Dual Labor Markets, Unemployment and Career Mobility*

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Abstract

We study how duality of the labor market (the co-existence of fixed-term and protected open-ended contracts) affects the occupational careers of workers, and through this channel aggregate outcomes (productivity and employment). Intuitively, attachment to occupations is affected by the cost/benefit of remaining in the occupation (which depends on the contract type the worker has or will have in the future) vs. starting in a new occupation (where it matters which contract types are available when starting afresh). We evaluate the forces that shape the careers of workers quantitatively, in a dynamic equilibrium model of the labor market. Finally, we use a version of the model calibrated to key statistics of the Spanish economy as a laboratory to study the role of duality by means of policy experiments.

Keywords:
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1 Introduction

Many economies feature the co-existence of two types of labor contracts: permanent contracts with high employment protection, and temporary, fixed-term contracts. In this paper, we study how such a *duality* affects the career mobility of workers in a labor market that is segmented along the occupation margin. We develop a quantitative theory to explore the link between the institutional feature of contract duality and occupational mobility. Our model framework sheds light on how duality affects aggregate productivity and welfare through the channel of career mobility. The mechanism we highlight in this context is that the equilibrium distribution of occupational tenure is endogenous to the labor market institutions.

In particular, we introduce contract duality into an equilibrium model of occupational mobility, building on Carrillo-Tudela and Visschers (2022). Labor market segmentation is a primitive of our model economy. Similarly, we take the institutional framework (duality) as given, which reflects that our focus lies on understanding its implications for career mobility.[1] The model emphasizes the role of idiosyncratic career matches in the sense that a worker looks for the best individual occupation, which is not necessarily the best for another worker (cf. Neal, 1999). This results in excess mobility, i.e., flows across occupations that cancel each other out—in line with empirical evidence. Duality affects workers' occupational choices and thereby the distribution of stochastically evolving career productivities. Intuitively, workers have different incentives to quit their current career when in either a temporary or a permanent contract, ceteris paribus. Likewise, the extent to which a new career involves starting with (a sequence of) temporary contract(s) affects the attractiveness of such a career switch. On the other side of the market, firms' vacancy posting decision is affected by the availability of two contract types—and by the endogenously resulting distribution of workers in the unemployment pool.

We calibrate the model to match key statistics of the Spanish labor market. Our calibrated model performs well along patterns related to occupational mobility and duality. Given the calibrated model, we explore how policies that alter the institutional framework of duality affect career mobility and aggregate outcomes. In preliminary results we find that there is scope to increase aggregate productivity and reduce the unemployment rate through reducing firing costs of the permanent contracts; while keeping the temporary contracts as an alternative contract type. Relative to channels discussed in the literature in this context, the new channel in our context is through increased occupational mobility. This channel also turns out to be the most

[1] Throughout, we will use *career mobility* and *occupational mobility* interchangeably.

relevant quantitatively.

Literature. Our theoretical framework builds on a frictional labor market setting, which has been emphasized in Mortensen and Pissarides (1999) to lend itself for the analysis of labor market institutions. As such, variations of the standard search and matching framework have been used to study the consequences of employment protection in general (represented as firing costs) for aggregate employment (e.g., Garibaldi and Violante, 2005) or worker turnover (e.g., Pries and Rogerson, 2005). More directly related to our analysis, several studies focus in particular on the consequences of contract duality and reforms to it for aggregate labor market outcomes (e.g., Bentolila et al., 2012; Boeri and Garibaldi, 2019; Boeri et al., 2015; Cahuc et al., 2016; Cahuc and Postel-Vinay, 2002; Dolado et al., 2021; Garcia-Cabo, 2018; Güell and Petrongolo, 2007; Jahn et al., 2012; Zweimüller et al., 2017), individual human capital accumulation (Cabrales et al., 2017; Garcia-Cabo, 2018; Güell and Petrongolo, 2007; Hospido et al., 2022), or for aggregate productivity (e.g., Bartelsman et al., 2016; Bassanini et al., 2009; Pijoan-Mas and Roldan-Blanco, 2022). The contribution of our analysis to those studies is that we highlight career mobility as a new channel through which duality affects those outcomes.

Occupational tenure and mobility has been linked to individual-level outcomes and aggregate labor market measures. For example, Kambourov and Manovskii (2009) emphasize the bigger importance of occupational tenure relative to firm tenure for individual wage trajectories, which is consistent with occupation-specificity of human capital. This in turn implies the cost of losing human capital for workers when changing their occupations: in line with this interpretation, Busch (2020) (for Germany) and Carrillo-Tudela et al. (2022) (for the United States) document that large earnings changes are disproportionately often accompanied by occupational switches. Carrillo-Tudela and Visschers (2022) link time-consuming occupational switching to the duration distribution of unemployment and the aggregate unemployment rate.

In Section 2, we present data patterns that motivate our analysis. Subsequently, in Section 3, we build an equilibrium model that will capture key features of this data and allow us to understand career selection. In Section 4, we estimate this model and evaluate different policies. Section 6 concludes.

2 Occupational Mobility in a Dual Labor Market

We use Spanish Social Security data, the Muestra Continua de Vidas Laborales (MCVL), which consists of a 4% representative random sample of all workers affiliated with the social security administration during at least one day in the year. The dataset was released in 2004 and, after that year, it follows the same sample of individuals over time, adding new observations each year to replace absences while keeping the sample representative of the population. It provides retroactive information on the workers' entire labor market history. We pool the database for workers from the years 2005 to 2019. Along with the job history, for each individual, a large amount of information is available, including personal and demographic characteristics (age, gender, education, nationality, region of residence) and labour market information (industry, occupation, type of contract). The dataset's unit of observation is any spell (employment, unemployment, or pension) in the individual's labour market, reporting the starting and ending date of the spell. We restrict to workers aged 16 to 65.

We use the ten occupational tax categories provided by the social security administration as a proxy of job occupation. Occupational categories are defined by the minimum and maximum contribution (i.e. nominal wage) that each group contributes to social security (see Table 9 in the Appendix). In our empirical part and the model, we split the ten occupational categories into three major groups, based on the minimum and maximum contributions. Occupations within major groups are similar in terms of wages. Hence, mobility within a major group can be interpreted as a horizontal reallocation. On the opposite, occupations in different major groups have very different wages, which suggests that movements across major groups are vertical reallocations.

We focus on the occupational mobility of workers who went through non-employment. We record an occupational change when an unemployed worker finds a job in an occupation that is different from the occupation where she was employed in the last job held. We compute the monthly proportion of new hires (i.e., unemployed workers that find a job) that experienced a change in occupation in period t. We will refer to those as occupational movers.

2.1 Mobility within and across major occupation groups

We start exploring the importance of the occupational mobility of unemployed workers in the aggregate. For that, Figure 1 displays the proportion of occupational movers in Spain from 2002 to 2019. In 2019, approximately 40% of all newly hired unemployed were occupational

Table 1: Summary statistics by occupation

Occupation	Emp.	Temp.	Part-time	Inflow	Outflow	Col.	Wage
Engineers, college grad, managers	8.2	23.2	11.2	2.3	1.4	75.4	2,777
Technical engineers, grad assistants	6.7	29.3	14.3	2.9	1.8	73.1	2,454
Admin and technical managers	4.6	11.4	7.2	2.2	1.9	33.3	2,253
Non-grad assistants	3.7	19.1	15.6	3.4	2.7	23.0	1,842
Administrative officers	12.6	16.5	17.8	8.7	6.9	23.7	1,762
Subordinates	4.5	30.4	18.8	5.4	3.8	10.8	1,443
Administrative assistants	13.9	28.4	23.6	15.4	12.3	21.4	1,353
First and second class officers	18.5	33.8	10.9	20.3	15.9	4.3	1,433
Third class officers and technicians	11.1	38.5	20.7	20.0	18.6	5.9	1,315
Labourers	16.3	46.6	22.0	19.1	34.9	4.4	1,095

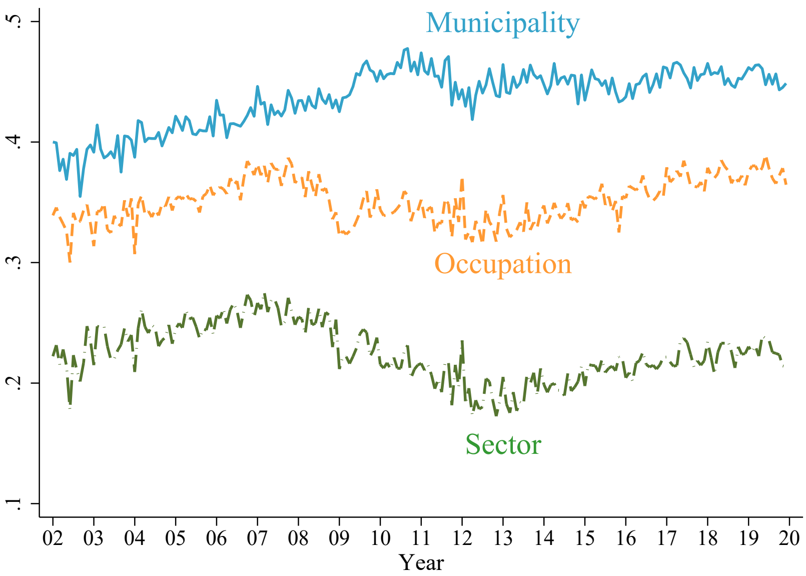
MCVL, 2005-2019. Real monthly full-time equivalent wages.

movers. The figure exhibits a stable trend since 2015, indicating a reasonably stable proportion of occupational mobility in the labor market. This figure is comparable to the US (Carrillo-Tudela and Visschers, 2022) and the UK (Carrillo-Tudela et al., 2016), where occupational mobility is assessed based on major occupation groups or 1-digit occupations. Despite the differing classification methodologies, the number of occupations falls within a similar range. Furthermore, consistent with other developed economies, occupational mobility is pro-cyclical, as indicated by the shadow bars in Figure 1. Specifically, unemployed individuals are more likely to transition between occupations during economic expansions than during recessions.

The right-hand panel of Figure 2 illustrates the occupation mobility matrix, wherein each cell denotes the percentage of unemployed individuals that worked in occupation j before unemployment who transition to occupation destination i. The diagonal cells ($j = i$) represent the proportion of occupational stayers (those who remain in the same occupation). The extent of occupational mobility varies significantly across different occupations, with mid-range ones (such as non-graduate assistants, administrative offices, and subordinates) and third-level officers exhibiting higher levels of mobility. On the other hand, the upper and lower ends of the occupational distribution (including graduates and elaborates) display the lowest levels of occupational mobility, with less than 30-40% of individuals transitioning to a different occupation.

