Firms' Commitment, Layoff Costs, and Labor Market Reform

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Abstract

I build a directed search model with dynamic wage contracts in which firms and workers can choose (i) the submarket in which they want to search; and (ii) the type of contract, which differs based on layoff and posting costs. I document that the type of contract is a determinant of the pass-through of firm-level productivity shocks to wages. In particular, contracts with high layoff costs provide higher insurance against firm-level shocks. I then simulate the introduction of the Jobs Act (JA) in the economy. I show that a calibrated version of the model can quantitatively account for many peculiar dynamics of the Italian labor market in the aftermath of the JA.

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I thank my family for supporting me through thick and thin. This dissertation is dedicated to Ludo, who has always been the one and only stationary point in the dynamic motion of life. All errors are mine.

CONTENTS

1. INTRODUCTION

Layoff costs have been considered partly responsible for high unemployment rates in Italy. Common wisdom suggests that layoff costs can reduce the overall efficiency of the economy by decreasing the rate of turnover. While the canonical search model unambiguously highlights the distortionary effects of firing costs on the economy, we aim to complete the overall understanding by exploring a context where workers are risk-averse and layoff costs increase firms' commitment. In particular, workers' incomes are subject to two kinds of oscillations: those resulting from wage responses to productivity shocks and those resulting from job losses. While the first type is usually associated with small fluctuations in income (Guiso et al., 2005), job losses create not only a significant drop in income but also generate a highly persistent negative shock to future labor market outcomes (Jarosch, 2023). From this point of view, firing costs should protect workers against the risk of job losses. Indeed, *ceteris paribus*, when the cost of firing is higher, layoffs should be less frequent. Thus, contracts with high layoff costs offer workers insurance against job losses. The key idea is that firms can choose the lay-off costs associated with the contract that they offer. Indeed, on one hand, the presence of lay-off costs *de facto* increases the degree of firms' commitment. Consequently, those firms can commit to offering higher-value contracts even in the presence of adverse productivity shocks. Thus, these contracts are more attractive to workers, making it easier for firms to hire them. On the other hand, contracts with higher firing costs are more costly to design. Indeed, they have to specify the nature of the commitment, and due to this higher complexity, they cost more. Thus, firms face a trade-off between paying a higher cost to open the vacancy and having the ability to commit or choosing the cheaper contract characterized by a lower level of commitment power.

We examine the effects of a shock to the value of firing costs on the labor market. In particular, we aim to study how the structure of the labor market responds when a policy reduces the firing costs of a single type of contract. To answer this question, I build a search model with several ingredients: (i) risk-averse workers; (ii) two contracts that differ in the firing and posting costs; and (iii) on-the-job search. While the model can fit a wide range of policy interventions that target layoff costs, I focus on the dynamics of the Italian labor market in the aftermath of the Jobs Act (JA).

The Jobs Act was a structural reform that occurred in Italy in 2015, which, among other things, reduced the firing cost for open-ended positions. Indeed, before March 2015, the Italian labor market was characterized by two types of contracts that essentially differed in the cost associated with firings: while open-ended positions were extremely difficult to terminate, fixed-term workers could be fired almost at zero cost. The JA reduced the firing cost of open-ended positions. In the aftermath of the JA, we saw a steady decrease in the number of open-ended positions as a share of total employment. This dynamic cannot be accounted in standard models of search. Indeed, after the policy, for firms, the value of permanent positions is higher than before, due to lower firing costs. Thus, we should expect an increase in both hiring and firing. Since the JA was also accompanied by a hiring subsidy for open-ended positions, a reduction in the EPL for open-ended contracts should induce a substitution of fixed-term contracts with open-ended contracts. However, the dynamics of the labor market were quite the opposite. In particular, we did not see a substitution effect; instead, the proportion of temporary contracts as a share of total employment increased steadily.

Related Literature

The study is related to several strands in the literature. It primarily pertains to a body of work that evaluates the effects of labor market reforms that occurred in Europe starting from the '80s. Cabrales and Hopenhayn (1997) develop a model of job creation and destruction with dismissal costs to analyze the effects of the Spanish labor reform of 1987. Krause and Uhlig (2012) and Krebs and Scheffel (2013) study the German Hartz reforms introduced between 2003 and 2005. Boeri and Garibaldi (2019) and Cirillo et al. (2017) evaluate the steady-state effects of the 2015 Italian reform. The common theme is that these reforms were introduced in Europe in the hope of mitigating what has been called *eurosclerosis* (Blanchard and Summers, 1986) *i.e.*, the substantial persistence of unemployment and the protracted effects of shocks on unemployment.

From a theoretical standpoint, this study is related to the large literature on job search. We develop a model of directed search in the spirit of Moen (1997), which builds on Pissarides (2000), and Burdett et al. (2001). Albrecht et al. (2006) presents a model characterized by wage dispersions with homogenous agents when workers are allowed to apply for more than one job. Menzio and Shi (2011) develops a model of directed search in which transitions of workers between unemployment and employment and across employers are driven by heterogeneity in the quality of firm-worker matches. They show that the model can be solved out of steady state using the property of *block recursivity* (Menzio and Shi, 2010). Our main reference is Souchier (2022), which introduced dynamic wage contracts subject to two-sided limited commitment.

The rest of the thesis is organized as follows. Section 2 presents the institutional setting of the JA and the key policy intervention. Section 3 summarizes the key stylized facts of the post JA labor market dynamics. Section 4 illustrates the theoretical framework and defines the equilibrium. Section 5 describes the calibration of the model and the parametrization. Section 7 shows the model's fit of the data. Section 8 conludes.

