary, most productive matches end up in fixed-term contracts, while open-ended jobs are relegated to middle productivities. Then, I assume that productivity shocks are i.i.d and that new matches optimize the job destruction rate of fixed-term jobs. I find that the higher the productivity, the lower the optimized job destruction rate of fixed-term contracts. Again, highest productivities lead to fixed-term jobs while open-ended contracts cover intermediate productivities. It leads to a counter-factual result; the shortest fixed-term contracts are the most likely to be converted into open-ended contracts. The contractual ranking in job creation Rion (2019) and Rion (2020) is not robust to the introduction of convertibility. Introducing heterogeneity in the arrival rate of productivity shocks does not alter this finding. Cahuc et al. (2016) and Cahuc et al. (2019) also lead to the counter-factual finding that the shortest fixed-term contracts are the most likely to be converted into open-ended contracts if the productivity of new matches is random instead of settled.

Basic framework

Starting from the basic framework delineated above, what happens with job creation if the productivity of jobs is heterogeneous? I assume that new firm-worker pairs draw their productivity y job from a distribution with cdf G .

The match chooses the contract that maximizes the joint surplus, going back to searching being also an available option. Nash bargaining ensures that the chosen contract also maximizes the firm's and worker's surpluses. If firms pay γ per unit of time to maintain a vacancy, the present discounted value of a vacancy verifies

$$rV = -\gamma + q(\theta)(1 - \eta) \int \max \{S^p(y), S^f(y), 0\} dG(y) \quad (4.2.3)$$

where η is the worker's share of the joint surplus and joint surpluses now depend on the productivity of the match y .

I shall define a few useful thresholds to describe job creation in this framework. I define profitability thresholds y^c and y^f for open-ended and fixed-term contracts.

$$\begin{aligned} S^p(y^c) &= 0 \\ S^f(y^f) &= 0 \end{aligned}$$

I assume that splits of fixed-term jobs occur more frequently than cost-less separations of open-ended jobs. Mathematically speaking, it boils down to $s < \delta$. This assumption is in line with the data in Western European countries. Under this assumption, the surplus of open-ended jobs has a higher slope than the surplus of fixed-term jobs.

$$\frac{\partial S^p}{\partial y} = \frac{1}{r + s + \lambda} > \frac{1}{r + \delta + \lambda} = \frac{\partial S^f}{\partial y}$$

As a result, there exists a threshold y^* that breaks even the surplus of open-ended jobs and the surplus of fixed-term jobs.

$$S^p(y^*) = S^f(y^*) \quad (4.2.4)$$

Open-ended jobs dominate fixed-term ones as productivity exceeds y^* .

The ranking of the thresholds y^c , y^f and y^* shapes job creation. Proposition 15 makes it clearer.

Proposition 15. *These assertions are equivalent*

1. $y^* > y^f$
2. $y^* > y^c$
3. $y^c > y^f$

Using the free-entry condition (4.2.1), the definition of V (4.2.3) and integrations by parts, the job creation condition arises.

$$\frac{\gamma}{(1-\eta)q(\theta)} = \frac{1}{r+s+\lambda} \int_{\max(y^c, y^*)}^{+\infty} (1-G(y))dy + \frac{1}{r+\delta+\lambda} \int_{y^f}^{\max(y^f, y^*)} (1-G(y))dy \quad (4.2.5)$$

The next proposition describes job creation.

Proposition 16. *Considering an equilibrium (θ, y^c, y^f, y^*)*

- *If $F > rU/(r+\delta)$, job creation only occurs through open-ended contracts. In this case, $y^* \leq y^f \leq y^c$; open-ended contracts are hired when $z \in (y^c, +\infty)$ as figure 4.2.7 displays.*

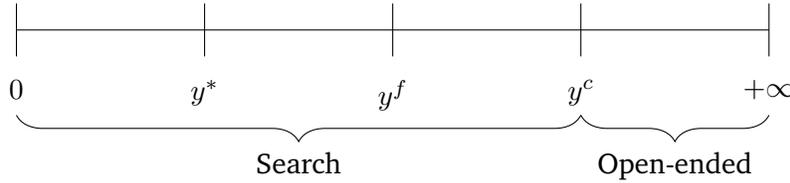


Figure 4.2.7: Hiring open-ended contracts only

- *Otherwise, job creation is dual. Fixed-term contracts are hired when $z \in (y^f, y^*)$ and open-ended contracts are hired when $z \in (y^*, +\infty)$. Figure 4.2.8 sums it up.*

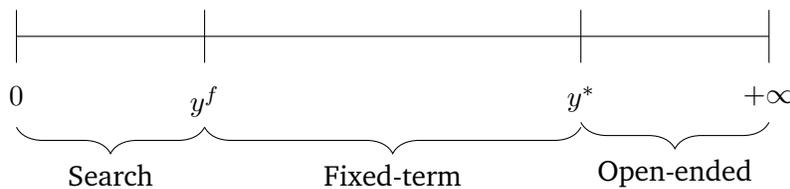


Figure 4.2.8: Dual job creation

In this framework, open-ended contracts serve to lock up highly productive matches. The match must be productive enough for immediate gains to exceed the expected firing costs. Open-ended contracts make the best out of a high productivity draw, as they last longer than fixed-term contracts. Fixed-term contracts provide a proper option when productivity is not that high; they strike a balance between going back to searching for a high productivity draw and producing for a while. Rion (2019) models job creation in the same manner. The only difference is that productivity shocks are i.i.d and job destruction is endogenous. Productivity shocks are not necessarily adverse and do not systematically lead to a split of open-ended contracts.

Convertible fixed-term contracts

Now, I assume that fixed-term contracts are converted into open-ended ones if it is profitable to do so. Fixed-term contracts are worth converting if no adverse productivity shock has struck before the termination shock. I also assume that the conversion of fixed-term contracts into open-ended contracts entails the renegotiation of the wage according to a Nash-sharing rule. Thus, the conversion decision is efficient for both the firm and the worker. I denote w and w' the negotiated wages when fixed-term jobs are created and converted. The firm's and worker's surpluses from a fixed-term contract with productivity y write

$$\begin{aligned} rJ^f(y, w) &= y - w + \lambda(J^f(0, w) - J^f(y, w)) + \delta \left(\max [J^p(y, w'), 0] - J^f(y, w) \right) \\ rW^f(y, w) &= w + \lambda(W^f(0, w) - W^f(y, w)) + \delta \left(\max [W^p(y, w'), U] - W^f(y, w) \right) \end{aligned}$$

The joint surplus of a fixed-term contract with productivity y boils down to

$$S^f(y) = \frac{y + \delta S^p(y)^+}{r + \delta + \lambda} - \frac{rU}{r + \delta}$$

The definition of y^c and y^f remain the same. The following proposition describes job creation.

Proposition 17. *Consider an equilibrium,*

- *If $F > rU/(r + \delta)$, job creation only occurs through fixed-term contracts as Figure 4.2.9 sums it up.*

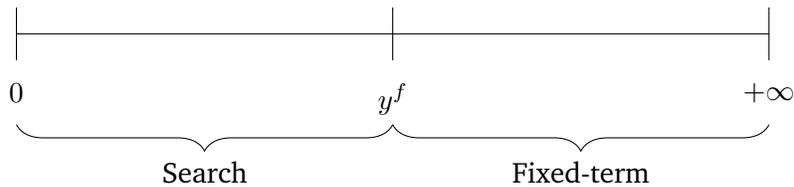


Figure 4.2.9: Hiring fixed-term contracts only

- *Otherwise, job creation is dual. There exists y^* such that fixed-term contracts are hired when $y > y^*$ and open-ended contracts are preferred $y \in (y^c, y^*)$. Figure 4.2.10 sums it up.*

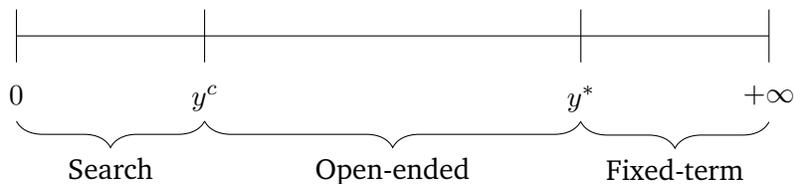


Figure 4.2.10: Dual job creation

The conversion option reverses the roles of open-ended and fixed-term contracts in job creation. Open-ended contracts no longer lock up high productivity draws in a better way than fixed-term contracts. Fixed-term contracts provide more flexibility. If an adverse productivity shock occurs before a termination shock, no conversion occurs. Otherwise, the conversion enables to take advantage of the high productivity draw through an open-ended contract. Is there any room left for open-ended contracts? Fixed-term contracts are rigid in some sense; the match cannot split after an adverse productivity shock. If firing costs are small enough or fixed-term contracts are long enough, agents find expensive not to split in case of an adverse productivity shock, while open-ended contracts allow such separations at a cost. As a result, open-ended contracts are relevant for intermediate productivities when the separation cost is not too high or fixed-term contracts are too long. Therefore, the results from Rion (2019) about job creation do not resist to introducing conversion of fixed-term matches.