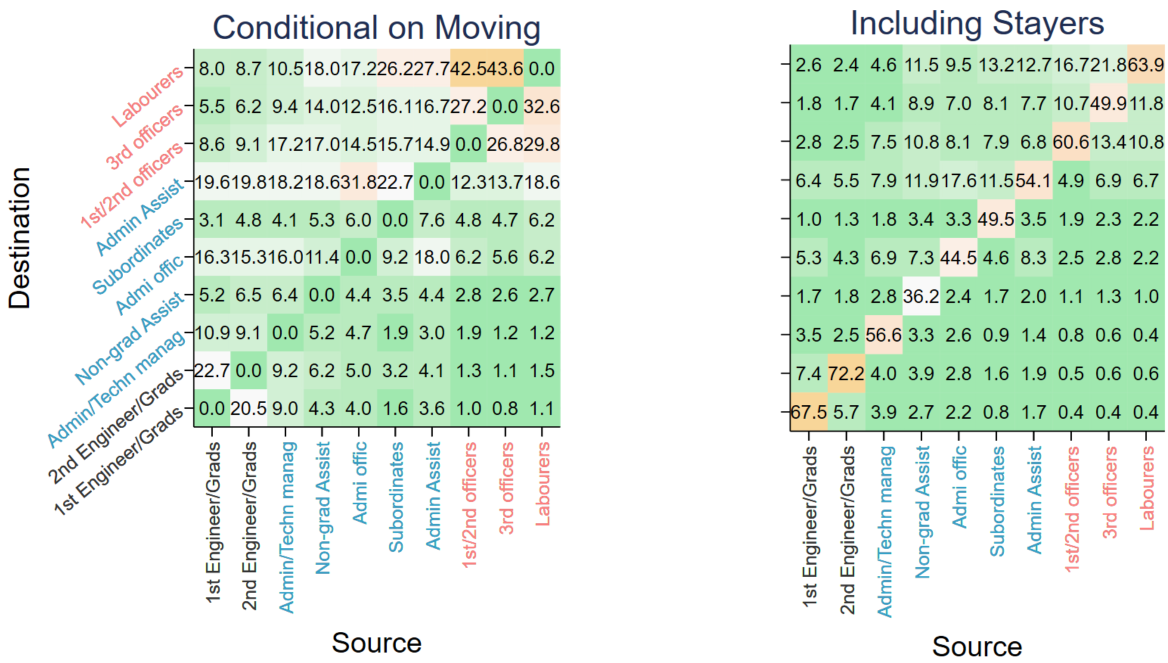
The left-hand panel of Figure 2 presents the occupational mobility matrix specifically for individuals who have changed occupations. Unlike the previous matrix, each cell in this panel represents the proportion of individuals who have moved from occupation source j to occupation

Figure 1: Movers as share of UE flows, SS registers



Source: MCVL. Sample of workers aged 16 to 65. Monthly data, seasonally adjusted.

Figure 2: Occupational Mobility Matrix



Source: MCVL. Sample of workers aged 16 to 65. Each cell in the left matrix displays the share of occupational movers that worked in source occupation j and move to destination occupation i in a given month. The right matrix displays the share of unemployed workers that were employed in occupation j and find a job in occupation i. The diagonal of the right matrix ($i = j$ represents the share of occupational stayers in each occupation.

destination i. As a result, the diagonal cells ($j = i$) are zeros. This revised matrix offers a more nuanced understanding of the destination of occupational movers for each source occupation, providing valuable insights into the patterns of occupational mobility across the labor market. The analysis reveals that movements between occupations at the lower and upper ends of the occupational distribution concentrate within smaller subsets of occupations. In contrast, mid-range occupations exhibit a more diverse range of destination occupations. The data reveals that occupational changers are not exclusively upwards movements, which seems to suggest that we can not think of occupational movements as climbing the job ladder. For instance, only 20% of second-level graduates upgrade to first-level graduates, but the rest (80%) move to lower-skill occupations, which can be considered as downgrading (i.e., 15% and 20% move to administrative officers and admin assistants, respectively). The relatively low share of upgrading is due to the fact that we are excluding on-the-job occupational movers. Another relevant feature in the data is the significant concentration of occupational movers among certain occupational groups, including first and second-level graduates (among high-skilled occupations) and officers and laborers (toward the lower end of the skill distribution). This concentration, combined with the observation that some groups share similar minimum and maximum wages, motivates its division into three major occupational groups for further analysis. Figures 13 and 14 in the Appendix display the occupation mobility matrix by type of contract. Comparing elements in the diagonal in the right-hand panel of both figures, we see that in all occupations, mobility is larger among previously permanent workers, but the differences are very small. Regarding movers (left-hand panel of Figures 13 and 14), we also see very few differences in the mobility patterns by type of contract.

Table 2 presents the percentage of workers who change occupations across and within major occupation groups. The low-skilled major group accounts for the majority of occupational movements (65.2%), with a substantial proportion of those movements occurring within that major group (43.4%). In contrast, the high-skilled major group accounts for only 3.6% of all occupational movers. The majority of occupational movers across major groups originate from and move between the mid- and low-skilled major groups, with 20.7% of the movements occurring from low to mid and 16.4% from mid to low.

2.2 Why is career mobility important? (TBC)

- High returns to occupational tenure.

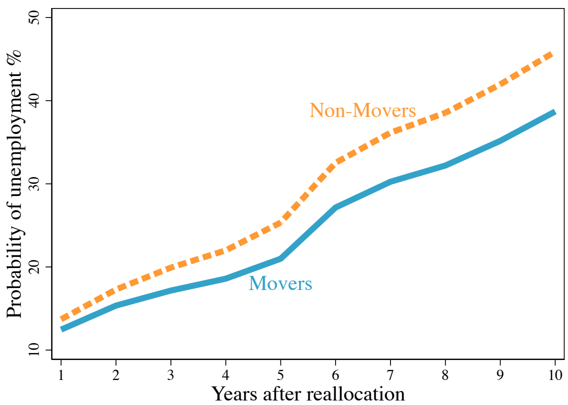
Table 2: Matrix of occupational movers across major groups

	Total	3.6	31.1	65.2	
Major group of destination	Low	0.8	16.4	43.4	60.7
	Mid	2.0	12.0	20.3	34.3
	High	0.8	2.7	1.5	5.0
		High	Mid	Low	Total
	Major group of source				

The table displays the share of all occupational movers that move from major occupation group o to major occupation group p. In the diagonal, movers for which the destination occupation belongs to the same major group as the origin occupation.

- Employment outcomes after occupational change: unemp prob and wage change (based on on (Huckfeldt, 2022))

Figure 3: Probability of unemployment, movers vs non-movers



Source: MCVL, 2005-2019. The figure displays the probability of being unemployed in a given moment of time after re-employment. The initial period is set to January 2003.

2.3 Occupational mobility and duality

The substantial occupational churn in Spain, in line with other developed countries, coexists with the high duality in the labor market, which makes the Spanish labor market a unique case to study the interaction between duality and occupational reallocation. Panel A of Table 3 illustrates the enormous relevance of temporary contracts in the flow of workers from unemployment to employment (UE), that account for 82.7% of re-employment. Similarly, most of the unemployed that find a job held a temporary job before unemployment (81.4%). Regarding occupational mobility, movers account for 41.8% of all UE flows.

Panel B reports the proportion of previous permanent and previous temporary workers that find a temporary or permanent job. Persistence in temporary employment is large: 90.9% of temporary workers that become unemployed are re-employed as temporary, while the share of previously permanent finding permanent jobs is 53.2%. Again, these numbers stress the relevance of temporary jobs for displaced workers. Reallocation is similar among previous permanent and temporary workers (44.2 and 41.2, respectively). However, the contract composition of reallocated workers is very different: 65% (28.7 divided by 28.7+15.5) of displaced permanent workers re-enter as temporary if they change occupation, while this number reduces to only 32% in the case of non-movers.

Table 3: Contract mobility, by occupation mobility

Panel A: Contract Mobility Matrix Flow Matrix
% of workers with contract c that re-entry with contract c in old/new occ.

	New contract			
	Non-movers		Movers	
Previous contract	Permanent	Temporary	Permanent	Temporary
Permanent	7.0%	3.4%	2.9%	5.3%
Temporary	3.1%	44.7%	4.3%	29.2%

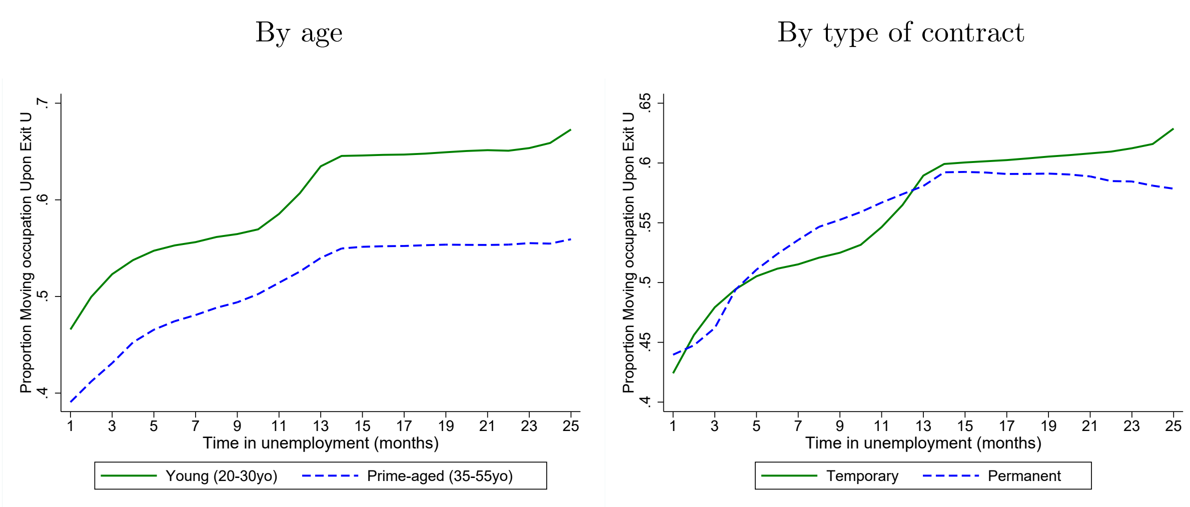
Panel B: Contract Mobility Transition Matrix

	New contract			
	Non-movers		Movers	
Previous contract	Permanent	Temporary	Permanent	Temporary
Permanent	37.7%	18.1%	15.5%	28.7%
Temporary	3.8%	55.0%	5.3%	35.9%

Panel A displays the transition matrix from temporary/permanent to mover/non-mover and permanent/temporary, where the eight elements of the matrix sum up to 100%. Panel B displays the fraction of previous permanent (first row) and previous temporary workers (second row) that are non-movers and movers with a permanent or temporary contract. In Panel B each row sums up to 100%.