2. INSTITUTIONAL SETTING

The JA represents a structural reform aimed at reducing the dual structure within the labor market. Specifically, before March 2015, the labor market was characterized by two types of contracts: open-ended and fixed-term. For open-ended contracts, the reinstatement clause does not apply only in cases of "fair" dismissal (*giustificato motivo oggettivo*). There are two types of fair dismissal; those resulting from the inadequacy of the worker in relation to the company's needs, and those that occur for economic or technological reasons when the latter are *significant*. *De facto*, firing an open-ended worker for a firm was challenging; it was both costly and subject to the discretionary power of courts. However, starting from March 2015, the JA eliminated the reinstatement clause for all *new* open-ended positions[1], replacing it with severance payments that increased steadily with tenure. Essentially, a new labor contract was introduced. Consequently, based on the differences in layoff costs, the labor market was characterized by three types of contracts in the short-run: open-ended contracts prior to 2015, open-ended contracts post-2015, and fixed-term contracts. We call these contracts permanent, semi-permanent, and flexible, respectively.

The 2015 Budget Law introduced a substantial hiring subsidy for new open-ended contracts. Employers were exempt from paying social security contributions up to a limit of 8,060 Euros per year for each worker, lasting for three years after hiring. To prevent misuse by employers, the subsidy excluded workers who had held an open-ended contract in the previous six months or with the same firm in the three months before December 2014. This subsidy applied uniformly across all firms, regardless of size. However, the cap on the subsidy made it more advantageous for lower-wage jobs, typically found in smaller firms. The subsidy was effective from January 2015 and applied for three years to contracts signed within that year. Meanwhile, the JA contract was implemented in March 2015 and was meant to be gradually applied to all open-ended contracts on a permanent basis.

Notice that the JA indirectly affected permanent workers through a change in their outside options. Intuitively, when workers employed with a permanent contract voluntarily choose to switch firms, they will lose the legal protection associated with their current contracts. Indeed, the employment legislation that will be applied to the new contract is the one associated with semi-permanent contracts. Thus, if workers value protection

[1]The reinstatement clause remains only in cases of discriminatory layoffs and other minor incidents.

against unemployment, they will remain in the current firm. As a result, the mobility of permanent workers should decrease. Moreover, since (i) fixed-term contracts are often chosen as a means to reach open-ended positions; and (ii) the value of an open-ended position changed after the reform, it follows that the value of a temporary position was also affected by the reform.

3. STYLIZED FACTS

Figure 1 shows the transition probabilities from unemployment to employment (UE), and from employment to unemployment (EU). In line with the theory, the JA (dashed blue line) shifted the firing curve. As a consequence, also the UE rate increased. In particular, the EU rate steadily increased, rising from 13.5% to 14.5%. On the contrary, the dynamics of the EU rate are more difficult to reconcile with the theory.

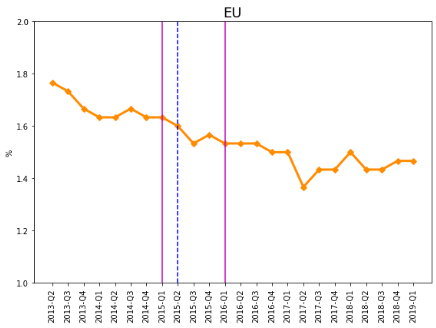

Figure 1.1

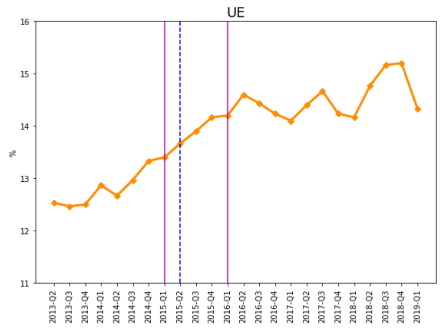

Figure 1.2

Figure 1: Transition Probabilities. Data from Employment and unemployment (LFS), Eurostat.

Figure 2.1 shows the number of open-ended and fixed-term contracts from 2012:Q2 to 2019:Q4. When the JA was introduced (2015:Q2), almost 86% of the workforce had an open-ended contract. In the aftermath of the reform, the prevalence of open-ended contracts was significantly reduced, for a reduction of about 3.5%. The counter image of this phenomenon is the parallel rise in the number of fixed-term positions, that increased by more than 30%. Figure 2.2 shows the total hires under fixed-term contracts. In the absence of other interventions, the rise of fixed-term contracts is quite puzzling. Indeed, after the introduction of the new permanent contract, which is associated with lower layoff costs, firms should be more willing to offer this contract than before. For a fixed number of workers willing to be employed as permanent workers, the number of permanent workers as a share of total employment should increase rather than decrease. This dynamic could be the result of either the JA or other policies that directly targeted fixed-term contracts. The aim of this study is to understand if and why a policy that targets the layoff costs of permanent workers might have played a part in determining this peculiar phenomenon.