Optimized duration and i.i.d productivity shocks

The following analysis shows that the models with heterogeneous arrival rate in adverse productivity shocks as well as heterogeneous productivities of matches lead to counter-factual results when some assumptions are relaxed: the shortest fixed-term contracts are the most likely to be converted into open-ended ones and the most productive matches are hired under fixed-term contracts.

I relax the assumption that productivity shocks are necessarily adverse. Now, I assume that they are independent and identically distributed and drawn from a law with cumulative distribution function G . Consequently, Assumption 1 is no longer needed to ensure that separating open-ended matches be efficient after a productivity shock. Continuing open-ended contracts now display non-trivial surpluses. The joint surpluses writes

$$S^c(z) = (J^c(z) - [V - F]) + (W^c(z) - U)$$

In contrast with the surplus of new open-ended contracts, firing costs belong to the outside option of firms with continuing open-ended workers. The associated firm's and worker's surpluses are

$$\begin{aligned} rJ^c(y) &= y - w^c(y) + s(V - J^c(y)) + \lambda \int (\max [J^c(y'), V - F] - J^c(y)) dG(y') \\ rW^c(y) &= w^c(y) + \lambda \int (\max [W^c(y'), U] - W^c(y)) dG(y') + s(U - W^c(y)) \end{aligned}$$

where $w^c(y)$ is the negotiated wage through Nash bargaining. Therefore, the joint surplus boils verify

$$(r + s + \lambda)S^c(y) = y - rU + (r + s)F + \lambda \int \max [S^c(y'), 0] dG(y')$$

In this framework, as we shall demonstrate later, the possibility to convert expiring fixed-term contracts into open-ended ones makes open-ended hires irrelevant. To this extent, I introduce a fixed hiring and transformation cost c , which corresponds to the administrative cost of hiring a worker or transforming an expired fixed-term contract into an open-ended one. Consequently, the surplus of a new open-ended contract with productivity y becomes

$$S^p(y) = S^c(y) - F - c$$

The duration of fixed-term contracts is endogenously chosen to maximize the joint surplus when a worker-firm pair forms and conversions into open-ended contracts become possible when fixed-term contracts end. The surplus associated with a job creation through a z -productivity fixed-term contract denoted as $S_o^f(z)$ now includes the choice of the instantaneous expiration probability δ and verifies

$$S_o^f(y) = \sup_{\delta \geq 0} S^f(y, \delta) - c$$

where $S^f(y, \delta)$ denotes the joint surplus of a fixed-term contract with productivity y and expiration probability δ .

Firm's and worker's surpluses of a fixed-term contract become

$$\begin{aligned} rJ^f(y, \delta) &= y - w^f(y) + \lambda \int (J^f(y', \delta) - J^f(y, \delta)) dG(y') + \delta (\max [J_0^p(y), V] - J^f(y, \delta)) \\ rW^f(y, \delta) &= w^f(y) + \lambda \int (W^f(y', \delta) - W^f(y, \delta)) dG(y') + \delta (\max [W_0^p(y), U] - W^f(y, \delta)) \end{aligned}$$

The resulting joint surplus of a fixed-term contract with productivity y and job destruction rate δ write

$$(r + \lambda + \delta)S^f(y, \delta) = y - rU + \delta S_0^p(y)^+ + \lambda \int S^f(y', \delta) dG(y') \quad (4.2.6)$$

The job creation condition is now

$$\frac{\gamma}{(1-\eta)q(\theta)} = \int \max [S^p(y), S_o^f(y), 0] dG(y)$$

The following proposition characterizes the optimal duration of fixed-term contracts.

Proposition 18. *Let y be in the support of G .*

- If $Ey/r < \alpha \equiv U + \int S^p(y')^+ dG(y')$, the optimal expiration rate δ^* verifies

$$\delta^*(y) = \begin{cases} +\infty & \text{if } x(y) \leq 0 \\ \lambda \frac{1+\sqrt{1+x(y)}}{x(y)} - r & \text{if } 0 < x(y) < \frac{\lambda}{r} \left(2 + \frac{\lambda}{r}\right) \\ 0 & \text{otherwise} \end{cases}$$

where $x(y) = \frac{y - r\alpha - (r + \lambda) \left(S^p(y)^+ - \int S^p(y')^+ dG(y') \right)}{r\alpha - Ey}$

- Otherwise, $\delta^*(y) \in \{0, +\infty\}$

$Ey/r - \alpha$ is the expected surplus of a fixed-term contract with zero probability of destruction after a productivity shock. The gain is the present discounted value of expected production Ey/r , while the losses α are the present discounted values of a return into unemployment U and the expected value of a conversion into a open-ended contract $\int S^p(y')^+ dG(y')$. These two events do not occur under a zero probability of fixed-term job destruction, which explains why they appear as losses. Conversely, a productivity shock has a probability one to hit such an eternal fixed-term contract, which explains the role of the *expected* surplus as a hiring criterion.

If $Ey/r \geq \alpha$, a no-end fixed-term contract is expected to be profitable considering the impact of productivity shocks throughout its existence. Therefore, if the immediate surplus of a new match — namely the surplus before any productivity shock hits — is not too low, a zero probability of destruction is optimal. Otherwise, an immediate destruction is preferable and an infinite probability of destruction is chosen.

Conversely, if $Ey/r < \alpha$, a no-end fixed-term contract has an expected negative surplus after a productivity shock. This encourages firms to shorten the stipulated durations of fixed-term contracts

in order to avoid productivity shocks. Intuitively, if the productivity of the match is neither too low nor too high to opt for an infinite or zero probability of job destruction, there is room for optimization in terms of durations. The contract must be long enough to benefit from the current level of productivity but short enough to avoid losses associated with a productivity shock, which is expected to be detrimental. In that regard, an increase in the probability of shock occurrence pushes up the destruction probability for a given productivity y .

The probability of destruction decreases with the productivity of the firm-worker pair. Importantly, proposition 18 and its ramifications are still valid if the match chooses the duration instead of the destruction probability of a fixed-term contract as is the case in Cahuc et al. (2016).

According to proposition 18, the next assumption is necessary to rule out labor markets with polar durations of fixed-term contracts.

Assumption 2. $Ey/r < \alpha$

The following proposition states the optimal choice between fixed-term and open-ended contracts in function of the productivity of the match.

Proposition 19. *Under Assumption 2,*

- If $c = 0$, job creation only occurs through fixed-term contracts
- If $0 < c < \frac{\lambda}{r} \left(\alpha - \frac{Ey}{r} \right)$, job creation is dual if and only if $x(y^c) < x^* \equiv (2 + \beta) \beta$, where $\beta = \sqrt{\frac{c\lambda}{r\alpha - Ey}}$. Otherwise, job creation only occurs through fixed-term contracts.

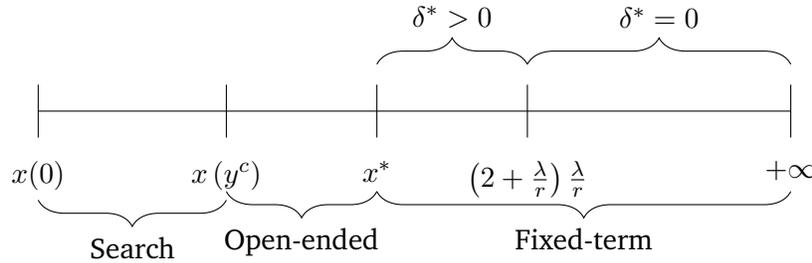


Figure 4.2.11: Dual job creation when $0 < c < \frac{\lambda}{r} \left(\alpha - \frac{Ey}{r} \right)$

- If $c \geq \frac{\lambda}{r} \left(\alpha - \frac{Ey}{r} \right)$, job creation is dual if and only if $x(y^c) < x^* \equiv \frac{\lambda}{r} + \frac{c(r+\lambda)}{r\alpha - Ey}$. Otherwise, job

creation only occurs through fixed-term contracts. fixed-term contracts have a zero probability of destruction.