The aggregate time series of occupational movers hides large differences across workers. For instance, occupational mobility is large among younger workers and it increases with the unemployment duration. The left-hand panel of Figure 4 displays the proportion of occupational movers as a function of workers' unemployment duration. We plot it separately for young (20-30) and prime-age workers (35-55). As expected, occupational mobility is higher among young workers. Also, regardless of workers' age, mobility increases as the time in unemployment increases. The left-hand panel of Figure 4 shows that 35% of young-age workers who had at least one month in unemployment changed occupation at re-employment, while more than 60% of those who had at least 9 months in unemployment changed occupation at re-employment. The

Figure 4: Occupational Mobility by unemployment duration



Source: MCVL, 2005-2019. The figure displays the fraction of workers who had at least x months in unemployment and had changed occupation at re-employment.

right-hand panel of Figure 4 displays the mobility-duration profile for workers who held a temporary and a permanent job before becoming unemployed. We find few (unconditional) differences in the extent of occupational mobility between previously temporary and permanent workers. Among recent unemployed (those with only one month in unemployment), occupational mobility is higher among previously permanent workers, while the opposite is observed for unemployed with long-term unemployed (more than a year). These small differences must be seen with caution, as they may be the result of composition effects (temporary workers are younger and work in different sectors and occupations) and, more importantly, can also be explained by selection, as the sample of permanent workers that lose a job is, in terms of unobserved characteristics, very different than those in temporary jobs that enter to unemployment.

We now analyze the dependence of occupational mobility on the type of contract held in the last employment spell, the length of time in unemployment, and other demographic variables by the estimation of the following linear probability model:

$$\begin{aligned} Mob_{i,t} =& \alpha + \beta^T temporary_{i,t} + \beta^D UD_{i,t} + \beta^{T,D} temporary_{i,t} \times UD_{i,t} + \\ & \beta^s Sector_i + \beta^O Occupation_i + \beta^r region_i + \boldsymbol{\delta} X_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{1}$$

where the $Mob_{i,t}$ is a dummy for occupational mobility that takes a value equal to 1 if the worker i had found a job in an occupation that is different from his previous job in time t; and 0 if the

Table 4: Estimation results: change of occupation

	(1)	(2)	(3)	(4)
UD (β^D)	0.012***	0.012***	0.012***	0.009***
	(0.000)	(0.000)	(0.000)	(0.001)
$temporary$ (β^T)	-0.004***	-0.013***	0.029***	-0.191***
	(0.001)	(0.001)	(0.001)	(0.007)
$temporary \times UD$ (β^{TD})		-0.001***	-0.001***	0.001***
		(0.000)	(0.000)	(0.000)
Time Trend	✓	✓	✓	✓
Worker Controls		✓	✓	✓
Sector/Occupation/Prov FE			✓	✓
Sector/Occupation/Prov FE $\times temporary$				✓
Observations	3926159	3926159	3892062	3892062

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$. Worker controls: sex, immigrant status, education, part-time dummy, and age group. Sample of workers 16 to 65. We restrict to workers that are unemployed for less than 2 years. Source: Spanish MCVL, 2005M1-2019M12

worker had found a job in the same occupation as her previous job. The variable $temporary_{i,t}$ is a dummy that equals 1 if the worker had a temporary job in the last employment spell before unemployment and 0 if she had a permanent one. The variable UD denotes the duration of unemployment (in months). We include sector, occupation, and region fixed effects. We also condition on a vector of variables $X_{i,t}$ which includes a time trend, age, education, immigrant status, part-time dummy and the monthly unemployment rate. In the baseline estimation, we also include interactions between sector, occupation, and region fixed effects and the dummy $temporary_{i,t}$.

Columns (1)-(6) present the results of the estimation for the coefficient associated with the duration of unemployment, the temporary contract dummy, and the interaction of the two. We find that holding a temporary job before unemployment is associated with lower occupational mobility. In the baseline estimation, in Column (6), the estimated coefficient is -0.190. The positive coefficient associated with the duration of unemployment implies that mobility increases with the duration of unemployment, as already shown in Figure 4. The positive duration dependence is higher for previously temporary workers, as the estimated coefficient for the interaction between temporary contracts and duration of unemployment is positive and significant. Based on the model estimates, we find that for a worker with average characteristics in the economy, the probability of changing occupation in the initial month of unemployment is 31% if their last contract was temporary. In comparison, for an otherwise similar worker with a permanent contract, the probability is 34%. The positive relationship between the duration of unemployment and the likelihood of changing occupation is higher for individuals who previously held temporary jobs, resulting in a gradual reduction of the gap over time. For instance, after 12 months of unemployment, the probability reaches 43.7% for previously temporary workers and 45.6% for previously permanent workers. Remarkably, this gap is effectively eliminated after 24 months of unemployment. . Last, comparing columns (1) to (5) we can see that adding worker demographics (controls), unemployment rate or fixed effects barely affects the estimation of β^T. However, we do find that adding an interaction between the occupation, sector, and region fixed effects and the temporary dummy largely changes the magnitude of the estimated coefficient. This implies that it is very relevant to take into account the different sector/occupational compositions of temporary and permanent workers that transit to unemployment.

This section has revealed that the mobility rates of temporary and permanent workers are similar without conditioning for composition effects. However, after controlling for these effects, the estimation has shown that previous temporary workers are less likely to move. The result may seem counter-intuitive since temporary workers typically have shorter tenures and accumulate less occupational experience, thus having more incentives to switch occupations. However, the estimation overlooks the selection of displaced permanent workers, which could result in a bias in the estimated coefficients. Specifically, the high firing costs associated with permanent contracts may indicate low productivity among permanent workers who become unemployed, leading to negative selection. In this case, workers will have a larger drive to change their occupations and improve their match productivity. In the subsequent section, we develop a model that accounts for these conflicting forces on occupational mobility stemming from the duality of the labor market.

3 A Quantitative Model of Occupational Mobility and Duality

In this section, we provide a novel theoretical framework, which serves to analyze the economic forces behind workers' occupational mobility in a labor market that is characterized by contract duality, and to study the implications of policy changes. The model builds on Carrillo-Tudela and Visschers (2022) and adds the presence of two types of contracts: temporary, characterized by low employment duration, and permanent contracts, characterized by high firing costs. The model features labor search frictions and multiple occupations among which workers can choose to undergo their careers. In the following, we (i) give an overview of the economy, (ii) summarize the timing of shocks and decisions, (iii) specify the problems of workers and firms recursively, (iv) discuss the policy functions and outline equilibrium.

3.1 Overview of the Economy

There is a continuum of risk neutral ex-ante identical workers and a continuum of identical firms. Time is discrete and all agents discount the future with discount factor β. Firms produce the output good using labor as input. Labor comes at different levels of productivity z and human capital x. The labor market is segmented into major occupation groups $o \in \mathcal{O}$. A firm can choose to offer a temporary or a permanent contract. To hire a worker of type (z, x) within major occupation o on a contract of type c, a firm must post a vacancy in sub-market (c, z, x, o). In the remainder, we will typically denote the vector (z, x, o) by ω.

Within a sub-market, the matching function $m\left(v(c,\omega), u(c,\omega)\right)$ determines the number of new matches in a given period based on the number of vacancies $v(c,\omega)$, and the number of unemployed $u(c,\omega)$ in that sub-market. As is standard, we assume that $m(\cdot)$ features constant returns to scale and is increasing in both its arguments. The probability that an unemployed worker searching in sub-market (c,ω) finds a vacancy is denoted by $\lambda(\theta(c,\omega)) \equiv m(\theta(c,\omega), 1)$, where $\theta(c,\omega) = v(c,\omega)/u(c,\omega)$ defines the market tightness. Similarly, $q(\theta(c,\omega)) \equiv m(1, 1/\theta(c,\omega))$ denotes the probability that a vacancy finds a worker.

A worker is characterized by career productivity z, occupation-specific human capital x, and major occupation $o \in \mathcal{O}$. Human capital x evolves stochastically along a ladder with a discrete number n_x of rungs with transition probabilities that depend on employment status. While employed, human capital stochastically increases by one rung per period, whereby the probability of moving up depends on the current level. While unemployed, human capital stochastically drops by one level per period. Regardless of employment status, career productivity z follows a Markov process. Every period, workers face an exogenous probability of retirement. After retirement, they receive a fixed utility stream normalized to zero, and they are replaced by a new generation of workers that start at the lowest rung on the human capital ladder.

Reallocation of workers across occupations happens through unemployment: An unemployed worker decides whether to search for a new job in the old occupation, or to reallocate to a new occupation. The occupational switch implies drawing a new career productivity z. In terms of human capital x, reallocating to a new occupation within a major occupation group entails stepping down the ladder by one rung; reallocation across major occupation groups entails falling down to the lowest rung on the ladder. Thus, human capital is occupation specific, but partly transferable within major occupation groups. When searching for a job, the worker chooses which contract type to look for and enters the corresponding sub-market (c, ω).

Every period, a match can be terminated exogenously. The first difference between permanent contracts and temporary contracts is that we assume a higher separation rate for the latter. A match can also end endogenously as a consequence of a drop in the productivity z. The second difference between permanent contracts and temporary contracts is that endogenously terminating a match with a worker on a permanent contract, the firm needs to pay a firing cost. No such cost exists when firing a worker on a temporary contract.

3.2 Timing

A period is divided into four stages. In stage 1 shocks realize. For workers employed in a match, career productivity z evolves according to its Markov process and human capital x evolves according to the realization of the appreciation shock. Then, existing matches are exogenously separated with contract-specific probability δ_c. If a match is separated, the worker moves to stage 4 as unemployed.

Workers in unemployment at the beginning of stage 1 are in one of two situations. If last period they chose to look for a job in their current occupation, their career productivity z evolves following the Markov process, human capital x evolves according to the realization of the depreciation shock, and they move to stage 3.

If last period they chose to look for a new occupation they are in relocation unemployment, human capital x evolves according to the realization of the depreciation shock. In stage 2, these workers allocate a unit endowment of search effort across the different occupation groups. The effort monotonically translates into the probability to randomly draw a new z in some major occupation group. In this case, if they remain in their current major occupation, $o' = o$, their human capital drops by 1 rung; if they change major occupation, $o' \neq o$, their human capital drops to the lowest rung. They then move to stage 3. If they do not succeed in arriving in a new occupation (the probability of drawing a new z somewhere is possibly smaller than 1), they move to stage 4 unemployed in relocation unemployment.

Also in stage 2, matches (between workers and firms) that are not exogenously separated decide whether to endogenously separate or not, which they do if the surplus is negative. When separated, the worker moves to stage 4 as unemployed. When not separated, the worker moves to stage 4 employed in the current match. Workers unemployed at the beginning of stage 2 choose whether to (try to) relocate to another occupation, or to search in their current occupation. When choosing to relocate, the worker moves to stage 4 as unemployed in relocation unemployment. When searching in their current occupation, they move to stage 3.