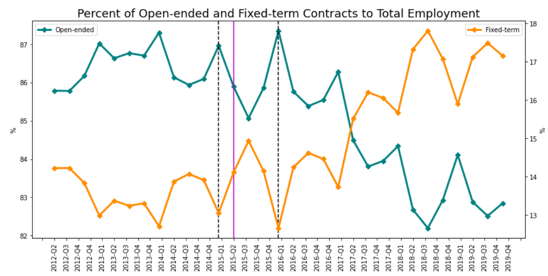

Figure 2.1

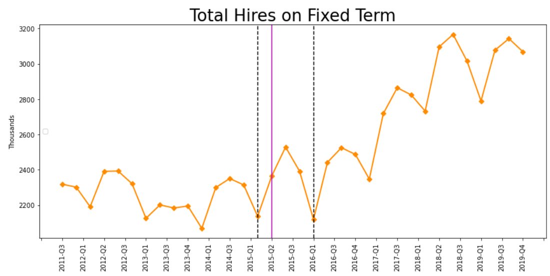

Figure 2.2

Figure 2: Labor Market Dynamics. Data from Employment and unemployment (LFS), Eurostat.

4. MODEL

The model is a version of Souchier (2022) with two key extensions: (i) the continuation value in the contract is not state-contingent; (ii) I allow the presence of multiple contracts with different firing and posting costs.

4.1. Environment

Time is discrete and continues forever. In the quantitative part, I set $\Delta t = 1$ quarter.

Agents We assume that the economy is populated by a continuum of risk-averse, ex-ante homogeneous workers with measure one and a continuum of risk-neutral firms with positive measure. Workers have no access to financial markets so they consume all their wage, ω, when employed, and home production, b, when unemployed. Firms and workers share the same discount rate, β. Firms all produce the same goods and have access to the same production technology. The idiosyncratic productivity process, z, independent across firms, lies in the finite set $\mathcal{Z}$ and follows a Markovian process with evolution law $\pi(z'|z)$. When first matched, the idiosyncratic component of productivity is drawn from a fixed distribution g_z. The output of a match is Ae^{z_t}.

Directed Search We assume that the labor market is characterized by a continuum of submarkets indexed by (v, i) where v is the value offered by a firm to a worker, and i is the type of contract that can be either temporary (T) or permanent (P). Contracts differ in the ability of firms to commit, captured by different firing costs, χ^i, and in the cost of opening a vacancy, k^i. In particular, I assume that the cost of opening a vacancy is higher for contracts with higher firing costs (permanent contracts). This modeling choice captures the idea that permanent contracts are more difficult to design, resulting in higher posting costs. For instance, a textual analysis of a sample of contracts shows that permanent contracts contain around 1,120 words, compared to just 122 words for temporary contracts. Therefore, firms not only choose the submarket in which they want to post the vacancy but also the type of contract. In doing so, firms must solve a trade-off between the likelihood of filling the vacancy and the posting costs. On one hand, since permanent contracts increase the commitment power of firms, they are more attractive to workers, making it easier for firms to hire them. On the other hand, the posting cost for permanent contracts is higher.

Let us denote the tightness of submarket (v, i) as $\theta(v, i; \psi)$. On a submarket with tightness θ, workers find jobs with probability $p(\theta)$, while firms find candidates with probability $q(\theta) = p(\theta)/\theta$. As common in the literature, we assume p is increasing, while q is decreasing, and that $p(0) = 0$, $q(0) = 1$. The state of the economy, ψ, is described by:

$$\psi = (u, g)$$

where $u \in [0,1]$ is the measure of the unemployed workers, and g : $\mathcal{Z} \times \mathcal{V} \times \mathcal{I} \rightarrow [0,1]$, with $g(z, v, i)$ denoting the measure of workers that are employed in matches with idiosyncratic productivity z, with contract $i \in \{T, P\}$, and life time utility promise v. Both unemployed and employed workers are allowed to search on the job. Denote by λ_j with $j \in \{u, e\}$ the search rate for unemployed and employed workers, respectively.

Time Each period is divided in four stages:

1. Firm-level shocks are realized;

2. Production: unemployed workers consumes b units of output, while worker employed at a job z produces Ae^z units. Firms pay current wages, and workers consume;

3. Search: workers search with probability λ_j with $j \in \{u, e\}$. Firms can create vacancies in any market at unit cost $k^i > 0$, for $i \in \{T, P\}$;

4. Separation: employed worker become unemployed with probability δ, where δ is an exogenous shock;

5. Matching: worker searching in *(x,i)* meets a vacancy with probability $p(\theta(x, i; \psi))$. Vacancy located in *(x,i)* meets a worker with probability $p(\theta(x, i; \psi))/\theta(x, i; \psi)$. Upon matching, the idiosyncratic component of productivity, z, is drawn by a fixed distribution g_z.

Contracts Upon meeting, firms and workers sign wage contracts. Following Souchier (2022); Sannikov (2008) I write the contract recursively in terms of wage and continuation value[2]. The components of the contract are the wage paid today and a unique value for

[2]For the moment I assume that with the contract that I specify the BRE exits and it is unique. While

tomorrow. Formally we have that a contract is a collection of the following functions for all t

$$\omega_t(V_t, z_t), \quad \text{and} \quad V_{t+1}(V_t, z_t)$$

The first component of the contract is the wage, ω_t, paid today. It depends on the value promised to the worker, V_t, and the current productivity state, z_t. The second component of the contracts is the continuation value $V_{t+1}(V_t, z_t)$ that is also a function of the realized state of the art of the economy today and the value promised to the worker.

Following Souchier (2022), we assume that the contract is subject to a limited commitment by firms. In particular, firms cannot commit to a contract that delivers negative profit. Temporary and permanent contracts have a different ability to commit. In particular, since layoff costs associated with permanent positions are higher, firms matched with permanent workers are more willing to absorb negative profit.