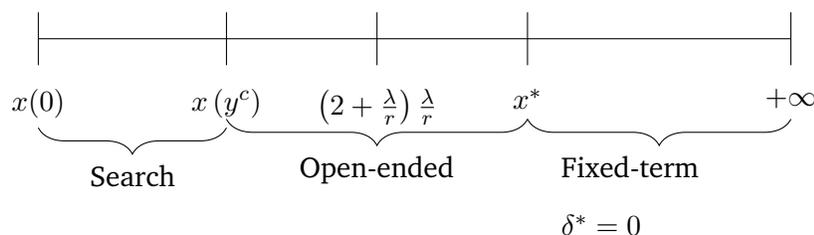


Figure 4.2.12: Dual job creation when $c \geq \frac{\lambda}{r} \left(\alpha - \frac{Ey}{r} \right)$

When there is no hiring cost, a new open-ended contract is equivalent to a new fixed-term contract with zero duration. Consequently, fixed-term contracts at least weakly dominate open-ended contracts at the hiring stage.

When the hiring cost is positive the job creation scheme is reversed with respect to the basic model with heterogeneous productivities. The endogenous choice of fixed-term contracts' job-destruction probability is not responsible for this plot twist. The possibility to convert an expiring fixed-term contract into a open-ended one accounts for this inversion. Indeed, on one hand, the flexibility provided by fixed-term contracts has expanded, as it now enables long-term relationships through both long fixed-term contracts and conversion into open-ended contracts. Avoiding the supplementary contracting cost constitutes the only motivation to directly hire through open-ended contracts instead of converting a fixed-term contract.

The firing cost is implicitly taken into account in the program of fixed-term matches because of the possibility of conversion to an open-ended contract at expiry. Consequently, fixed-term contracts cease to constitute waiting devices in opposition to productive open-ended contracts. The possibility to convert fixed-term contracts into open-ended ones makes fixed-term contracts sufficiently more flexible than open-ended contracts to cope with both high and low productivities at the hiring stage. The only caveat of fixed-term contracts with a finite duration is a superior administrative costs. In case of conversion, the contracting cost is paid twice. Firms and workers no longer strike a balance between productivity and flexibility as in the previous model. The sole compromise takes place between flexibility and hiring costs.

When productivity is moderate, the match can opt for a short fixed-term contract. On one hand, this provides a flexibility gain: if an adverse productivity shock occurs, the contract will end up quickly. The shorter the contract, the thinner this advantage. On the other hand, if an open-ended contract is beneficial, the contracting cost is paid twice. The shorter the contract, the heavier this drawback. Consequently, open-ended contracts tend to be preferred to very short fixed-term contracts whenever the former are beneficial. Conversely, when productivity is high, the hiring costs become small compared to the flexibility gains a longer fixed-term contract provides. As productivity converges towards infinity, a no-term fixed-term contract is even better than a open-ended contract. Somehow, the rigid open-ended contract is more flexible than a no-end fixed-term contract, which constitutes a better device to lock a firm-worker pair with a high productivity as there is a zero probability of separation.

When the hiring cost is high, the scope for short fixed-term contracts is reduced and open-ended contracts turn out to be more attractive. Finite fixed-term contracts are irrelevant as they impose paying twice hiring costs. Job creation only occurs through no-end fixed-term contracts and open-ended contracts. The limit point is the expected difference in surplus a finite fixed-term contract provides when a productivity shock occurs compared to a no-end fixed-term contract, namely $-\lambda(Ey/r - \alpha)/r$. This situation is not realistic. Therefore, a high contracting cost is incompatible with a proper fit of the data, hence the following additional assumption.

Assumption 3. $0 < c < \frac{\lambda}{r} \left(\alpha - \frac{Ey}{r} \right)$

The necessary theoretical foundations are elaborated enough to demonstrate the inadequacy of such a model to match data. Under assumptions 2 and 3, if job creation is dual, the resulting equilibrium is such that the shortest fixed-term contracts are the most likely to be converted into open-ended contracts, which is at odds with the data. The only way to remedy this problem is to consider equilibria with job creation through fixed-term contracts exclusively. Open-ended job creation solely occurs through conversion of fixed-term contracts. This is not relevant considering the ridiculous empirical probabilities of the latter event. Interestingly, notice that introducing heterogeneous firms in terms of shock arrival rate λ does not change these findings. To this extent, the model of Cahuc et al. (2016) critically relies on the hypothesis that new jobs have a fixed productivity. In this manner, a one-to-one link can be established between the distribution of the productivity shock arrival rate λ

and the distribution of fixed-term matches' durations. Assuming heterogeneous productivities for new matches leads to the same counter-factual conclusions for each value of the shock arrival rate λ .

Conclusion

In this paper, I have reviewed random-matching models accounting for labor market dualism. I have shown that the contractual layout of job creation crucially depends on the modeling of fixed-term contracts.

When fixed-term matches can costlessly split in response to shocks, fixed-term contracts are flexible; job creation tends to favor fixed-term contracts. One way leave room for open-ended jobs in the labor market equilibrium is to make expiring fixed-term contracts convertible into open-ended contracts, or constrain job creation. In that regard, many papers direct a settled share of new matches to each type of contract, which prevents studying contractual substitution effects in job creation.

On the contrary, when fixed-term matches cannot split before their stipulated end date regardless undergone adverse shocks, fixed-term contracts are rigid. In that case, job creation may leave room for both contracts. Job creation does not only occur through fixed-term contracts and there is no need for *ad hoc* job creation rules to get both types of contracts involved. Contractual substitution effects are not shut down at the hiring stage.

The nice features of models with rigid fixed-term contracts come at a high price; the resulting models lack robustness. In models with heterogeneous productivities, the ranking of contracts in job creation dramatically changes if fixed-term matches become convertible into open-ended ones. If firm-worker pairs optimize the duration of fixed-term contracts, the shortest fixed-term contracts are the most likely to be converted into open-ended contracts at expiry. As for models with heterogeneous processes of workload fluctuations, they critically depend on the assumption that the productivity of new matches is settled. Relaxing this assumption leads to the aforementioned counter-factual conclusions.

Overall, future models have to consider carefully the modeling of fixed-term contracts and navigate through the pros and cons of both modeling strategies. Building a robust model of job creation in a

dual labor market that takes seriously contractual substitution effects is still to be done.

Appendix

4.A Workload fluctuations

4.A.1 Proofs

Proposition 7

Proof. I rule out trivial cases where open-ended contracts are never relevant and assume open-ended contracts are profitable when there are no adverse productivity shocks.

Assumption 4. $y > rU$

S^p is continuous and decreases with λ . Indeed, the derivative of S^p with respect to λ goes by

$$\frac{\partial S^p}{\partial \lambda} = \frac{-y + rU - rF}{(r + \lambda)^2} < \frac{-(y - rU)}{(r + \lambda)^2} < 0$$

Moreover, $S^p(0) = y/r - U$ and $\lim_{\lambda \rightarrow +\infty} S^p(\lambda) = -F < 0$. As a result, there exists a unique λ^p such that

$$S^p(\lambda^p) = 0$$

id est $\lambda^p = \frac{y - rU}{F}$

□

Proposition 8

Proof. Consider the derivative of S^f with respect to δ .

$$\frac{\partial S^f}{\partial \delta} = -\frac{y}{(r + \delta + \lambda)^2} + \frac{rU}{(r + \delta)^2} > 0$$

i.e. $\delta < \lambda \left(\sqrt{\frac{y}{rU}} - 1 \right)^{-1} - r \equiv \delta^*(\lambda)$ for all $\lambda \geq \lambda^p$

Note that δ^* is linear in λ with a positive slope and, thus, is continuous and increasing in λ . In addition, $\delta^*(0) = -r < 0$ and $\lim_{\lambda \rightarrow +\infty} \delta^*(\lambda) = +\infty$. Thus, there exists a unique $\underline{\lambda}$ such that $\delta^*(\underline{\lambda}) = 0$.

$$\underline{\lambda} = r \left(\sqrt{\frac{y}{rU}} - 1 \right)$$

□

Proposition 9

Proof. For a given λ , 2 cases arise in the program $S_o^f(\lambda) = \max_{\delta \geq 0} S^f(\lambda, \delta)$

- If $\delta^*(\lambda) > 0$, *id est* if $\lambda > \underline{\lambda}$ then $\delta^*(\lambda)$ is the unique maximizer of $\delta \mapsto S^f(\delta, \lambda)$ and $S_o^f = S^f(\delta^*(\lambda), \lambda)$.
- Otherwise, if $\delta^*(\lambda) \leq 0$, *id est* if $\lambda \leq \underline{\lambda}$, $\delta^*(\lambda)$ does not comply with the non-negativity constraint over the optimal δ . Note that $\delta \mapsto S^f(\delta, \lambda)$ is continuous and decreasing over the interval $[\delta^*(\lambda), +\infty]$. Hence, $\delta = 0$ leads to the highest possible value of the surplus and respects the constraint $\delta \geq 0$.