In stage 3, unemployed and firms meet in a standard DMP frictional labor market. Firms post vacancies in all contract-specific sub-markets (c, ω), and unemployed workers with a given ω choose which c-sub-market to search in.

In stage 4, production takes place in existing matches. Both in new matches and in continued matches, workers and firms split the surplus through the wage w, which is set according to Nash bargaining. Workers receive and consume wages w. Unemployed workers consume b.

3.3 Workers and Firms

Employed workers. Let $V^E(c, \omega)$ denote the end-of-period value function of workers who in stage 4 are characterized by individual state variable $\omega = (z, x, o)$, and who are employed in contract $c = \{T, P\}$. The worker earns a wage $w(c, \omega)$.[2]

Following the description above, in stage 1 of next period, career productivity z and human capital x stochastically evolve to (z', x'). The human capital ladder has N^x rungs $\{x_1, \ldots, x_{N^x}\}$ in ascending order. The contract-specific probability of exogenous match termination is δ_c. In this case, the end-of-period value next period is that of an unemployed worker with $\omega' = (z', x', o' = o)$, which we denote by $V^U(\omega')$.

If not separated exogenously, the worker and firm can choose in stage 2 to endogenously to terminate the match (see below on this joint decision of worker and firm). Let $s(c, \omega') = \{0, 1\}$ be an indicator function that takes value 1 in this case. The worker's end-of-(next)-period value of unemployment is determined by the same value function $V^U(\omega')$ for $\omega' = (z', x', o' = o)$.

If not terminated (exogenously or endogenously), the match continues with the same contract c and the new ω'. Collecting these elements, the end-of-period value of being employed is defined

[2]As we discuss in Section 3.4, the wage negotiation process implies different wages within a sub-market for workers in newly formed matches versus workers in continued matches. To simplify notation, we do not include this in the discussion of the value functions of workers and firms.

recursively by

$$V^E(c,\omega) = w(c,\omega) + \dots \\ \beta \mathbb{E}_{\omega'|\omega}\Big[\big(\delta_c + (1-\delta_c)\, s(c,\omega')\big)\, V^U(\omega') + (1-\delta_c)\, \big(1 - s(c,\omega')\big)\, V^E(c,\omega') \Big], \tag{2}$$

where $\mathbb{E}_{\omega'|\omega}$ denotes the expectation over tomorrow's ω' conditional on today's ω.

Unemployed workers. Next, consider a worker who is unemployed at the end of the period (in stage 4) with productivity (z, x) in major occupation group o. The worker collects unemployment benefits b. Again, following the description above, in stage 1 of next period, career productivity z and human capital x stochastically evolve to (z', x') still in major occupation group $o' = o$, so that $\omega' = (z', x', o')$.

In stage 2 of next period, the unemployed worker with ω' decides to go for relocation, or to search for a job. In the latter case, the choice is between $c = T$ and $c = P$. In either of those sub-markets the probability of receiving a job offer in stage 3 depends on sub-market tightness $\theta(c, \omega')$ and is denoted by $\lambda(\theta(c, \omega'))$. If matched, the end-of-(next)-period value for the worker is $V^E(c, \omega')$. If not matched, the end-of-(next)-period value is $V^U(\omega')$.

If choosing to relocate in stage 2, the worker pays a reallocation cost k and moves to stage 4 and end-of-(next)-period value is given by $R(\omega')$.[3] Then, in stage 2 the worker in relocation unemployment allocates search effort across the major occupation groups. Let $e_{o'}(\omega)$ denote the level of search effort that the worker puts into drawing a new z productivity in major occupation o', where $\sum_{o' \in \mathcal{O}} e_{o'}(\omega) = 1$. The probability of drawing a new z in major occupation o' is an increasing function of $e_{o'}(\omega)$ that also depends on current major-occupation o, denoted by $\alpha(e_{o'}(\omega), o)$.[4] Moreover, we assume that $\sum_{o' \in \mathcal{O}} \alpha(e_{o'}(\omega), o) \leq 1$, which allows for the possibility of not drawing a new z in any occupation. In this case, the worker remains in relocation unemployment and enters next period accordingly with ω'.

If the worker does get a chance to draw a new career productivity, z is drawn from its stationary distribution, $\pi(z)$, and human capital either drops to the lowest rung of the ladder, x_1, if $o' \neq o$, or diminishes by one rung if $o' = o$. Collecting these items, the end-of-period value

[3] When entering a period in relocation unemployment with characteristics ω, the z-productivity component is not relevant, because it will be redrawn. Still, in stage 1 human capital x can depreciate stochastically. Thus, we write $R(\cdot)$ as a function of ω for ease of notation.

[4] The dependency on o allows the model to capture gross flows across major occupations as in the data, which we will discuss in the calibration section.

of being in relocation unemployment with ω at stage 4 is

$$R(\omega) = \max_{\{e_{o'}(\omega)\}_{o' \in \mathcal{O}}} \sum_{o'} \alpha(e_{o'}(\omega), o) \int W^U(\tilde{z}, \tilde{x}, o') d\pi(\tilde{z}) + \dots$$
$$\left(1 - \sum_{o'} \alpha(e_{o'}(\omega), o)\right) \left[b + \beta \mathbb{E}_{\omega'|\omega} R(\omega')\right] - k \tag{3}$$
$$\text{with } \tilde{x} = \begin{cases} x_1 & \text{if } o' \neq o \\ \max\{x_1, x_{n-1}\} & \text{if } o' = o \text{ and } x = x_n \end{cases}.$$

The end-of-period value of unemployment is given by

$$V^U(\omega) = b + \dots \tag{4}$$
$$\beta \mathbb{E}_{\omega'|\omega} \max \left\{ R(\omega'), \max_{c \in \{T,P\}} \left[\lambda\left(\theta(c, \omega')\right) V^E(c, \omega') + \left(1 - \lambda\left(\theta(c, \omega')\right)\right) V^U(\omega')\right] \right\}.$$

Firms. Consider first the value of a job. Regardless of the contract type, a match produces $y(z, x, o)$ units of the consumption good in a given period. Upon separation from the worker, a firm must pay firing cost f_c—regardless of exogenous or endogenous separation. Other than that, the elements of the value function are known from the discussion of the worker problem. The end-of-period value of a job is given by

$$V^J(c, \omega) = y(\omega) - w(c, \omega) + \dots \tag{5}$$
$$\beta \mathbb{E}_{\omega'|\omega} \left[-f_c \left(\delta_c + (1 - \delta_c)\, s(c, \omega')\right) + (1 - \delta_c)\left(1 - s(c, \omega')\right) V^J(c, \omega')\right].$$

In order to post a vacancy in a sub-market (c, ω), the firm needs to pay a posting cost κ, which is the same for all sub-markets. Then, with a probability determined by the sub-market-specific market tightness, $q(\theta(c, \omega))$ the firm meets a worker. Otherwise the vacancy remains unfilled, and no production takes place. Thus, the value of a vacancy is given by

$$V^V(c, \omega) = -\kappa + q(\theta(c, \omega)) V^J(c, \omega) \tag{6}$$

3.4 Discussion of Policy Functions and Equilibrium

We now briefly discuss key elements of the model in equilibrium. A formal definition of equilibrium is relegated to the appendix. First, we assume free entry in each sub-market such that the expected value of posting a vacancy is zero. From (6) this implies that the cost of posting a vacancy must be equal to the expected value of filling that vacancy:

$$\kappa = q\left(\theta(c, \omega)\right) V^J(c, \omega).$$

Given the value of a job, the equation determines the equilibrium market tightness in a sub-market, $\theta(c, \omega)$.

Separation choice. Consider matches that were not exogenously separated by stage 2 of the period. The surplus of the worker is given by $\left(V^E(c,\omega) - V^U(\omega)\right)$, the surplus of the firm by $\left(V^J(c,\omega) - (-f_c)\right)$. A match is ended endogenously whenever its joint surplus is negative, which is the case when the value of the match falls bellow the value for the worker of being unemployed net of the firing costs that need to be paid upon separation. This gives the separation function

$$s(c,\omega) = \begin{cases} 1 & \text{if } V^E(c,\omega) + V^J(c,\omega) < V^U(\omega) - f_c \\ 0 & \text{otherwise.} \end{cases} \tag{7}$$

In equilibrium, the surplus will turn negative upon a drop of the worker's career productivity z.

Wages. Let ζ denote the worker's bargaining power in the Nash bargaining procedure. In the calibration of the model, we will specify the matching function as Cobb-Douglas $m(v,u) = u^\eta v^{1-\eta}$, and set ζ equal to the matching function elasticity η, so that Hosios condition for efficiency is satisfied (Hosios, 1990). The outside option of firms is different for already existing matches (where the firm needs to pay a firing cost upon separation) versus newly forming matches (where no firing cost is present). This implies that in sub-market (c,ω), there are two different wage rates: The wage rate $w^{new}(c,\omega)$ of newly formed matches solves

$$(1-\zeta)\left[V^E(c,\omega) - V^U(\omega)\right] = \zeta V^J(c,\omega),$$

while the wage rate $w(c,\omega)$ for continuing matches solves

$$(1-\zeta)\left[V^E(c,\omega) - V^U(\omega)\right] = \zeta\left[V^J(c,\omega) - (-f_c)\right].$$

Endogenous separations. Consider a sub-market ω, defined by workers' productivity z, occupational human capital x, major occupation o, and contract type c. At any point in time, depending on the stochastic evolution of (z,x) for the worker, the match will be broken endogenously if it is in the best interest for both parties to separate. This happens when the productivity of the match becomes low enough such that the total surplus of the match is negative as shown in (7). For a given type of contract, occupational human capital, and major occupation, we can define cutoffs on z below which the match is broken. Let $z^s(c,x,o)$ denote this cutoff. Specifically, this cutoff solves that the surplus of the match is zero, that is, $S(c, z^s(c,x,o), x, o) = 0$. Intuitively, given that the firing costs are larger for permanent contracts, endogenous separations happen at a lower productivity z in permanent than in temporary contracts, that is, $z^s(P,x,o) < z^s(T,x,o)$. Moreover, $z^s(c,x,o)$ decreases with human capital x. Figure 5 illustrates the cutoff.