In the notation that I use, I rely on the concept of block recursivity introduced by Menzio and Shi (2010, 2011). Under this property agents' value and policy functions do not depend on the entire distribution of workers across employment states (i.e., unemployment and employment in different matches). Because of this property, I can solve the model with heterogeneous agents *as if* I would solve a representative agent model.

4.2. Worker's Problem

Unemployed Workers We write the value of unemployment as follows:

$$\begin{aligned} V_u =& u(b) + \beta\, \mathbb{E}_t \Big\{ (1-\lambda_u) V_u \\ &+ \lambda_u \left[\max_v p(\theta(v,T))v + (1-p(v,T))V_u, \max_v p(\theta(v,P))v + (1-p(\theta(v,P))V_u \right]^+ \Big\} \end{aligned}$$

existence and uniqueness are guaranteed when contracts are specified with continuation values that are state-contingent, this may not occur when firms can only specify a single continuation value.

where $[.]^+ := \max[.]$. When unemployed, workers enjoy a utility of $u(b)$ from leisure or unemployed benefits. In the following period, with probability $(1-\lambda_u)$ unemployed workers do not search for new jobs, while with probability λ_u they start to search. If they do not search the continuation value is V_u. If they search workers need to solve a two-stage problem. Firstly, they choose within each contract the best submarket v. In doing so they face a trade-off between the offered utility v and the probability of getting the job, $p(\theta(v,i))$, which does not depend on the aggregate state of the economy. Secondly, they choose between the optimal choice in the permanent market and the optimal choice in the temporary market. Rearranging terms, we read the problem of unemployed workers as follows:

$$V_u = u(b) + \beta \left(V_u + \lambda_u D(V_u) \right) \tag{1}$$

where

$$D(x) := \left[\max_v p(\theta(v,T))(v-x)), \max_v p(\theta(v,P))(v-x) \right]^+$$

Denote as $\hat{s}_u$ the policy function associated with (1).

Employed Worker Given a contract, workers choose a search strategy to maximize the present value of utility. The value of a worker in state z_t reads as follows

$$V_t(z_t) = u(\omega_t) + \beta\, \mathbb{E}_t \Bigg\{ (1-\lambda_e) W_{t+1}(z_{t+1})$$

$$+ \lambda_e \left[\max_v p(\theta(v,T))v + (1-p(v,T))W_{t+1}(z_{t+1}), \max_v p(\theta(v,P))v + (1-p(\theta(v,P))W_{t+1}(z_{t+1}) \right]^+ \Bigg\}$$

where

$$W_{t+1}(z_{t+1}) = \mathbb{1}\{J_i(V_{t+1}, z_{t+1}) \geq -\chi^i\} V_{t+1} + (1 - \mathbb{1}\{J_i(V_{t+1}, z_{t+1}) \geq -\chi^i\}) V_u$$

The worker in the current period enjoys a wage ω_t. In the following period, one of the following may occur: (i) workers find a job in a different market under a contract i with value v with a probability of $\lambda_e p(\theta(v,i))$; (ii) employed workers stay in the match and receive a continuation utility of W_{t+1}. If the match is not destroyed, i.e., if the firm does not realize a negative profit, workers receive the promised lifetime utility of V_{t+1}. On the contrary, if firms are realizing losses, the match is destroyed, and the employed workers become unemployed, resulting in a continuation utility of V_u. Rearranging terms we read the problem of employed workers as follows

$$V_t(z_t) = u(\omega_t) + \beta\,\mathbb{E}_t \Bigg\{ W_{t+1}(z_{t+1}) + \lambda_e D(W_{t+1}(z_{t+1})) \Bigg\} \tag{2}$$

$$\tag{3}$$

where

$$W_{t+1}(z_{t+1}) = V_u + \mathbb{1}\{J^i(V_{t+1}, z_{t+1}) \geq -\chi^i\}(V_{t+1} - V_u)$$

Denote with $\hat{s}(z_t, V_{t+1})$ the policy function associated with (2).

4.3. Firm's Problem

Denote by $J^i(V, z_t)$ the present value of profits for a firm matched with a worker with promised value V with contract i, when the current productivity is given by z_t. The value of a firm reads as follows

$$\begin{aligned} J^i(V_t, z_t) = {} & f(z_t, i) - \omega_t \\ & + \beta\,\mathbb{E}_t \Bigg\{ (1-\lambda_e) J^i\Big(V_{t+1}, z_{t+1}\Big) + \lambda_e (1 - p(\theta(\hat{s}))) J^i\Big(V_{t+1}, z_{t+1}\Big) \Bigg\} \end{aligned}$$