Therefore, the optimized surplus of fixed-term jobs $S_o^f(\lambda) = S^f(\lambda, \delta^*(\lambda))$ verifies

$$S_o^f(\lambda) = \begin{cases} \frac{y}{r+\lambda} - U & \text{if } \lambda \leq \underline{\lambda} \\ \frac{(\sqrt{y} - \sqrt{rU})^2}{\lambda} & \text{otherwise} \end{cases}$$

S_o^f decreases with λ . Moreover, $S_o^f(0) = y/r - U > 0$ and $\lim_{\lambda \rightarrow +\infty} S_o^f(\lambda) = 0^+$. Thus, $S_o^f > 0$. □

Proposition 10

Proof. Now, I consider the function $\Delta = S^f - S^p$. If $\lambda \leq \underline{\lambda}$, Assumption 1 entails that

$$\Delta(\lambda) = \frac{\lambda(F - U)}{r + \lambda} < 0$$

Thus, $S^f(\lambda) > S^p(\lambda)$ for all $\lambda \leq \underline{\lambda}$.

If $\lambda > \underline{\lambda}$, Δ can be expressed as

$$\Delta(\lambda) = \frac{F\lambda^2 - 2\sqrt{rU}(\sqrt{y} - \sqrt{rU})\lambda + r(\sqrt{y} - \sqrt{rU})^2}{\lambda(r + \lambda)}$$

The sign of Δ boils down to the sign of the numerator, which is a second-degree polynomial function.

It has two positive roots λ_1^* and λ_2^* .

$$\lambda_1^* = \sqrt{rU} \frac{\sqrt{y} - \sqrt{rU}}{F} \left(1 - \sqrt{1 - \frac{F}{U}} \right)$$

$$\lambda_2^* = \sqrt{rU} \frac{\sqrt{y} - \sqrt{rU}}{F} \left(1 + \sqrt{1 - \frac{F}{U}} \right)$$

It is possible to locate these roots with respect to the thresholds $\underline{\lambda}$ and λ^p .

$$\lambda_1^* = \sqrt{rU} \frac{\sqrt{y} - \sqrt{rU}}{F} \left(1 - \sqrt{1 - \frac{F}{U}} \right) < \sqrt{rU} \frac{\sqrt{y} - \sqrt{rU}}{F} \left(1 - \left(1 - \frac{F}{U} \right) \right) = \underline{\lambda}$$

$$\underline{\lambda} = \sqrt{rU} \frac{\sqrt{y} - \sqrt{rU}}{F} \left(1 - \left(1 - \frac{F}{U} \right) \right) < \sqrt{rU} \frac{\sqrt{y} - \sqrt{rU}}{F} \left(1 + \sqrt{1 - \frac{F}{U}} \right) = \lambda_2^*$$

$$\lambda_2^* = \sqrt{rU} \frac{\sqrt{y} - \sqrt{rU}}{F} \left(1 + \sqrt{1 - \frac{F}{U}} \right) < \sqrt{rU} \frac{\sqrt{y} - \sqrt{rU}}{F} \left(1 + \sqrt{\frac{y}{rU}} \right) = \lambda^p$$

The ordering $\lambda_1^* < \underline{\lambda} < \lambda^* \equiv \lambda_2^* < \lambda^p$ implies that

$$\begin{cases} S^p(\lambda) > S^f(\lambda) > 0 & \text{if } \lambda \leq \lambda^* \\ S^f(\lambda) > S^p(\lambda) > 0 & \text{if } \lambda^* < \lambda < \lambda^p \\ S^f(\lambda) > 0 > S^p(\lambda) & \text{otherwise} \end{cases}$$

Job creation takes place accordingly.

□

Proposition 11

Proof. I rule out trivial cases where open-ended contracts are never relevant and assume open-ended contracts are profitable when there are no adverse productivity shocks.

Assumption 5. $y > r(U + c)$

S^p is strictly decreasing in λ .

$$\frac{\partial S^p}{\partial \lambda} = \frac{-y + r(U - F)}{(r + \lambda)^2} < \frac{-(y - rU)}{(r + \lambda)^2} < 0$$

Assumption 5 ensures that $y > r(U + c) > y > rU$.

Note also that $S^p(0) = \frac{y}{r} - U - c$ and $\lim_{\lambda \rightarrow +\infty} S^p(\lambda) = -F - c$. Hence, there exists a unique λ^p such that $S^p(\lambda^p) = 0$.

$$\lambda^p = \frac{y - r(U + c)}{F + c}$$

□

Proposition 12

Proof. Consider 2 cases for a given λ :

- If $\lambda < \lambda^p$, then $S^p(\lambda) > 0$ and

$$\frac{\partial S^f}{\partial \delta}(\lambda, \delta) = -\frac{\lambda(F+c) + r(U+c)}{(r+\delta+\lambda)^2} + \frac{rU}{(r+\delta)^2} > 0$$

i.e. $\delta < \lambda \left(\sqrt{\frac{\lambda(F+c) + r(U+c)}{rU}} - 1 \right)^{-1} - r \equiv \delta^*(\lambda)$ for all $\lambda < \lambda^p$

- If $\lambda \geq \lambda^p$, then $S^p(\lambda) \leq 0$ and

$$\frac{\partial S^f}{\partial \delta} = -\frac{y}{(r+\delta+\lambda)^2} + \frac{rU}{(r+\delta)^2} > 0$$

i.e. $\delta < \lambda \left(\sqrt{\frac{y}{rU}} - 1 \right)^{-1} - r \equiv \delta^*(\lambda)$ for all $\lambda \geq \lambda^p$

Now, I compute the derivative of δ^* with respect to λ to study its variations.

- If $\lambda \geq \lambda^p$, $S^p(\lambda) \leq 0$ and δ^* is linearly increasing in λ .

$$\delta^*(\lambda) = \frac{\lambda}{\sqrt{\frac{y}{rU}} - 1} - r$$

- Otherwise, $S^p(\lambda) < 0$, and δ^* writes

$$\delta^*(\lambda) = \frac{\lambda}{\sqrt{\frac{\lambda(F+c) + r(U+c)}{rU}} - 1} - r$$

The derivative of δ^* verifies

$$\begin{aligned} (\delta^*)'(\lambda) &\propto \sqrt{\lambda(F+c) + r(U+c)} - \sqrt{rU} - \frac{\lambda(F+c)}{2\sqrt{\lambda(F+c) + r(U+c)}} \\ &\propto 2r(U+c) + \lambda(F+c) - 2\sqrt{rU}\sqrt{\lambda(F+c) + r(U+c)} \\ &\propto \left(\sqrt{rU} - \sqrt{\lambda(F+c) + r(U+c)} \right)^2 + rc > 0 \end{aligned}$$

As a result, δ^* is increasing in λ . Moreover, δ^* is continuous and $\delta^*(0) = -r$, $\lim_{\lambda \rightarrow \infty} \delta^*(\lambda) = +\infty$.

Thus, there exists a unique $\underline{\lambda}$ such that $\delta^*(\underline{\lambda}) = 0$. □

Proposition 13

Proof. For a given λ , 2 cases arise in the program $S_o^f(\lambda) = \max_{\delta \geq 0} S^f(\lambda, \delta)$

- If $\delta^*(\lambda) > 0$, *id est* if $\lambda > \underline{\lambda}$ then $\delta^*(\lambda)$ is the unique maximizer of $\delta \mapsto S^f(\delta, \lambda)$ and $S_o^f = S^f(\delta^*(\lambda), \lambda)$.
- Otherwise, if $\delta^*(\lambda) \leq 0$, *id est* if $\lambda \leq \underline{\lambda}$, $\delta^*(\lambda)$ does not comply with the non-negativity constraint over the optimal δ . Note that $\delta \mapsto S^f(\delta, \lambda)$ is continuous and decreasing over the interval $[\delta^*(\lambda), +\infty]$. Hence, $\delta = 0$ leads to the highest possible value of the surplus and respects the constraint $\delta \geq 0$.