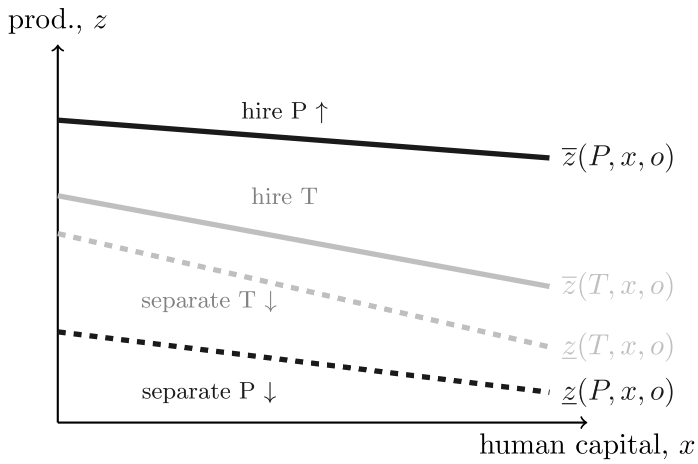
Temporary vs. permanent contracts. Within a given segment defined by workers' productivity z, occupational human capital x, and major occupation o, a firm decides between the two sub-markets characterized by the contract type c. The trade-off for the firm between the two available contract types lies in the cost of firing and the expected duration of the match.

On the one hand, the benefit of a temporary contract is that as the worker productivity z evolves stochastically, in the event that z becomes low enough for the match to be productive the match can be broken at a low firing cost for the firm $f_T < f_P$. On the other hand, the cost of a temporary contract is that even though z is high enough, the probability of the match ending is high compared to a permanent contract, $\delta_T > \delta_P$. Namely, the duration of the match is shorter in expectation, and hence the time during which the firm and worker can benefit from a productive match is short.

Now, consider a given major-occupation o and occupational human capital x. In sub-markets in which productivity is already at low levels z, the probability that such productivity evolves to be below the cutoff $z^s(c, x, o)$ is high, and therefore the firm puts a high weight on the probability of having to pay the firing cost. Thus, in this case a temporary contract is preferred because $f_T < f_P$. However, if productivity is high, the probability of separation and paying the firing cost is low. In this case the firm expects z to be above $z^s(c, x, o)$ for a long time, so it prefers to choose a contract that will last for longer, that is a permanent contract because $\delta_T > \delta_P$. We can define cutoffs on productivity z above which firms hire workers as $\overline{z}(c, x, o)$, which depend on type of contract, occupational human capital, and major-occupation. Then, in equilibrium we have that $\overline{z}(P, x, o) > \overline{z}(T, x, o)$, which implies that a firm posts temporary contracts in markets such that $z \in (\overline{z}(T, x, o), \overline{z}(P, x, o)$ and permanent contracts in markets with $z > \overline{z}(P, x, o)$. Moreover, $z^s(c, x, o)$ decreases with human capital x. Figure 5 displays the properties of these cutoffs.

Occupational Mobility. Reallocation across occupations implies a loss in occupational human capital x and a new draw of occupational productivity z from the invariant distribution. Then, intuitively, the higher the human capital x and productivity x, the less incentives for the worker to change careers. In particular, we can define a threshold $z^r(z, x, o)$ such that if z is below such cutoff the worker decides to change careers. Specifically, $z^r(z, x, o)$ is such that the value of reallocation equates that of continuing unemployed in the same occupation, that is, $R(o) = U(z^r(z, x, o), x, o)$. Similarly to the model in Carrillo-Tudela et al. (2022), there are

Figure 5: Separation and Hiring Cutoffs



two possibilities regarding to the position of the reallocation and separation cutoffs. First, if $z^r(z, x, o) > z^s(c, z, x, o)$, then all endogenous separations, from a contract that can be either temporary or permanent, turn into reallocation. Second, if $z^r(z, x, o) < z^s(T, z, x, o)$, then there exists a range of productivity levels $z \in (z^r(z, x, o), z^s(T, z, x, o))$ in which the worker is displaced because productivity is below the separation cutoffs for both temporary and permanent contract (recall that $z^s(T, z, x, o) < z^s(P, z, x, o)$), but it does not relocate to a new occupation. That is, because firms do not post vacancies below the separation cutoff, these workers are *rest unemployed* whose productivity is not low enough to relocate but also not high enough to be hired in that occupation.

Relocation choice. The decision to change occupations depends on the workers' current productivity in their current career, and on their accumulated human capital. As per (4), an unemployed worker in individual state ω decides to move into relocation unemployment if the value of relocating net of the reallocation cost, $R(\omega)$, exceeds the value of searching for a job in the current sub-market, $\max_{c \in \{T,P\}} \left[\lambda\left(\theta(c, \omega)\right) V^E(c, \omega) + \left(1 - \lambda\left(\theta(c, \omega)\right)\right) V^U(\omega)\right]$. When deciding to relocate, workers (i) draw a new productivity z from its invariant distribution, and (ii) move down the human capital ladder either by one rung if they stay in their current o or to the first rung if they change o. Therefore, the lower z and x are, the stronger the incentive to change careers by relocating to a new occupation.

3.5 Characterization of Equilibrium

Now, how do labor market policies affect these cutoffs?

4 Quantitative Analysis

In this section, we show the quantitative analysis of the model. First, we explain how we set the parameters of the model, and in particular what moments in the data we use to pin down those parameters. Then, to understand the interaction between the duality of labor markets and occupation mobility, we show the results of the model in counterfactual economies where we change the cost of firing a permanent worker and the duration of temporary contracts.

4.1 Parameterization

A period in the model corresponds to a week. We set the discounting factor β that corresponds to an annualized interest rate of 4%. Moreover, the death rate of agents, d, is set to match an average working life of 40 years, so the effective discounting rate is $(1 - d)/(1 + r)$. Population remains constant throughout the periods by replacing every worker that leaves the economy with a new worker. New workers start their working lives unemployed and draw their productivity from the invariant distribution of z. Over their career, productivity z evolves as an AR1 process with autocorrelation coefficient ρ_z and standard deviation σ_z. The process for z is discretized into n_z points, and we allow for a shift in the distribution by $\underline{z}$, which will affect the average productivity in the economy.

Regarding the production function $f(o, x, z)$ we assume that it has the following form,

$$f(x, z, o) = p_o x z^{\psi_o}, \tag{8}$$

where, p_o captures the productivity in major occupation o, and ψ_o captures the differences in returns to scale with respect to the worker occupation productivity, z, in each major occupation. We normalized $p_1 = 1$ and use the differences in average wages across major-occupations to identify the differences in productivity implied by the parameters p_o for $o = 2, 3$.

The parameters that are left to set are then the aggregate labor market parameters, (κ, b, η, s_e), the contract-specific parameters $(\delta_T, \delta_P, f_P, \rho)$, and the parameters related to the productivity of workers $(\rho_z, \sigma_z, \underline{z}, \delta_x, x_1, x_2, x_3, x_4)$, together with the reallocation cost c. We set all parameters using simulated method of moments, where the targeted moments from the Spanish data and their relationship with the parameters of the model are described next. All the moments in the data are computed at monthly rates, so we take the weekly simulations in the model and aggregate them at monthly frequency using the same procedure as we do in the data.

Some parameters are standard in the labor search literature. These parameters correspond to the cost of posting vacancies, κ, home production value, b, and the elasticity of the matching function η. They are informative about the aggregate labor market conditions, in particular, the average unemployment rate, separation rates, and unemployment survival profiles. Moreover, the model also allows workers who are just separated in a period to find a job immediately after. These transitions are determined by the parameter s_e, which indicates the units of search efficiency that workers in such situations have to go on the search market. This kind of transition is especially relevant for temporary workers. In the data, 10 percent of all employed temporary workers change jobs in a given month. We then use this moment in our calibration to pin down s_e.

The parameters associated with the duality of labor markets are $(\delta_T, \delta_P, f_P, \rho)$. They are clearly related to the relative performance of temporary and permanent contracts. Exogenous separation rates of the different types of contracts, together with the firing costs of permanent workers, are informative about the observed differences in separation rates between these types of contracts. In the data, we observe that the probability that an employed worker transitions to unemployment in a given month is almost seven times higher for temporary workers than for permanent workers. This is not surprising given the nature of these contracts, where temporary contracts are defined by law as contracts of fixed duration that cannot exceed 2 years,[5] and permanent contracts are associated with high firing costs which makes them last for longer. In the model, there are both endogenous and exogenous separation rates. The differences in exogenous separation rates δ_T and δ_P partly determine the differences in separation rates observed in the data, but because separations under temporary contracts do not involve a firing cost whereas those for permanent contracts do, decisions to separate based on the productivity of the worker are different in each case. This leads to a lower productivity threshold below which the worker is separated if the contract is permanent. In other words, firing costs inform us about the productivity differences of workers separated from permanent contracts compared to those separated from temporary contracts. This plays a crucial role in determining the mobility profiles as well as the unemployment survival profiles of workers whose last contract was temporary relative to those with permanent contracts. Therefore, we use the average mobility and the average unemployment duration of temporary relative to permanent to inform us about the firing costs and the exogenous separation rates.

[5] The Spanish labor legislation establishes that temporary contract length duration cannot exceed six months. However, the same company, through two or more temporary contracts, can employ the same worker for up to 24 months. After that, the worker will become permanent.

Table 5: Parameters of the model

Parameter		Value	Parameter		Value
Vacancy cost	κ	245.3	Exogenous separation, Temporary	δ_T	0.014
Autocorrelation prod.	ρ_z	0.999	Exogenous separation, Permanent	δ_P	0.001
Std. deviation prod.	σ_z	0.022	Firing cost, Temporary	f_T	0.000
Prod. correction	$\underline{z}$	0.922	Firing cost, Permanent	f_P	15.863
Mobility cost	κ	1.068	Promotion option probability	ρ	0.290
Unemployment benefit	b	0.722	Human capital (1 year)	x_1	1.357
Matching function elasticity	η	0.378	Human capital (2 years)	x_2	1.398
Search effort after separation	s_e	0.974	Human capital (5 years)	x_3	1.410
Skill depreciation	δ_x	0.019	Human capital (10 years)	x_4	1.576
Reallocation major-occ.	ν	0.114			

Table 6: Parameters of the model related to major-occupations

Parameter		Occupation 1	Occupation 2	Occupation 3
Productivity	p_o	1.000	0.651	0.625
Initial distrib.	e_o	0.209	0.490	0.301
Returns to scale.	ψ_o	1.000	0.278	0.291
Prob. moving to	α_{o1}	0.016	0.325	0.659
Prob. moving to	α_{o2}	0.009	0.268	0.723
Prob. moving to	α_{o3}	0.003	0.262	0.735

The parameters on the duality of contracts are also related to the share of temporary contracts in the economy, as when firing costs for permanent contracts tend to zero, and the exogenous separation rates of temporary become relatively larger, the amount of temporary contracts will tend to zero. In Spain, during the period analyzed here, temporary contracts accounted for 23.6 percent of total contracts, and among new hires, 81.6 percent were temporary contracts. Finally, on the duality of labor markets it is also important to capture the amount of promotions from temporary to permanent contracts. In the model, we allow workers in temporary contracts whose match is broken to have the possibility of being promoted to a permanent contract. This captures that when a temporary contract is exogenously terminated, due to the fixed-term nature of the contract, as in the data the firm has the possibility to keep the worker if he is upgraded to a permanent contract. The parameter governing these transitions is ρ, which is the probability that the firm has the option to promote the worker. In the Spanish data, the rate of promotion of temporary workers is 1.8% monthly, and this moment is included in the calibration.