In the current period, the firm earns revenue from production, $f(z_t, i)$, minus the wage paid to the worker ω_t. In the following period, if the worker does not search or he searches but is not able to find a job, the continuation utility is $J_i\Big(V(z_{t+1}), z_{t+1}\Big)$. The latter depends on the future utility promise, $V(z_{t+1})$, that the firm proposes to the worker. If the workers search and find a job with probability $\lambda_e p(\theta(\hat{s}))$) the continuation utility for the firm is zero. We may describe the problems faced by firms as follows:

$$J^i(V, z_t) = \max_{\omega_t, V_{t+1}} \quad \Bigg\{ f(z_t, i) - \omega_t + \beta\, \mathbb{E}_t \Big[J^i\Big(V_{t+1}, z_{t+1}\Big)(1 - \lambda_e p(\theta(\hat{s})))\Big] \Bigg\} \tag{4}$$

subject to

$$\begin{aligned}
(\text{PK}): &\quad V \leq u(\omega_t) + \beta\, \mathbb{E}_t \Big\{ W_{t+1}(V, z_t) + \lambda_e p(\theta(\hat{s}))\hat{s} \Big\} \\
(\text{IC-W}): &\quad \hat{s} \quad \text{solves} \quad \mathbb{E}_t[D(W_{t+1}(V, z_t))] \\
(\text{IC-F}): &\quad J^i(V_{t+1}, z_{t+1}) \geq -\chi^i
\end{aligned}$$

When firms choose continuation values, firms influence not only future profits but also the search decisions of the workers. As a consequence, different continuation values will lead to different *retention probability*, $(1 - \lambda_e p(\theta(\hat{s})))$.

The first constraint is the *promise keeping constraint*. This ensures that the worker receives at least the promised value V from the contract, either through the current wage or future values. The second constraint is the *incentive compatibility constraint* for the worker's search strategy. This constraint defines the worker's search strategy based on the expected continuation value W_{t+1}. The final constraint is the *participation constraint of the firm*, which stipulates that the firm's value should not fall below the cost of breaking the match, χ_i, which varies depending on the type of contract.

We denote as $\omega^i(V, z_t)$, and $V^i_{t+1}(V, z_t)$ the policy functions for the optimal choices in (4).

4.4. *Free Entry*

The number of firms is endogenously determined in equilibrium. In particular, there will be entry into the market as long the cost of opening a vacancy is not equal to the expected benefit. Thus, in equilibrium, firms are indifferent between opening or not a vacancy in submarket (V, i). More formally, the above condition reads as follows

$$q(\theta(v,i))\,\mathbb{E}_z(J^i(v,z)) = k^i \tag{5}$$

where $q(\theta(v,i))$ is the job-filling probability, $J^i(v,z))$ is the firm's of a match in submarket (v,i), and k^i is the cost of opening a vacancy under contract i. Following Schaal (2017), we restrict our attention only to those submarkets that are open in equilibrium so that, we summarize in the following complementary slackness condition:

$$\theta(v,i)(q(\theta(v,i))\,\mathbb{E}_z(J^i(v,z)) - k^i) = 0$$

4.5. *Labor Market Dynamics*

Using the optimal decision of firms and workers, we may now retrieve the implied evolution of employment and unemployment over time. Let u be the unemployment rate and $\Psi(z, V; i)$ the distribution of employment across submarkets, V, with current productivity state z.

The distribution of unemployed workers satisfies

$$\begin{aligned} u_{t+1} &= (1 - p(\theta(\hat{s}_u)))u_t \\ &+ (1-\delta)\sum_i \sum_{z_t, V_t} \sum_{z_{t+1}} (1 - \lambda_e p(\theta(\hat{s}_e(z_t, V_t))) \mathbb{1}\{J^i(V_{t+1}, z_{t+1}) < -\chi^i\} \pi(z_{t+1}|z_t) \Psi(z_t, V_t; i) \\ &+ \delta \sum_i \sum_{z_t, V_t} \Psi(z_t, V_t; i) \end{aligned} \tag{6}$$

Equation (6) states that the unemployed workers at the beginning of the next period are those unemployed who weren't able to find a job, $(1-p(\theta(\hat{s}_u)))$ in addition to the workers that lose their jobs because of either endogenous or exogenous separations. Notice that in equilibrium, separations are only dictated by exogenous reasons.

The dynamics of the distribution of employment is governed by the following equation:

$$\begin{aligned}
&\Psi(z_{t+1}, V_{t+1}; i) = \{\hat{s}_u = (V_{t+1}, i)\}p(\theta(\hat{s}_u))g(z_{t+1})u_t \\
&+ (1-\delta)\sum_i \sum_{z_t, V_t} \sum_{z_{t+1}} (1-\lambda_e p(\theta(\hat{s}_e(z_t, V_t)))\mathbb{1}\{J^i(z_{t+1}, V_{t+1}(z_{t+1})) \geq -\chi^i\}\pi(z_{t+1}|z_t)\Psi(z_t, V_t; i) \\
&+ (1-\delta)\sum_i \sum_{z_t, V_t} \sum_{z_{t+1}} \mathbb{1}\{\hat{s}_e(z_t, V_t) = (V_{t+1}, i)\}\lambda_e p(\theta(\hat{s}_e(z_t, V_t)))g(z_{t+1})\Psi(z_t, V_t; i) \qquad (7)
\end{aligned}$$

where $\mathbb{1}\{.\}$ denotes an indicator function. Equation (7) states that beyond the stayers, the inflows in market (V_{t+1}, i) occur from (i) the unemployed workers finding a job in the market; (ii) new hires form employment.