Therefore, the optimized joint surplus of fixed-term contracts S_o^f verifies

$$S_o^f(\lambda) = \begin{cases} S^f(0, \lambda) & \text{if } \lambda \leq \underline{\lambda} \\ S^f(\delta^*(\lambda), \lambda) & \text{otherwise} \end{cases} \quad (4.A.1)$$

Now, I pinpoint the derivative of S^f to study its variations.

- If $\lambda \leq \underline{\lambda}$, (4.A.1) and (4.2.2) yield

$$\frac{\partial S_o^f}{\partial \lambda} = \frac{\partial S^f}{\partial \lambda} \Big|_{(0, \lambda)} = -\frac{y}{(r + \lambda)^2} < 0$$

- If $\lambda > \underline{\lambda}$, (4.A.1) and (4.2.2) lead to

$$\frac{\partial S_o^f}{\partial \lambda} = \frac{\partial S^f}{\partial \lambda} \Big|_{(\delta^*(\lambda), \lambda)} + \frac{\partial \delta^*(\lambda)}{\partial \lambda} \frac{\partial S^f}{\partial \delta} \Big|_{(\delta^*(\lambda), \lambda)}$$

For a given λ , the proof of proposition 12 shows that $\delta^*(\lambda)$ nullifies the derivative of $\delta \mapsto S^f(\delta, \lambda)$

$$\frac{\partial S^f}{\partial \delta} \Big|_{(\delta^*(\lambda), \lambda)} = 0$$

Hence, the derivative of S_o^f with respect to λ boils down to

$$\frac{\partial S_o^f}{\partial \lambda} = \frac{\partial S^f}{\partial \lambda} \Big|_{(\delta^*(\lambda), \lambda)}$$

– If $\lambda < \lambda^p$, then $S^p(\lambda) > 0$ and

$$\frac{\partial S_o^f}{\partial \lambda} = -\frac{y + \delta^*(\lambda)S^p(\lambda)}{(r + \delta^*(\lambda) + \lambda)^2} + \frac{\delta^*(\lambda)}{r + \delta^*(\lambda) + \lambda} \underbrace{\frac{\partial S^p}{\partial \lambda}}_{<0} < 0 \quad (4.A.2)$$

– Otherwise, if $\lambda \geq \lambda^p$, then $S^p(\lambda) \leq 0$ and

$$\frac{\partial S_o^f}{\partial \lambda} = -\frac{y}{(r + \delta^*(\lambda) + \lambda)^2} < 0$$

Thus, S_o^f is decreasing and continuous. Moreover, $S_o^f(0) = S^f(0, 0) = y/r - U - c$ and $\lim_{\lambda \rightarrow +\infty} S_o^f(\lambda) = -c$. Hence, there exists a unique $\bar{\lambda}$ such that $S_o^f(\bar{\lambda}) = 0$. \square

Proposition 14

Proof. Consider λ such that $0 < \lambda \leq \underline{\lambda}$ and $\Delta \equiv S_o^f - S^p$.

$$\Delta(\lambda) = S_o^f(\lambda) - S^p(\lambda) = \frac{\lambda(F - U)}{r + \lambda} < 0$$

Δ is continuous, negative on $]0, \underline{\lambda}]$. In addition, $\Delta(0) = 0$ and $\lim_{\lambda \rightarrow +\infty} \Delta(\lambda) = F > 0$. Consequently, there must exist at least one $\lambda^* > \underline{\lambda}$ such that $\Delta(\lambda^*) = 0$.

First, I rewrite Δ for $\lambda > \underline{\lambda}$, $\lambda \neq \lambda^p$. To do this, I rewrite S_o^f . As stated in the proposition 12, δ^* nullifies $\partial S^f / \partial \delta$, which entails

$$S^p(\lambda)^+ = \frac{1}{r + \lambda} \left(y - \left(1 + \frac{\lambda}{r + \delta^*(\lambda)} \right)^2 rU \right)$$

This leads to the following expression for S_o^f .

$$S_o^f(\lambda) = \frac{y}{r + \lambda} - \left(1 + \frac{\delta^*(\lambda)}{r + \lambda} \left(1 + \frac{\lambda}{r + \delta^*(\lambda)} \right) \right) \frac{rU}{r + \delta^*(\lambda)} - c$$

As a result, Δ boils down to

$$\Delta(\lambda) = \frac{\lambda}{r + \lambda} \left(F - U \left[1 - \left(\frac{\delta^*(\lambda)}{r + \delta^*(\lambda)} \right)^2 \right] \right)$$

and its derivative writes

$$\Delta'(\lambda) = \frac{r}{\lambda(r + \lambda)} \Delta(\lambda) + \frac{2\lambda r U (\delta^*)'(\lambda) \delta^*(\lambda)}{(r + \lambda)(r + \delta^*(\lambda))^3}$$

Note that

$$\Delta'(\lambda^*) = \frac{2\lambda^* r U (\delta^*)'(\lambda^*) \delta^*(\lambda^*)}{(r + \lambda^*)(r + \delta^*(\lambda^*))^3} > 0$$

Thus, λ^* is unique. Otherwise, there would exist one λ^* such that $\Delta^*(\lambda^*) = 0$ and $(\Delta^*)'(\lambda^*) < 0$.

As a result, $\Delta(\lambda) \leq 0$ for $\lambda \leq \lambda^*$ and $\Delta(\lambda) > 0$ otherwise. 2 cases arise:

- if $S_o^f(\lambda^p) \leq 0 = S_o^f(\bar{\lambda})$, as S_o^f is decreasing, $\lambda^p \geq \bar{\lambda}$. Moreover, $\Delta(\lambda^p) \leq 0$, which implies that $\lambda^p \leq \lambda^*$. Overall, $\bar{\lambda} \leq \lambda^p \leq \lambda^*$. Job creation only occurs through open-ended contracts and encompasses matches with $\lambda \in [0, \lambda^p]$.
- if $S_o^f(\lambda^p) > 0 = S_o^f(\bar{\lambda})$, as S_o^f is decreasing, $\lambda^p < \bar{\lambda}$. Moreover, $\Delta(\lambda^p) > 0$, which implies that $\lambda^p > \lambda^*$. Overall, $\lambda^* < \lambda^p < \bar{\lambda}$. Job creation occurs through open-ended contracts when $\lambda < \lambda^*$, and through fixed-term contracts when $\lambda^* < \lambda < \bar{\lambda}$. Fixed-term matches such that $\lambda^* < \lambda < \lambda^p$ and that do not face an adverse productivity shock are converted into open-ended matches.

□

4.A.2 Additional graphs

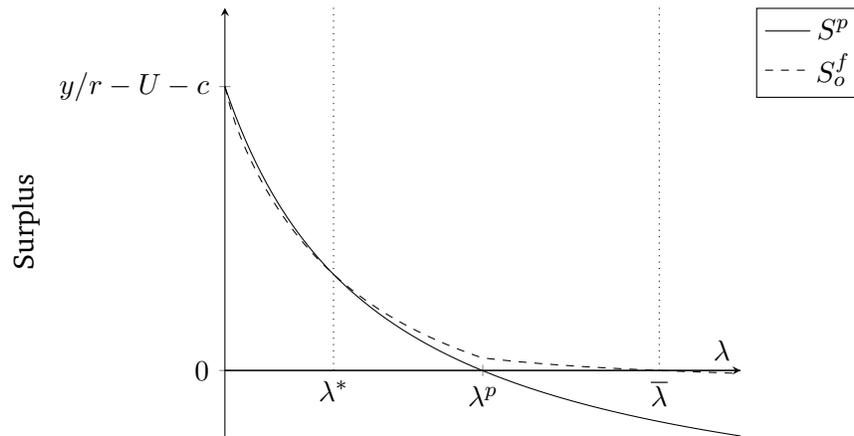


Figure 4.A.1: Arrival rate of productivity shocks and job creation: dual case

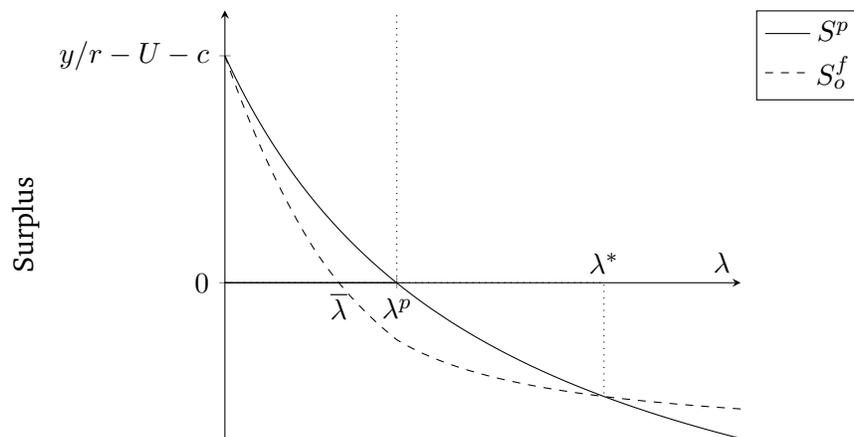


Figure 4.A.2: Arrival rate of productivity shocks and job creation: open-ended jobs only