Productivity of workers throughout their working life is determined by the evolution of career productivity z, accumulation of human capital in their current career, x, together with the possibility of depreciation during unemployment, δ_x, and their reallocation decisions, which depend directly on the cost of reallocation c. Therefore, mobility profiles and returns to occupational tenure will be informative to pin down these parameters. we start describing the stochastic process of career-productivities, which is characterized by a persistence ρ_z, standard deviation σ_z, and normalization parameter $\underline{z}$. The latter parameter is used as a normalization such that aggregate productivity in the economy is equal to 1. The persistence of the process affects the mobility decisions, and more importantly the mobility decisions as a function of the time spent in unemployment, as it affects the expectation of future improvement of current productivity. Overall mobility rates will also be affected by the reallocation cost c, which directly affects the incentives of workers to move. The variance of the process for career productivities, captured by σ_z, affects the importance of career productivity relative to occupational human capital, x. Because young workers are primarily affected by z rather than x—they have not been long enough in the labor market to acquire high levels of human capital—, the parameter σ_z determines the differences in mobility patterns of young relative to prime-age workers. These moments are therefore added to the set of targeted moments in the calibration strategy.

Finally, the parameters related to occupation-specific human capital are x_i for $i = 1, \ldots, 5$, and the probability of depreciation while unemployed, δ_x. The first level of human capital x_1 is normalized to 1, and the probabilities of increasing a level of human capital are set such that, on average human capital levels correspond to 1, 2, 5, and 10 years of occupational tenure. We use the returns to occupational tenure observed in the data to pin down these parameters, where using the panel of workers in our sample we regress monthly log wages on occupational tenure to compute the average returns after 1, 2, 5, and 10 years employed in the same occupation. Wages are residualized to take into account differences in the data that are not included in the model such as sex, industry, and geographic location. We also take into account worker fixed effect in the regression specification. The results show that returns increase by 15%, 17%, 20%, and 18%, after 1, 2, 5, and 10 years respectively, showing a concave profile of returns as standard. The importance of human capital accumulation also shapes the types of contracts in this economy and the selection of workers in each type of contract. Permanent workers have on average longer employment spells at a given firm and are therefore more likely to achieve high levels of human capital. If those are sufficiently high, when permanent workers are displaced they would have strong incentives not to reallocate despite possibly low levels of productivity, so as not to lose their accumulated human capital. Mobility patterns between temporary and permanent contracts are therefore also informative about the magnitude of returns to tenure, and the degree of human capital depreciation during unemployment.

4.2 Model Results

The model is able to capture the main features of the Spanish dual labor market and occupational mobility. Table 7 and 8 show the targeted moments in the model and in the data.

Table 7: Targeted Moments: Model and Data

	Model	Data		Model	Data
Average productivity	1.000	1.000	1-year return to occ. tenure	0.158	0.147
Unemployment rate	0.149	0.156	2-year return to occ. tenure	0.208	0.174
Unemp. rate young/prime age	1.093	1.710	5-year return to occ. tenure	0.220	0.197
Separation rate	0.017	0.023	10-year return to occ. tenure	0.214	0.182
Sep. rate young/prime age	1.327	2.222	Share temp. contracts	0.218	0.236
Prob. unemp. in 3 years	0.378	0.240	Share temp. contracts young	0.345	0.475
Mobility rate	0.409	0.438	Sep. rate temp/perm	5.962	6.928
Mobility young/prime age	0.907	1.167	Mobility temp/perm	0.772	0.965
Repeat mobility	0.546	0.709	Temp. to temp. transition (EE)	0.018	0.105
Sep. rate newly hired/all	2.022	2.250	Promotion rate temp.	0.013	0.019
U duration movers/stayers	1.993	1.252	Share of new hires temp.	0.713	0.816
Wage change EUE mover	-0.038	-0.103	Transtion temp-temp (EUE)	0.771	0.929
Wage change EUE non-mov.	-0.009	-0.084	Transtion perm-perm (EUE)	0.386	0.591
Mobility across major-occ.	0.497	0.438			

Table 8: Targeted Moments Major-Occupations: Model and Data

	Wages		Employment		Model			Data		
	Model	Data	Model	Data	Low	Medium	High	Low	Medium	High
Low	-0.292	-0.399	0.513	0.462	0.017	0.201	0.365	0.015	0.203	0.434
Medium	-0.284	-0.309	0.400	0.391	0.029	0.126	0.198	0.027	0.120	0.164
High	0.000	0.000	0.087	0.147	0.012	0.032	0.020	0.008	0.020	0.008

In the model, similarly to the data, 23.7% of all the employment contracts are temporary, and among the young (less or equal than 30 years old) this share increases to 38%. Higher shares of temporary contracts for younger workers are due to a lower occupational human capital early in the career: young workers have not been in the market long enough to accumulate human capital yet. At lower human capital levels, workers are more likely to search in the temporary contracts market. Given their lower human capital and higher propensity to have temporary contracts, it is then natural that young workers also experience higher separation and unemployment rates than prime-age workers, as in the data.

The model also captures the main features regarding the workers' career mobility. [ADD

MORE]

Table 8 displays the targeted moments referring to each major occupation. Major occupation 1 is the highest productivity occupation whereas major occupation 3 is lowest productivity occupation, as implied by the estimated parameters p_i, that are $p_1 \equiv 1$, $p_2 = 0.66$ and $p_3 = 0.62$ (see Table 6).[6] As a consequence, wages are lower in the medium and low major occupations than in the high productivity one. The model matches the mobility patterns in each major occupation group and also across groups.

Next, we turn to explaining the main mechanisms in the quantitative analysis of the model regarding the decisions on the type of contract and reallocation.

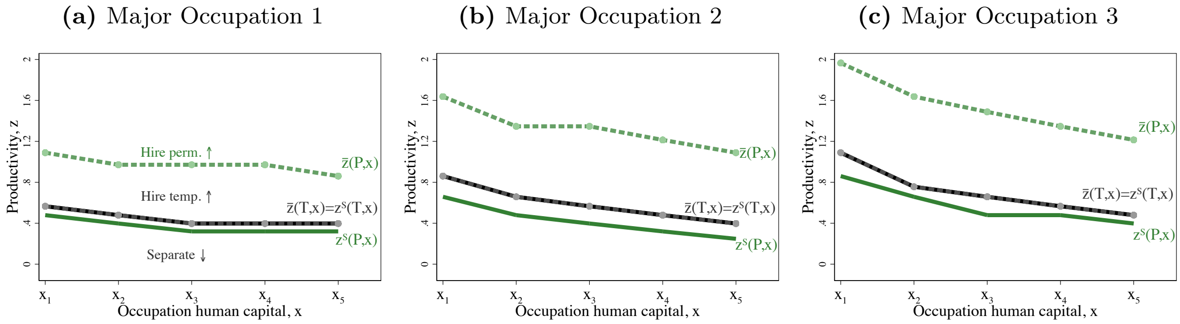
Type of contract: temporary vs. permanent. In each submarket (o, z, x) firms decide how many vacancies to post and what type of contract to offer: temporary or permanent. The main trade-off that firms face when choosing the type of contract is that permanent contracts are associated with longer expected duration of the match, but also higher costs in case that the match breaks. Instead, temporary contracts imply shorter expected duration of the match because $\delta_T > \delta_P$ but lower firing costs—in particular, we normalize $f_T = 0$ and estimate $f_P = 15.86$. These features of the contracts determine the differences between the hiring and endogenous separation policies across the two types of contracts.

Figure 6 displays the hiring cutoffs $\overline{z}(c, o, x)$ and separation cutoffs $z^s(c, o, x)$ for the three major occupations in the model. Consider first the cutoff in workers' productivity, z, below which a match endogenously separates under a permanent contract, $z^s(P, o, x)$ or a temporary contract $z^s(T, o, x)$. Recall that endogenous separation occur if the surplus of the continuation of the match becomes negative. That is, if the joint value of the match for the worker and firm becomes lower than their joint outside options, which includes the unemployment value for the worker, and the payment of the firing cost for the firm. Then, naturally, given the higher firing costs for permanent contracts, endogenous separations under such contracts happen at lower levels of productivity than for temporary contracts.

Now, consider the cutoff in workers' productivity, z, such that if $z = \overline{z}(P, o, x)$ firms post vacancies under a permanent contract, and if $z \in [\overline{z}(T, o, x), \overline{z}(P, o, x)]$ then they post temporary vacancies. A firm posts vacancies in submarket (c, o, x) if the surplus of starting a match is

[6] Hence, from now on we refer to major occupation 1 as the high productivity major occupation, to major occupation 2 as the medium productivity major occupation, and to major occupation 3 as the low productivity major occupation.

Figure 6: Hiring and Separation Decisions

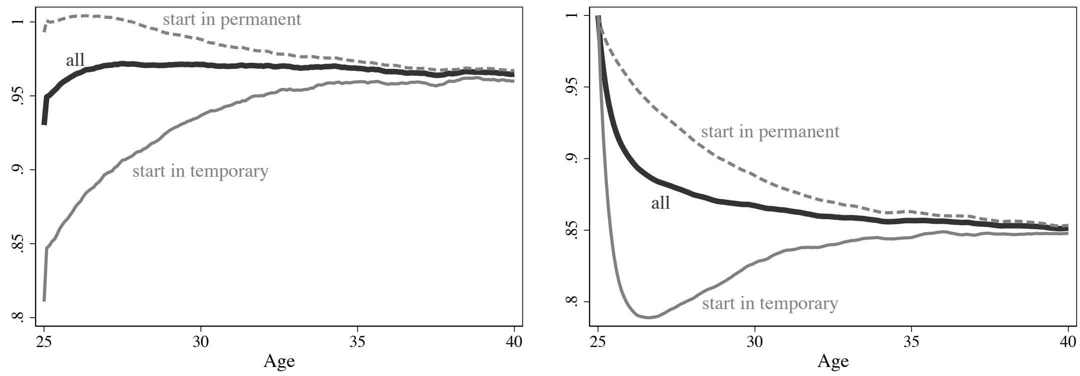


positive. Notice, that for permanent contracts the surplus of starting a match is different than that of the continuation of the match because upon meeting in the search stage, if the worker and firm decided not to start a match then the firing costs would not have to be paid. It is only when an already running match ends that firing costs are to be paid. However, for temporary contracts firing costs are zero, and so the surplus of starting a match is the same as the surplus of continuing a match, which imply that the separation and hiring cutoffs coincide. The decision of firms on whether to offer permanent or temporary contracts depend crucially on the stochastic process for the worker's career productivity. Intuitively, when z is high enough, given that its process is autocorrelated the probability that the match ends endogenously is low—only if z falls below the separation cutoff $z^s(P, o, x)$. In this case, to avoid a high probability of exogenous separations that temporary contracts feature, firms prefer to offer permanent contracts. It is only for low z that firms consider the higher probability of having to end the match endogenously, when they prefer to offer temporary contracts as they put a higher weight in the probability of having to pay the firing cost. Moreover, recall that in the case of an exogenous separation from a temporary contract, the firm would still have an option, with probability $\rho = 0.29$, to decide to promote the worker to a permanent contract and avoid the separation. This will occur if at the time of the separation is high enough; otherwise, the match ends and the firm does not pay any firing cost because it is a temporary contract.