Equilibrium

Definition. *A block-recursive equilibrium consists of a market tightness function $\theta : \mathbb{R} \times I \to \mathbb{R}_+$, a value function for the unemployed worker, V_u, a policy function for the unemployed worker, $\hat{s}_u$, a set of value functions for the firm $J^i : \mathcal{Z} \times \mathcal{V} \to \mathbb{R}$, for $i \in \{T, P\}$ a set of policy functions for firms $V^i_{t+1} : \mathcal{Z} \times \mathcal{V} \to \mathbb{R}$, $\omega^i : \mathcal{Z} \times \mathcal{V} \to \mathbb{R}_+$, a set policy functions for the employed workers $V^i : \mathcal{Z} \times \mathcal{V} \to \mathbb{R}$, and associated policy functions $\mathcal{Z} \times \mathcal{V} \to \mathcal{V} \times I$ such that:*

1. *$\theta(x, i)$ satisfies (5) for $i \in \{T, P\}$;*

2. *V_u satisfies (1), and $\hat{s}_u$ is the associated policy function;*

3. *Firms and employed worker strategies satisfy the optimal contract.*

5. PARAMETRIZATION

5.1. Functional Forms and Stochastic Process

The model is parametrized as follows. I pick a linear production function of the form $f(i, z) = f(z) = Ae^z$. Since time is discrete, I need a job-finding and job-filling probability bounded between 0 and 1. Following Schaal (2017), I pick the CES contact rate functions

$$p(\theta) := \theta(1 + \theta^\alpha)^{-1/\alpha}, \qquad q(\theta) := (1 + \theta^\alpha)^{-1/\alpha}$$

The idiosyncratic productivity shock follows an AR(1) process

$$z_t = \rho_z z_{t-1} + \sigma\varepsilon_{z,t}, \quad \varepsilon \sim \mathcal{N}(0, 1)$$

5.2. Calibration Strategy

The model is estimated using a method of moments. When it is possible, I follow the search-and-matching literature (Schaal, 2017; Shimer, 2005; Menzio and Shi, 2011) in choosing moments and targets.

The time period is set to be a quarter. I set the discount rate β to 0.98 so that the annual interest rate is about 5%. I assume that firms discount with the same rate of workers. I use a CRRA utility function with coefficient γ to 1.5 following Balke and Lamadon (2022). Similarly to Menzio and Shi (2011), I normalize the search efficiency of unemployed workers to 1. To discipline the value of the relative search efficiency of employed workers, I include in my moments the Employment-Empolyment rate (EE). From the Cerved data set, I estimate an annual autocorrelation of the idiosyncratic productivity process of 0.45. I thus set $\rho_z = (0.45)^{1/4}$ to match the annual autocorrelation. I set the volatility of firm productivity to be 0.14, as estimated by Souchier (2022). I assume that the temporary and permanent workers have the same production technology. Following Souchier (2022), I set the TFP equal to 1.

To discipline the choice of the labor market parameter (k_t, k_p, δ), I target the Unemployment-Employment (UE) rate, the Unemployment-Permanent rate (UP) rate, and the Employment-Unemployment (EU). Since the production technology is the same for temporary and permanent workers, excluding the posting costs, the sole determinant of the relative proportion of temporary and permanent contracts are the layoff costs. As a consequence, to inform the decision of the relative firing costs, (χ^p/χ^t), I include in my moments the ratio of permanent workers to temporary workers.

The model's parameters are estimated with a search algorithm that seeks to minimize the distance between the empirical and simulated moments. In particular, we compute for each moment the percentage distance of the simulated moment to the target, weighting equally all moments. Table 1 summarizes the parameter of the model.

Parameter	Value	Description	Target	Target Value	Model Value
		Household			
Calibrated:					
β	0.98	Discount factor HH	*External*		
γ	1.5	CRRA coefficent	*Balke and Lamadon (2022)*		
b	0.3	Utility from leisure	*Souchier (2022)*		
Estimated:					
λ_e	0.33	Relative search efficiency of employees	EE	0.02	0.0192
		Firms			
Calibrated:					
A	1	TFP	*External*		
ρ_z	$(0.45)^{1/4}$	Autocorrelation productivity process	*External*		
σ	0.15	St.d. productivity process	*Schaal (2017)*		
		Labor Market			
α	0.3	Elasticity of meeting function	*Souchier (2022)*		
Estimated:					
k^t	1.03	posting cost temorary	UE	0.147	0.182
k^p	1.63	posting cost permanent	UP	0	0
χ^p/χ^t	3.17	Lay-off costs	Permanent/Temporary	6	5.73
δ	0.007	Exogenous destruption	EU	.0163	0.0163

Table 1: Parameters and corresponding targets

6. RESULTS

Figure 3 shows the equilibrium job finding and job filling probabilities. Notice that both contracts coexist in equilibrium. For low lifetime utility promises, workers will search for fixed-term contracts. Indeed, in low submarkets, even if the utility promise is the same, the probability of finding a job under a fixed-term contract is higher. Consequently, for low utility promises, permanent contracts are strictly dominated by fixed-term positions. This equilibrium outcome is a consequence of the fact that permanent positions are more costly to open. As a consequence, temporary contracts are more able to serve the low portion of the market. The opposite is true for high utility promises. In high submarkets, only permanent positions are available. This is a direct consequence of the different abilities to commit. Due to the presence of high firing costs, firms with permanent contracts have a higher ability to commit to delivering high utility values even in the presence of negative productivity shocks. Thus, permanent contracts serve the portion of the market that is more attractive for workers.