4.B Heterogeneous productivities

4.B.1 Proofs

Proposition 15

Proof. I denote $\rho^p = 1/(r + s + \lambda)$ and $\rho^f = 1/(r + \delta + \lambda)$. As mentioned above, $\rho^p > \rho^f$.

- Assume that $y^* > y^f$. (4.2.4) implies that $\rho^p y^* = (\rho^p - \rho^f) y^* + \rho^f y^* = \rho^p y^c + \rho^f (y^* - y^f)$.

Since $y^* - y^f > 0$, the latter equality implies $y^* > y^c$.

- Assume that $y^* > y^c$. Again, jointly with algebraic manipulations, (4.2.4) implies that $\rho^f y^c = -(\rho^p - \rho^f) y^c + (\rho^p - \rho^f) y^* + \rho^f y^f > -(\rho^p - \rho^f) y^c + (\rho^p - \rho^f) y^c + \rho^f y^f > \rho^f y^f$, which entails that $y^c > y^f$.
- Assume that $y^c > y^f$. Algebraic manipulations and (4.2.4) imply that $(\rho^p - \rho^f) y^* = \rho^p (y^c - y^f) + (\rho^p - \rho^f) y^f > (\rho^p - \rho^f) y^f$, which implies $y^* > y^f$. \square

\square

Proposition 16

Proof. • If $F \geq rU/(r + \delta)$, $y^c \geq y^f$. Referring to proposition 15, the latter inequality entails $y^* \leq y^f \leq y^c$. (4.2.5) entails that only open-ended contracts weigh in job creation for productivities $y > y^c$.

- Otherwise, $y^c < y^f$ and proposition 15 ensures that $y^f < y^c < y^*$. (4.2.5) entails that job creation is dual. For productivities $y^f < y < y^*$, job creation occurs through fixed-term contracts. Productivities y such that $y > y^*$ involve open-ended contracts.

\square

Proposition 17

Proof. • If $F \geq rU/(r + \delta)$, then $S^f(y^c) \geq 0 = S^p(y^c)$. Since S^f is increasing in y and $S^f(y^f) = 0$, y^f and y^c verify $y^f \leq y^c$.

For all $y \leq y^c$, S^p and S^f are linear in y and

$$S^p(y) = \frac{y - y^c}{r + s + \lambda}$$

$$S^f(y) = \frac{y - y^f}{r + \delta + \lambda}$$

Using these expressions, one may demonstrate that fixed-term contracts deliver a higher joint surplus than their open-ended counterparts for productivities $y \leq y^c$.

$$S^f(y) = \frac{y^c - y^f}{r + \delta + \lambda} + \frac{y - y^c}{r + \delta + \lambda} > \underbrace{S^f(y^c)}_{\geq 0} + \underbrace{\frac{y - y^c}{r + s + \lambda}}_{=S^p(y)} \geq S^p(y)$$

The first inequality stems from the fact that $s < \delta$, which ensures that $(r + s + \lambda)^{-1} > (r + \delta + \lambda)^{-1}$.

As a result, the only hires with a productivity lower than y^c occur through fixed-term contracts with a minimal productivity y^f .

As for productivities $y > y^c$, using the linearity of S^f and S^p , one may show that fixed-term contracts still dominate open-ended ones.

$$S^f(y) = \underbrace{\left(1 + \frac{s}{r + \delta + \lambda}\right)}_{>1} \frac{y - y^c}{r + s + \lambda} + S^f(y^c) > S^p(y) + \underbrace{S^f(y^c)}_{\geq 0} > S^p(y)$$

- Otherwise, $S^f(y^c) < 0 = S^p(y^c)$. S^f being increasing in y and $S^f(y^f) = 0$, y^f and y^c verify $y^f > y^c$. Moreover, S^p and S^f are linear in y and for all $y > y^c$

$$\frac{\partial S^f}{\partial y} = \left(1 + \frac{s}{r + \delta + \lambda}\right) \frac{1}{r + s + \lambda} > \frac{1}{r + s + \lambda} = \frac{\partial S^p}{\partial y}$$

Thus, there exists $y^* > y^f$ such that $S^p(y^*) = S^f(y^*)$. Consequently, the ranking of joint surpluses verify

$$\begin{cases} S^p(y) > 0 > S^f(y) & \forall y^c < y < y^f \\ S^p(y) > S^f(y) > 0 & \forall y^f < y < y^* \\ S^f(y) > S^p(y) > 0 & \forall y > y^* \end{cases}$$

Job creation takes place accordingly.

□

Proposition 18

Proof. Let me denote $z(y) = y - r\alpha - (r + \lambda) \left(S_0^p(y)^+ - \int S_0^p(y')^+ dG(y') \right)$. Notice that y is increasing in y . Algebraic manipulations deliver another expression of S^f as follows

$$S^f(y, \delta) = \frac{1}{r + \delta + \lambda} \left(z(y) - \frac{\lambda}{r + \delta} (r\alpha - Ey) \right) + S_0^p(y)^+ \quad (4.B.1)$$

Differentiating this expression with respect to δ yields

$$\frac{\partial S^f}{\partial \delta} = -\frac{1}{(r + \delta + \lambda)^2} \left(z(y) - \frac{\lambda}{r + \delta} (r\alpha - Ey) \right) + \frac{1}{r + \delta + \lambda} \frac{\lambda}{(r + \delta)^2} (r\alpha - Ey)$$

Consequently, provided that $r + \delta > 0$,

$$\frac{\partial S^f}{\partial \delta} \geq 0 \Leftrightarrow z(y)(r + \delta)^2 - 2\lambda(r\alpha - Ey)(r + \delta) - \lambda^2(r\alpha - Ey) \leq 0$$

Studying the variations of S^f boils down to assessing the sign of a second-degree polynomial in $(r + \delta)$.

- If $r\alpha = Ey$, $\text{sign} \left(\frac{\partial S^f}{\partial \delta} \right) = \text{sign}(-z(y))$. In this case, $\delta^*(y) \in \{0, +\infty\}$ if $z(y) \neq 0$. Otherwise, any non-negative δ maximizes S^f .
- If $r\alpha > Ey$, $\text{sign} \left(\frac{\partial S^f}{\partial \delta} \right) = \text{sign}(P_y(r + \delta))$, where $P_y(X) = -x(y)X^2 + 2\lambda X + \lambda^2$. Several subcases arise.

– If $x(y) \leq -1$, $\partial S^f / \partial \delta \geq 0$ and $\delta^*(y) = +\infty$

- If $-1 < x(y) < 0$, P_y has two negative roots and, thus, is positive on $(0, +\infty)$. Consequently, S^f is increasing in δ over the latter interval and $\delta^*(y) = +\infty$
- If $x(y) = 0$, P_y is linear and positive over $(0, +\infty)$ and $\delta^*(y) = +\infty$.
- If $x(y) > 0$, P_y has one negative and one positive root, the latter verifying $r + \delta_0 = \lambda \frac{1 + \sqrt{1 + x(y)}}{x(y)}$. Either $\delta_0 < 0$, in which case S^f decreases over $(0, \infty)$ and $\delta^*(y) = 0$, or $\delta_0 \geq 0$, in which case S^f attains a maximum at $\delta^*(y) = \delta_0 \in (0, \infty)$.