A comparison of the cutoffs for separation and hiring decisions across major occupations in Figure 6 shows that major occupation 1 (the highest aggregate productivity, p_o major occupation) requires lower workers' career productivity in order to hire a worker than in the other major occupations. Namely, the higher aggregate productivity of the major occupation, p_o, compensates for low workers' career productivity, z. A similar explanation applies to explain why in the highest productivity major occupation separation cutoffs are slightly below than in lower productivity major occupations.

Figure 7: Wage and Employment Over the Life Cycle

(a) Average Wage **(b)** Employment Probability



We turn to analyzing the importance of the type of contract for the evolution of the labor market of workers. From the point of view of workers, temporary contracts are associated with high separation rates, and thus a lower rate of accumulating human capital in a particular occupation. This is so because during unemployment spells—to which temporary workers are more exposed —workers do not accumulate human capital, and instead it can depreciate. On the contrary, workers employed in permanent contracts experience longer employment spells at the same job and hence are more likely to accumulate human capital.

To see how the employment dynamics depend on the type of contract, in Figure 7 we consider workers who when they are 25 years old are employed either in a temporary or a permanent job. Then, we follow them over time to see the average evolution of their wages and employment over the life cycle. The reason for this model outcome lies in the different composition of workers that start in a temporary contract relative to those in a permanent contract. On average, the ones starting in a temporary job have lower productivity than those starting in a permanent job (see Figure 6). That is why, their initial wages are lower than those starting in a permanent job. Over time, especially at the beginning of their working life, workers accumulate occupational human capital, and hence their wages increase. The wages of those workers who started in a temporary contract eventually catch up with those who started in a permanent contract as a consequence of the increase in human capital and productivity (through reallocation or the mean-reverting stochastic process of z). Regarding the probability of being employed, by construction of the graph at age 25 they are all employed. However, workers who start in a temporary contract are more likely to be displaced, and hence their probability of being employed rapidly decreases.

Over time, as these workers accumulate more human capital and change careers to be better matched, their employment probability converges to that of workers who start with a permanent contract.

Career mobility. Here we analyze the decisions of unemployed workers to change careers. Figure 8 shows the cutoffs on workers' career productivity below which workers decide to change careers, $z^R(x)$, together with the separation decisions $z^s(c, o, x)$.

The first thing to notice from Figure 8 is the difference across major occupations regarding the position of the reallocation cutoff $z^R(x)$ with respect to the separation cutoffs $z^s(c, o, x)$ for $c = \{T, P\}$. In the highest productivity major occupation—that is, major occupation 1—the reallocation cutoff is lower than the separation cutoffs, for both temporary and permanent workers. This implies that workers whose productivity is $z \in [z^R(x), z^S(c, o, x)]$ are *rest unemployed*. Instead, in major occupations 2 and 3 the opposite happens: $z^R(x) > z^S(c, o, x)$ for $x = \{T, P\}$. This means that all endogenous separations that happen in these major occupations turn into reallocation immediately after separation.

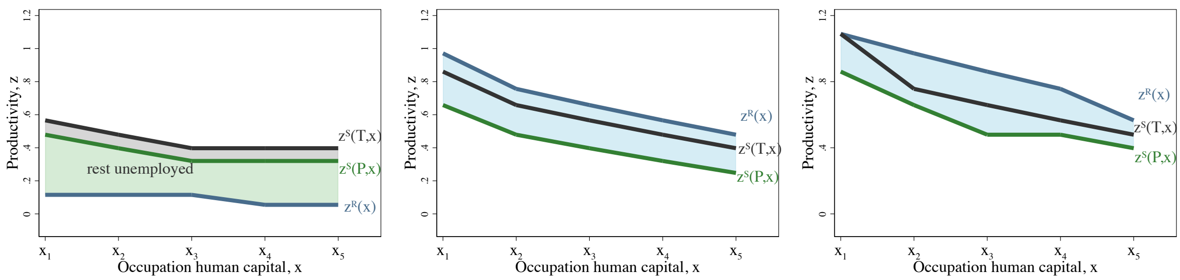
Let us start explaining why in major occupation 1 there is an interval of productivities in which workers rest unemployed. If productivity is $z \in [z^R(x), z^S(c, o, x)]$, workers prefer to be unemployed and wait for a better realization of their productivity than changing careers. The latter implies not only losing accumulated human capital that is specific to their previous career, but also the possibility of changing major occupations, which in the case of currently being in the highest productivity major occupation would imply a *downgrade* in the major occupations ladder. Hence, in such situation, workers choose the relocate only if their productivity is at very low levels. Otherwise, they prefer to remain unemployed even if that implies that they can not effectively find a new job in the current period.

Depending on the extent of the area of rest unemployed, overall unemployment in the economy will vary. Moreover, the overall occupational human capital in the economy is also affected by the extent of this area, as while unemployed, workers human capital depreciates. Given that $z^S(T, o, x) > z^S(P, o, x)$ for the reasons explained before, the area of rest unemployed is determined by the distance between the separation cutoff under temporary contracts, $z^S(T, o, x)$, and the reallocation cutoff $z^R(x)$. Therefore, changes in policy that increase the separation cutoff of temporary contracts can turn into an increase in rest unemployment.

The opposite happens in major occupations 2 and 3, as the reallocation cutoff is above the

Figure 8: Reallocation and Separation Decisions

(a) Major Occupation 1 (b) Major Occupation 2 (c) Major Occupation 3



separation cutoffs. Therefore, all workers that endogenously separate from a firm decide to change careers. Note also that the decision to change careers depends crucially on the level of human capital specific to a career that the worker has accumulated. Naturally, the more human capital a worker has, the lower the incentives to change careers as that implies losing such human capital—partly in the case of within major occupation reallocation, and all of it in the case of across major occupation reallocation. Thus, the reallocation cutoff clearly decreases with x as shown in Figure 8.

Now, how does the type of contract affect workers' career mobility in this case? Note first that we can think of employed workers with productivity $z \in [z^S(c, o, x), z^R]$ as *mismatch* because their productivity is low enough that they would have changed careers if they were unemployed. In this case, given that the separation cutoff for permanent workers is below the one for temporary workers—due to higher firing costs—the area that determines the extent of mismatch is defined by the distance between $z^S(P, o, x)$ and $z^R(x)$. Policies affecting the separation of permanent workers—such as the level of firing costs—can vary the number of mismatched workers. Intuitively, even if a worker's career productivity is low, due to the existence of search frictions and high firing costs, both the worker and the firm prefer to remain in the match and thus it prevents workers from changing to a career in which they can perform better, and hence, remain *mismatched*.

Next, we explore precisely how these policy changes affect workers' mobility and the overall economy.

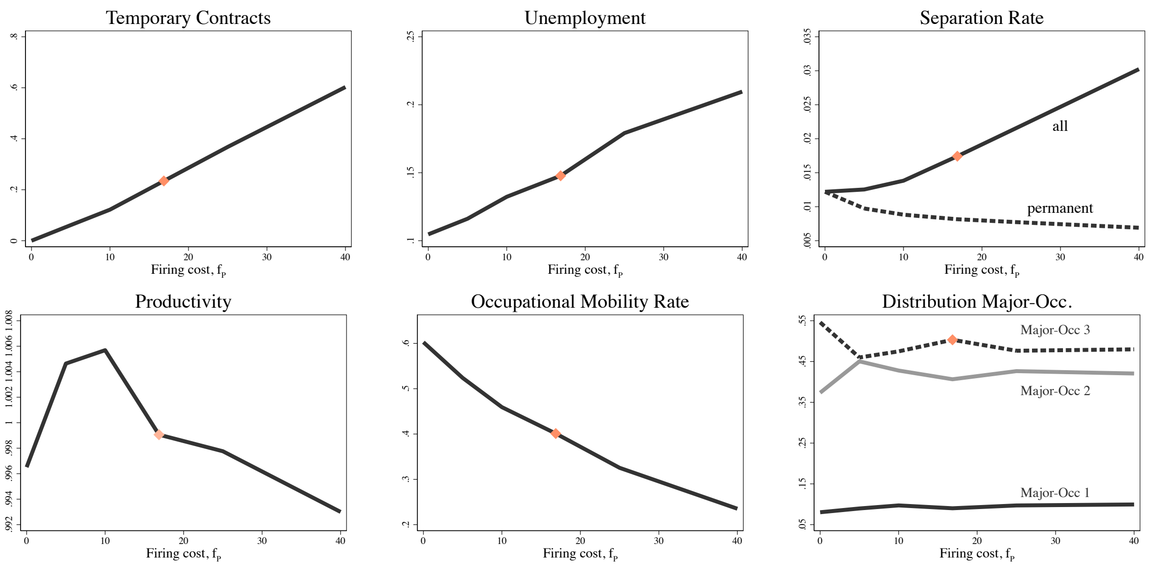
5 Policy Counterfactuals

In order to understand the interaction between dual labor markets and occupational mobility, and their effects on the overall economy, we run two policy counterfactuals: first, we analyze the effects of changing the firing costs of permanent, and second, we study the effects of changing the duration of temporary contracts.

5.1 The Role of Firing Costs

This counterfactual aims at understanding the consequences of a policy that varies the duality of labor markets by changing the cost of firing permanent workers. Figure 9 displays the effects of changing firing costs for permanent workers on different outcomes of interest of the economy. We can divide the effects that such policy has on the overall economy into two groups. First, changes that are a direct consequence of the effects of the policy on the type of contracts that prevail in the economy, that is, temporary or permanent contracts. Second, changes in the economy that happen as a consequence of the effects of the policy on the career mobility of workers. We proceed to explain those in detail.

Figure 9: Change in Firing Costs of Permanent Contracts



Type of contract: temporary vs. permanent. Consider what happens after a decrease in the cost of firing permanent workers. Naturally, this makes posting vacancies for permanent contracts more attractive to firms because it increases the value of permanent matches. Hence, the share of permanent contracts increases after a decrease in permanent firing costs, and the job finding rate for unemployed workers increases due to the higher vacancy postings by firms.