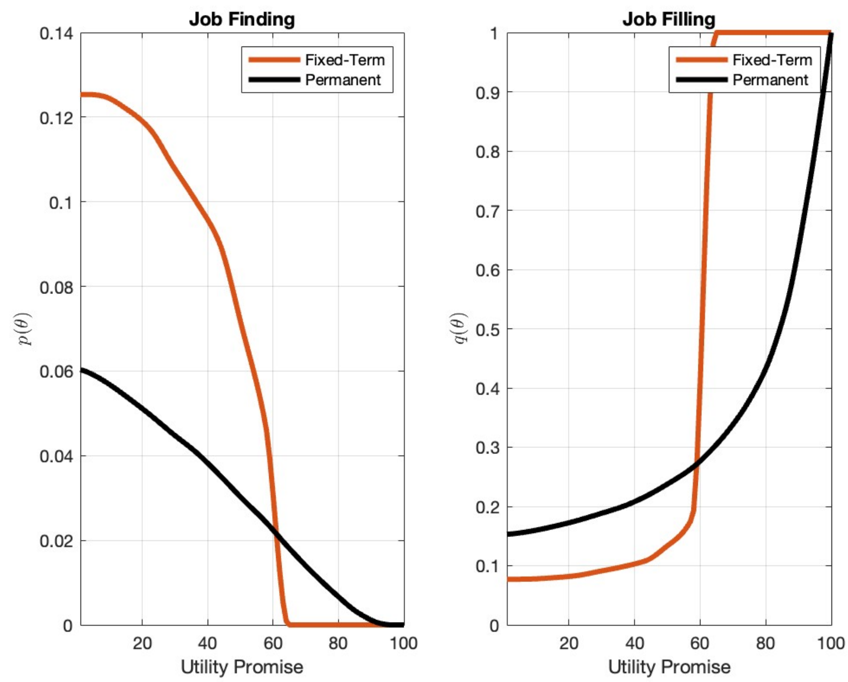

Figure 3

6.1. *Wage Insurance*

To validate the model, I examine whether it accurately reflects the transmission of idiosyncratic productivity shocks to wages. My reference is Guiso et al. (2005), which reports a wage response of 0.0049 to independent and identically distributed shocks. To capture the extent to which firms' specific productivity shocks transmit to earnings, we run the following regression

$$\log \omega_i = \alpha + \delta \log y_i + \varepsilon_i$$

where $\omega_{i,t}$ is the wage of individual i, and $y_{i,t}$ is the value-added of the match.

Variable	Esitmate	Standard Error
α	-0.1	0.0189
δ	0.0048	0.0559
Observations	100,000	

Table 2: Sensivity of Wages to Value-Added Shocks

The point estimate for the elasticity of wages to productivity shocks is rather similar to the one documented by Guiso et al. (2005) even if in my model the productivity process follows an AR(1).

6.2. *The Sources of Wage Rigidity*

I now document how the insurance depends on the contracts. More specifically, I construct a panel data using model-generated data to asses whether the pass-through is different for temporary and permanent contracts. To answer this question, I run the following regression

$$\log \omega_{i,t} = \alpha + \phi \log y_{i,t} + \varepsilon_{i,t}$$

Figure 4 shows the point estimate with confidence intervals. We document that in general wages are relatively more stable than productivity. Moreover, the two contracts differ in the magnitude of the pass-through. For permanent workers, the point estimate is almost 0, suggesting that permanent workers are fully insured against transitory shocks. On the contrary, we reject the hypothesis of full insurance for temporary workers. The above results are in line with the existing literature. In particular, Souchier (2022) documented that a reduction in firing costs increases the pass-through of both sectoral shocks and firm-level shocks. The novel result of my study is that I allow for the presence of workers with different pass-throughs to coexist in equilibrium. Notice that a change in layoff costs of one contract has an effect on the distribution of agents across contracts. Since the pass-through is contract-dependent, ultimately, there will also be an effect on the aggregate pass-through of productivity shocks to wages.