When do we have $\delta_0 \geq 0$? The latter condition is equivalent to $r(1 + x(y)) - \lambda\sqrt{1 + x(y)} - (r + \lambda) \leq 0$, which is - again - a second-degree polynomial in $\sqrt{1 + x(y)}$ with roots -1 and $(\lambda + r)/r$. Consequently, $\delta_0 \geq 0$ if and only if $-1 \leq \sqrt{1 + x(y)} \leq (\lambda + r)/r$. Since $x(y) > 0$, this is true whenever $x(y) \leq \frac{\lambda}{r} (2 + \frac{\lambda}{r})$.

- If $r\alpha < Ey$, $\text{sign} \left(\frac{\partial S^f}{\partial \delta} \right) = -\text{sign} (P_y(r + \delta))$. One may revisit the cases tackled above.

- If $x(y) \leq 0$, S^f is decreasing in δ over $(0, +\infty)$ and $\delta^*(y) = 0$
- If $x(y) > 0$, P_y has one negative and one positive root, the latter verifying $r + \delta_0 = \lambda \frac{1 + \sqrt{1 + x(y)}}{x(y)}$. Either $\delta_0 < 0$, in which case S^f increases over $(0, \infty)$ and $\delta^*(y) = +\infty$, or $\delta_0 \geq 0$, in which case S^f attains a minimum at $\delta_0 \in (0, \infty)$ and $\delta^*(y) \in \{0, +\infty\}$.

□

Proposition 19

Proof. The choice between a fixed-term and a open-ended contract at the hiring stage can be summed up in the sign of the function Δ defined as $\Delta(y) = S_0^f(y) - S_0^p(y)^+$. The latter can be rewritten as

$$\Delta(y) = S^f(y, \delta^*(y)) - c - S_0^p(y)^+$$

Using (4.B.1), the previous equation becomes

$$\Delta(y) = \frac{r\alpha - Ey}{r + \delta^*(y) + \lambda} \left(x(y) - \frac{\lambda}{r + \delta^*(y)} \right) - c$$

Several cases arise when $c > 0$

- If $x(y) \leq 0$, $\delta^*(y) = +\infty$ and $\Delta(y) = -c < 0$. Hiring only takes place through open-ended contracts under the constraint that $y \geq y^c$.

- If $0 < x(y) < \frac{\lambda}{r} (2 + \frac{\lambda}{r})$, using the definition of δ^* spelled in proposition 18, one may rewrite $\Delta(y)$ as

$$\Delta(y) = \frac{r\alpha - Ey}{\lambda} \left(\frac{x(y)}{1 + \sqrt{1 + x(y)}} \right)^2 - c$$

Algebraic manipulations entail that

$$\text{sign}(\Delta(y)) = \text{sign}\left(x(y) + 1 - \beta\sqrt{1 + x(y)} - (1 + \beta)\right)$$

$$\text{where } \beta = \sqrt{\frac{c\lambda}{r\alpha - Ey}}$$

The right-hand side of the equation above is a second-degree polynomial in $\sqrt{1 + x(y)}$. Therefore, since $x(y) > 0$, $\Delta(y) \geq 0$ if and only if $x(y) \geq (2 + \beta)\beta$.

- If $x(y) \geq \frac{\lambda}{r} (2 + \frac{\lambda}{r})$, $\delta^*(y) = 0$ and $\Delta(y) = \frac{r\alpha - Ey}{r + \lambda} (x(y) - \frac{\lambda}{r}) - c$. Thus, $\Delta(y) \geq 0$ if and only if $x(y) \geq \frac{\lambda}{r} + \frac{c(r + \lambda)}{r\alpha - Ey}$.

Notice that the latter condition is always fulfilled in this specific case if and only if $\beta \leq \frac{\lambda}{r}$. If $\beta \leq \frac{\lambda}{r}$,

$$\begin{aligned} \frac{\lambda}{r} + \frac{c(r + \lambda)}{r\alpha - Ey} &= \frac{\lambda}{r} + \beta^2 \left(1 + \frac{r}{\lambda}\right) \\ &\leq \frac{\lambda}{r} + \beta^2 + \beta \\ &\leq \frac{\lambda}{r} + \left(\frac{\lambda}{r}\right)^2 + \frac{\lambda}{r} \\ &\leq \frac{\lambda}{r} \left(2 + \frac{\lambda}{r}\right) \end{aligned}$$

Conversely, if $\frac{\lambda}{r} + \frac{c(r + \lambda)}{r\alpha - Ey} = \frac{\lambda}{r} + \beta^2 \left(1 + \frac{r}{\lambda}\right) \leq \frac{\lambda}{r} (2 + \frac{\lambda}{r})$, algebraic manipulations directly entail that $\beta^2 \leq \left(\frac{\lambda}{r}\right)^2$, which proves that $\beta < \frac{\lambda}{r}$.

We now have all the necessary information to circumscribe the equilibria with dual job creation.

- If $\beta < \frac{\lambda}{r}$, $\Delta(y) \geq 0$ if and only if $x(y) \geq (2 + \beta)\beta$. In other words, fixed-term contracts

are hired whenever $x(y) \geq (2 + \beta) \beta$. x being increasing in y , there is room for job creation through open-ended contracts if and only if $x(y^c) < (2 + \beta) \beta$.

- If $\beta \geq \frac{\lambda}{r}$, $\Delta(y) \geq 0$ if and only if $x(y) \geq \frac{\lambda}{r} + \beta^2 \left(1 + \frac{r}{\lambda}\right)$. Job creation is dual if and only if $x(y^c) < \frac{\lambda}{r} + \beta^2 \left(1 + \frac{r}{\lambda}\right)$. In this case, all fixed-term contracts have a zero probability of job destruction.

To end the proof, notice that $\beta < \frac{\lambda}{r}$ is equivalent to $c < \frac{\lambda}{r} \left(\alpha - \frac{Ey}{r}\right)$. Moreover, when $c = 0$, revisiting each point above ensures that hiring through a fixed-term contract is weakly preferable to hiring through a open-ended contract. □

4.B.2 Additional graphs

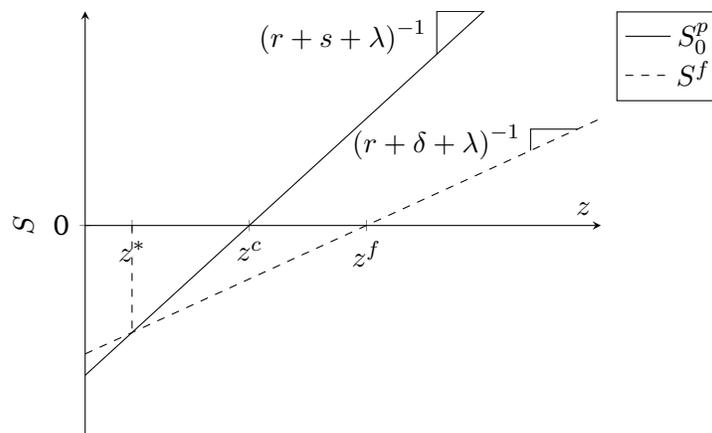


Figure 4.B.1: Job creation with open-ended jobs only

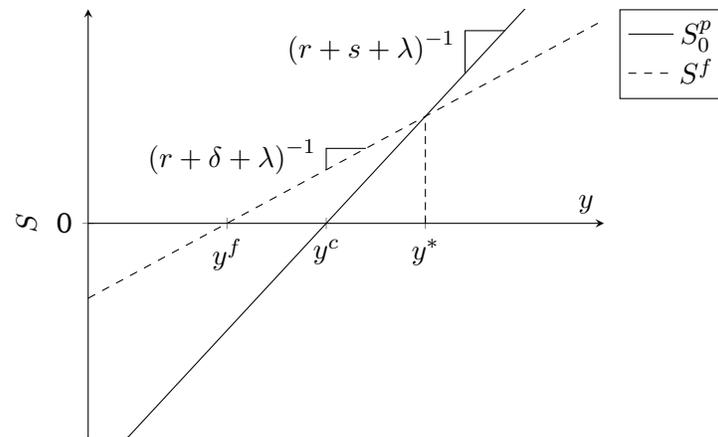


Figure 4.B.2: Dual job creation

Chapter 5

General Conclusion

In this dissertation, I have explored various macroeconomic implications of labor market dualism. In the first chapter, I have reviewed stylized facts and the related literature in my first chapter. The prominence of fixed-term contracts in labor market flows contrast with the seemingly constraining legislation in that matter. A consensus emerges in the literature on three major points: (i) stringent employment protection legislation fuels the expansion of fixed-term employment; (ii) employment protection legislation has an ambiguous effect on unemployment; (iii) fixed-term job creation and destruction flows as well as fixed-term employment are much more volatile than their open-ended counterparts.