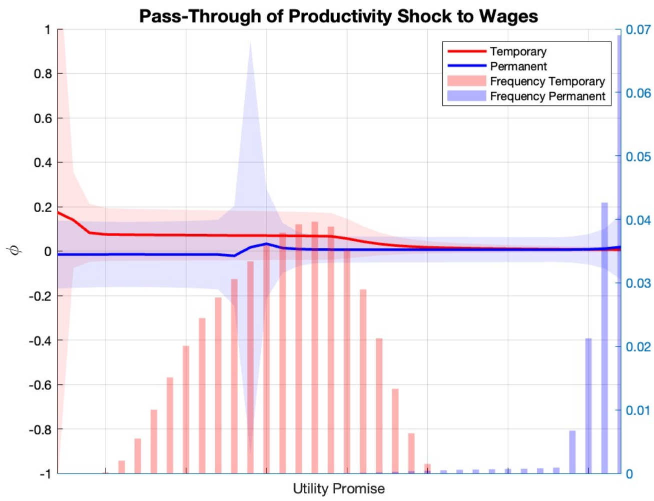

Figure 4

7. ACCOUNTING FOR THE POST JA LABOR MARKET DYNAMICS

We now explore whether the model can quantitatively explain the dynamics of the Italian labor market after the introduction of the JA (Jobs Act). More specifically, after the reform, unemployed and temporary workers can only search for open-ended contracts with layoff costs strictly smaller than those of permanent workers. For the purposes of the simulation, I assume that (i) the posting cost for semi-permanent positions are equal to the one of permanent contracts; (ii) I calibrate the firing cost of semi-permanent workers to be 14 months of the average wage compensation. Figure 5 shows the results of the simulation. The model seems to fit quite well with the data, despite the external calibration of the layoff costs shock. The model predicts a steady decrease in the number of permanent workers as a share of the total workforce, and consequently, a steady increase in fixed-term positions. In particular, the model-implied growth of fixed-term positions is around 31%, compared to 26% in the data. These dynamics are a consequence of two forces: (i) a direct effect of the JA on the new permanent contract; (ii) a general equilibrium effect of the latter on the value of temporary contracts. In particular, after the introduction of the semi-permanent contracts, firms are no longer able to offer the high-value contracts that they offered before the JA. Since the cost of opening the vacancy has not changed, the portion of the market that is served by semi-permanent positions has been reduced. This, in turn, has an impact on temporary contracts. Indeed, fixed-term contracts are often chosen as a means to reach open-ended positions, and since the frontier of the possible offered value has been reduced, workers are less likely to find high utility promise in semi-permanent positions. The reduction in the outside option has an impact on the value of being a temporary worker. So, after the reform, for a given utility promise, the probability of finding a job in a temporary position has also decreased. As a consequence, after the reform, more temporary workers will start to search for a fixed-term position than before. Since the inflow from unemployment into temporary positions has not changed but the outlaws have been reduced, the result is an increase in the portion of fixed-term positions as a share of total employment.

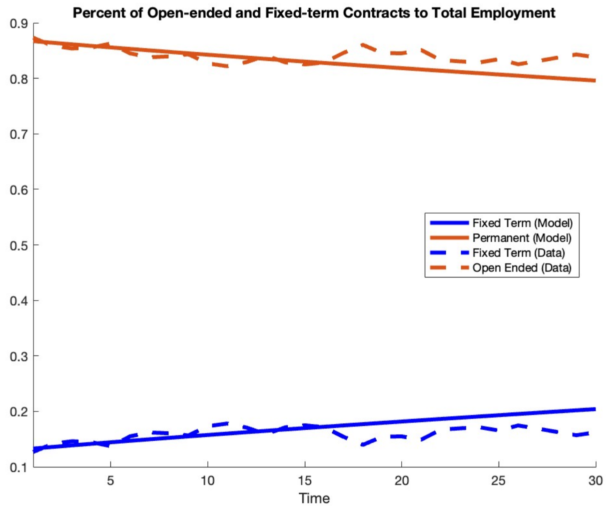

Figure 5

8. CONCLUSION

This thesis studies a labor market characterized by the presence of multiple contract types. I built a model in which both firms and workers can choose not only the submarkets in which they want to search but also the type of contract, which differs based on layoff costs. In my baseline analysis, I allow for the presence in equilibrium of both temporary and permanent workers. Permanent positions serve the segment of the market characterized by a high lifetime utility promise, as a consequence of the higher ability of firms to commit. Moreover, I show that the type of contract is one of the determinants of the pass-through of firm-level productivity shocks to wages. In particular, permanent contracts offer higher insurance against idiosyncratic productivity shocks. The quantitative model accurately accounts for the dynamics of the Italian labor market in the aftermath of the Jobs Act.

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9. APPENDIX

9.1.

Numerical Solution

The problems of (1), (2), and (4) define three nested problems that must be solved to find an equilibrium. The value functions are computed on a $nz \times nv$ grid with $nz = 5$ and $nv = 15$. The algorithm works in the following way

1. Guess a value function $J_i^{(k)}(V,z)$ for $i \in \{T,P\}$;

2. Set (5) equal to 0. Using the free-entry, solve numerically for $J_i^{(k)}(V,z)$ to obtain $q^{(k)}(\theta(v,i))$, so that
$$q^{(k)}(\theta(v,i)) = \frac{k^i}{\mathbb{E}_z\left[J_i^{(k)}(V,z)\right]}$$

3. Using value function iteration, find the fixed point of the mapping
$$V_u = b + \beta\Big\{V_u^{(k)} + \lambda_u \max\left[\max_v p(\theta(v,T))(v - V_u), \max_v p(\theta(v,P))(v - V_u)\right]\Big\}$$
save the corresponding rule $\hat{x}_u$.

4. Since the promise-keeping is binding, define
$$\omega_t(V,z_t) = u^{-1}\Big(V - \beta\,\mathbb{E}_t\Big\{W_{t+1}(z_{t+1}) + \lambda_e D(W_{t+1}(z_{t+1}))\Big\}\Big)$$

5. Compute one iteration of the mapping
$$J_i^{(k+1)}(V,z_t) = \max_{V_{t+1}}\ \Big\{f(z_t,i) - \omega_t(V,z_t) + \beta\,\mathbb{E}_t\Big[J_i^{(k)}\Big(V_{t+1},z_{t+1}\Big)(1-\lambda_e p(\theta(\hat{s})))\Big]\Big\}$$

subject to

$$\begin{aligned}
(\text{PK}): &\quad V \leq u(\omega_t) + \beta\,\mathbb{E}_t\Big\{W_{t+1}(z_{t+1}) + \lambda_e p(\theta(\hat{s}))\hat{s}\Big\}\\
(\text{IC-W}): &\quad \hat{s} \quad \text{solves} \quad \mathbb{E}_t[D(W_{t+1})]\\
(\text{IC-F}): &\quad J_i(V_{t+1}, z_{t+1}) \geq -\chi^i
\end{aligned}$$

and save the corresponding decision rules $V_{t+1}(V, z_t)$.

6. Stop if $\|J_i^{k+1} - J_i^k\| \leq \varepsilon$ for $i \in \{T, P\}$. In case of no convergence go to (2) with the updated value functions.