In view of these observations, a natural question I have dealt with is the desirability of reforming dual labor markets. To do so, using a structural model calibrated on French data, I consider the steady-state and transitional effects of a change in firing costs. I identify two mechanisms that make the steady-state responses of fixed-term and open-ended employments non-monotonous with respect to changes in firing costs. Overall, while cutting firing costs yields welfare benefits, steady-state employment outcomes are unclear. Moreover, open-ended employment decreases and unemployment increases during the transition, which may last several years. I also find that a small uncertainty in firing costs significantly increases fixed-term employment and decreases open-ended employment.

Labor movements mostly occur on the fixed-term side of the labor market, as the literature has widely shown. The way firms use fixed-term jobs to cope with the most common types of shocks and price rigidity has not been studied, though. I have addressed this issue in the third chapter. I plug a variant of the model used in the second chapter into a typical New-Keynesian framework. I estimate and calibrate the model on Euro area data. The model replicates well labor market moments, notably the counter-cyclical share of fixed-term contracts in job creation. A change in firing costs does not modify inflation volatility, while it changes the volatility of inflation components. Moreover, I find that fixed-term employment responds differently to a negative pure demand shock and to an uncertainty shock. Fixed-term employment may be an indicator of the perceived risk in the economy.

Fluctuations in job creation flows explain a prominent share of unemployment fluctuations and the concentration of turnover on the fixed-term side of the labor market impacts unemployment

fluctuations. However, only a few papers have tried to model the choice between fixed-term and open-ended contracts in job creation. I have reviewed these papers in the fourth chapter. Two polar assumptions about the modeling of fixed-term contracts drive the results in the literature. Some papers assume that fixed-term contracts are flexible and can end any time at zero cost. Others assume that fixed-term contracts are rigid and cannot split before their stipulated termination date. Modeling fixed-term contracts as flexible leads to job creation flows with fixed-term contracts only. On the contrary, rigid fixed-term contracts enable both open-ended and fixed-term contracts to naturally intervene in job creation. Being able to account for contractual substitution effects using rigid fixed-term contracts comes at some cost. The ranking of contracts in job creation is not robust when the productivity of new matches is heterogeneous. This observation notably covers the models of chapters 2 and 3.

In this dissertation, I have made strong choices that may seem arguable. The set of assumptions enabling tractability in chapter 2 are one of those. I thought it was essential to keep mechanisms as clear as possible when addressing transitions, which often require computer-intensive resources in the macroeconomic literature. The simplifying assumptions I made in chapter 3 respond to another motive: comparability. As far as I know, chapter 3 is the first work embedding a dual labor market in a New-Keynesian framework. I thought it would be relevant to present a baseline model without any further complications, such as wage rigidity, heterogeneous firms and workers or persistent idiosyncratic shocks. In this manner, comparing my findings with the well-established findings in the labor economics literature on the one hand and the DSGE literature on the other hand is possible.

Making more realistic assumptions would be the next step in my research. Typically, introducing decreasing returns to scale, firms with heterogeneous sizes, heterogeneous workers and job-to-job movements would be interesting extensions. Drawing from the literature about firms' labor demand under adjustment costs would probably provide interesting insights.

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RÉSUMÉ

En Europe de l'Ouest, l'emploi temporaire s'est renforcé au cours des dernières décennies malgré des dispositifs légaux décourageant son usage. Cette thèse s'intéresse aux effets macroéconomiques de cet essor. De nombreux chercheurs pointent du doigt la protection légale de l'emploi. Néanmoins, la plupart des articles traitant du sujet se limitent à l'étude des états stationnaires et négligent les états transitoires. Le premier chapitre comble ce manque en construisant un modèle classique d'appariement. Des coûts de licenciement protègent les CDI, tandis que les CDD se terminent sans coût à échéance. Les paires employeur-employé nouvellement constituées choisissent le contrat qui maximise leur surplus commun. Le modèle est calibré sur des données françaises. Après une réforme instituant uniquement des CDI protégés par des coûts de licenciement plus faibles, la convergence vers le nouvel équilibre est lente ; l'emploi CDI décroît tandis que le chômage augmente. Le second chapitre s'intéresse aux fluctuations au sein d'un marché segmenté. Pour ce faire, un modèle presque similaire à celui du premier chapitre est intégré dans un cadre Néo-Keynésien. La protection de l'emploi affecte l'usage des CDD, ce qui en retour modifie l'optimisation de l'emploi et des prix par les entreprises. L'effet des coûts de licenciements sur les évolutions de l'inflation est étudié. Le modèle est calibré et estimé sur des séries trimestrielles caractéristique de la Zone Euro à l'aide d'une méthode de Monte Carlo séquentiel. Le modèle reproduit bien les moments caractéristiques d'un marché du travail dual. La variance de l'inflation n'est pas affectée par un changement des coûts de licenciement, bien que les dynamiques de ses différentes composantes sont radicalement différentes. A l'aide d'une méthode de perturbation d'ordre trois, l'effet de l'incertitude est étudié en introduisant des volatilités stochastiques dans les processus de chocs. L'emploi CDD réagit différemment à un choc d'incertitude et à un choc négatif sur la demande, ce qui peut permettre de les distinguer empiriquement. Le troisième chapitre se penche sur la modélisation de la création d'emploi dans les modèles d'appariement. La littérature peut être catégorisée selon la manière de modéliser les CDD. Une approche flexible considère que les CDD peuvent être licenciés gratuitement et à tout moment. A l'inverse, une approche rigide définit les séparations avant terme comme étant impossibles. Un compromis entre robustesse et prise en compte des effets de substitution contractuels à l'embauche émerge. L'approche flexible mène généralement à des embauches en CDD uniquement. De nombreux articles recourent alors à des règles d'embauche ad hoc qui dirigent une proportion fixée des nouvelles paires employé-employeur vers des CDI, ce qui exclut de fait le choix entre contrats à l'embauche. Si l'approche rigide permet aux CDD et aux CDI d'intervenir naturellement dans les créations d'emplois, les critères de sélection des contrats à l'embauche manquent de robustesse.

MOTS CLÉS

Coûts de licenciement, Dualisme, CDD, Macroéconomie

ABSTRACT

Despite a strict law regarding the use of atypical contracts, fixed-term employment has been expanding in Western Europe over the last decades. My dissertation studies the macroeconomic implications of this expansion. Academics assert that high firing costs account for it. However, most papers consider steady-state responses of the labor market to changes in firing costs and overlook transitions. In my first chapter, I bridge that gap and model a dual labor market as an extension of the classic Mortensen-Pissarides model. Firing costs protect open-ended contracts, whereas fixed-term contracts have a given average duration and costlessly end at expiry. New firm-worker pairs choose the contract that maximizes their joint surpluses. I calibrate the model on French data and find that transitions to a unique contract equilibrium with lower firing costs take a long time, reduce open-ended employment and increase non-employment. In my second chapter, I study fluctuations in a dual labor market with a quite similar model plugged in a typical New-Keynesian framework. As employment protection impacts the resort to fixed-term contracts, it impacts the way firms optimize their pricing decisions in response to shocks. I also look how changing firing costs alters inflation dynamics. I calibrate and estimate the model on Euro area quarterly time series data using a Sequential Monte Carlo method. The model replicates well labor market moments. I find that inflation volatility does not respond to changes in firing cost, whereas the dynamics of inflation components are deeply altered. Using a third-order perturbation method and introducing stochastic volatility, I find that fixed-term employment may enable to tell apart uncertainty and negative demand shocks. My third chapter focuses on the modeling of job creation in matching models. I review the literature and categorize papers regarding their modeling of fixed-term contracts. Fixed-term contracts may be considered as flexible - they may split anytime at zero cost - or rigid - they cannot split before their stipulated expiry date. A trade-off arises between robustness and being able to account for contractual substitution at the hiring stage. Job creation tends to occur through fixed-term contracts only, when they are flexible. Thus, many papers resort to ad hoc hiring rules that direct a settled share of new matches towards open-ended contracts, which shut down contractual substitution effects in job creation. On the contrary, rigid fixed-term contracts lead to dual job creation, but the ranking of contracts in job creation lacks robustness.

KEYWORDS

Firing costs, Dualism, Fixed-term contracts, Macroeconomics