Another effect of a decrease in firing costs of permanent workers is that it induces more separations of that type of worker, as it is now cheaper to do so. That is, the cutoff on workers' career productivity below which endogenous separation occurs, $z^S(P, o, x)$, decreases when the firing cost decreases. This implies that for permanent workers the rate of separation is higher at lower firing costs. However, given that in the overall economy, the share of permanent workers increases and that for permanent workers the rate of separation is lower than for temporary, the average separation rate of workers decreases when the firing cost decreases. This can be seen in Figure 9. The average separation rate is increasing in firing costs of permanent workers even if that for permanent workers decreases.

Career mobility. Policies that change the level of firing costs of permanent workers have an effect on the mobility of workers across occupations. Figure 9 shows that workers' mobility is decreasing in the level of firing costs. As explained above, in our quantitative results a decrease in firing costs implies a higher job finding rate for workers—because of more incentives to firms to post vacancies—and thus a higher value of unemployment. This in turn makes the value of reallocation more attractive to workers as it decreases the cost of changing careers (recall that reallocation implies an additional period of unemployment). Therefore, a decrease in firing costs increases the cutoff on workers' career productivity, $z^R(o,x)$, below which they change careers, and thus it can contribute to a higher mobility rate.

Figure 10: Separation and Reallocation Cutoffs: Decrease in Firing Costs

(a) Major Occupation 1 **(b)** Major Occupation 2 **(c)** Major Occupation 3

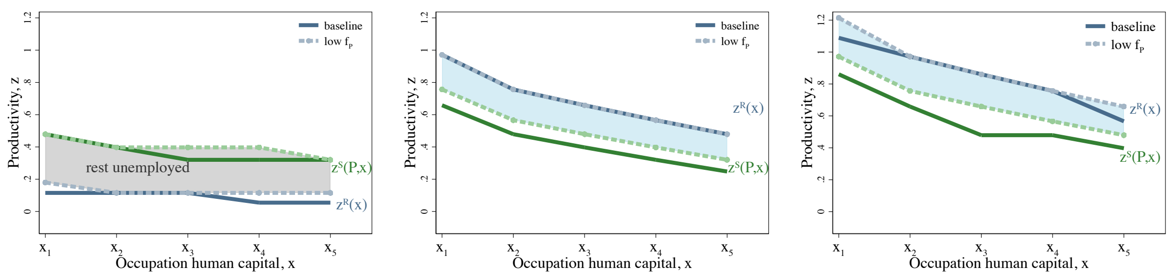


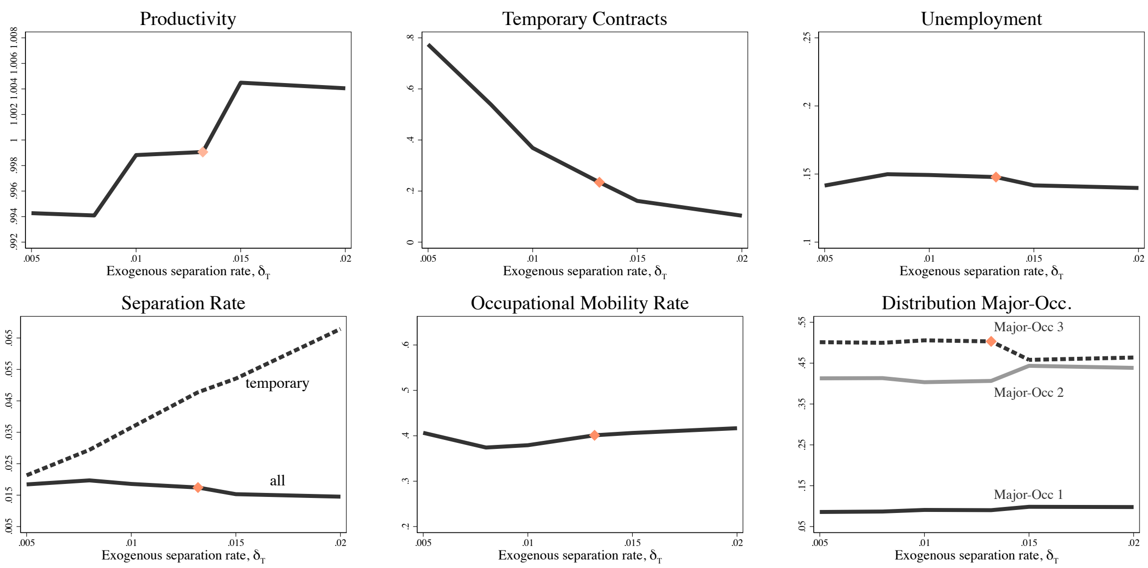
Figure 10 shows these changes in both the reallocation and separation of permanent workers explained above across the three major occupations. In particular, it displays these cutoffs in the baseline (solid lines) and compares them with a counterfactual economy in which firing costs are lower (dashed lines). Consider first, the case of major occupations 2 and 3 for which we obtain that $z^R(o,x) > z^S(P,o,x)$, which implies the existence of a range of workers' productivity in which employed workers are *mismatched*—that is, $z \in [z^S(P,o,x), z^R(o,x)]$. Given that a decrease in firing costs increases the separation cutoff, absent any change in the reallocation cutoff, this would imply that the region of *mismatched* workers decreases. This is precisely what happens in the quantitative analysis of the model for major occupations 2 and 3. Intuitively, workers that under high firing costs are stuck in careers in which their productivity is low, under lower firing costs their low productivity matches are broken, which gives them an opportunity to change to a better career. Hence, it promotes higher mobility of workers.

Consider now the case in major occupation 1 i which the opposite happens, namely, $z^R(o, x) < z^S(P, o, x)$. In this case, workers whose productivity is $z \in [z^R(o, x), z^S(P, o, x)]$ are *rest unemployed.* That is, their career productivity is too low to be employed but not sufficiently low so as to change careers. Hence, an increase in the reallocation cutoff $z^R(o, x)$ resulting from changes in the firing cost can reduce the share of rest unemployment—and thus, of overall unemployment—because of the higher mobility of workers. In our quantitative analysis, as displayed in Figure 10, the effect arising from the increase in $z^R(o, x)$ dominates the decrease in $z^S(P, o, x)$, and hence, the region of rest unemployment shrinks after a decrease in firing costs.

5.2 The Role of the Duration of Temporary Contracts

We turn now to the second counterfactual in which we vary the exogenous destruction rate of temporary contracts, δ_T. By varying this parameter we are effectively changing the average duration of temporary contracts, so we view this experiment as policies that determine the fixed duration of this type of contract. Figure 11 shows the result of this exercise.

Figure 11: Change in Exogenous Separation of Temporary Contracts



Interestingly, compared with the counterfactual in which the policy change is on the level of firing costs of permanent workers, changes in the exogenous separation rate of temporary contracts do not have a significant effect on unemployment or career mobility rates.

6 Conclusion

In this paper we study how the duality of labor markets, that is the co-existence of time-limited fixed contracts and permanent contracts, affects occupational mobility—and through this channel aggregate outcomes . We provide evidence that in Spain more than 40 percent of transitions into re-employment involve a change in occupation. Occupational mobility is systematically different for the two types of contracts. In particular, workers that held a temporary job before unemployment are less likely to change occupations after re-employment. We build an equilibrium model to assess the role of temporary contracts for mobility and to provide a framework in which to analyze policy. The model is able to capture the main features of the Spanish labor market regarding its duality in job contracts as well as the mobility patterns for different groups of workers. We show that high employment protection policies such as the prevalence of high firing costs, decrease the mobility of workers across occupations and, consequently decrease the average productivity in the economy and increase the unemployment rate.

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Appendices

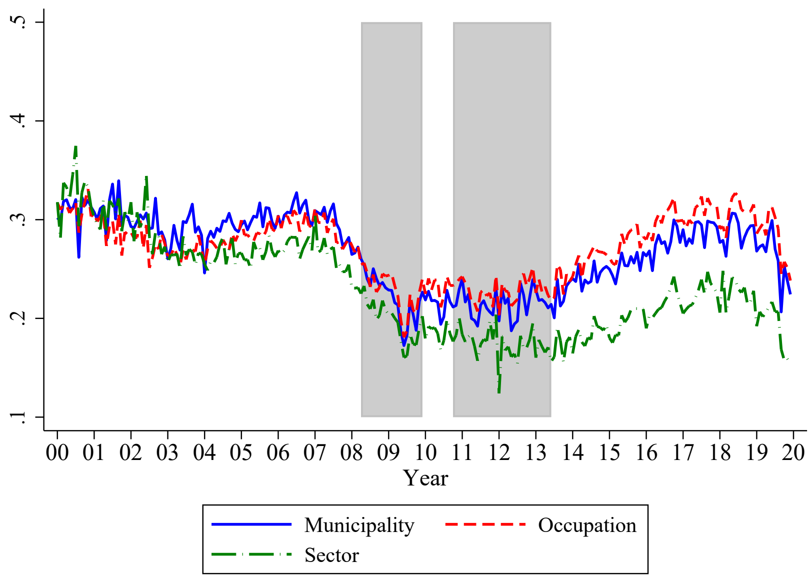
Table 9: MCVL Occupation Classification

Engineers, college graduates and senior managers
Technical engineers and graduate assistants
Administrative and technical managers
Non-graduate assistants
Administrative officers
Subordinates
Administrative assistants
First and second class officers
Third class officers and technicians
Labourers

Table 10: ISCO-08 Classification

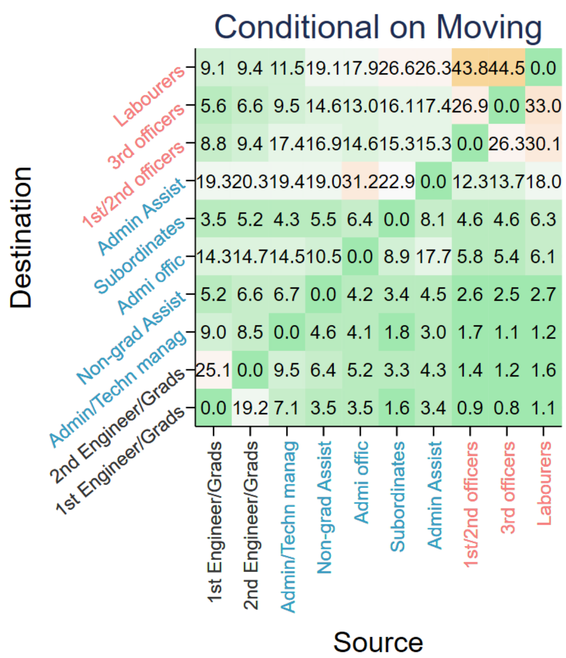
Managers
Professional
Technicians and associate professionals
Clerical support workers
Service and sales workers
Skilled agricultural, forestry and fishery workers
Craft and related trades workers
Plant and machine operators, and assemblers
Elementary occupations

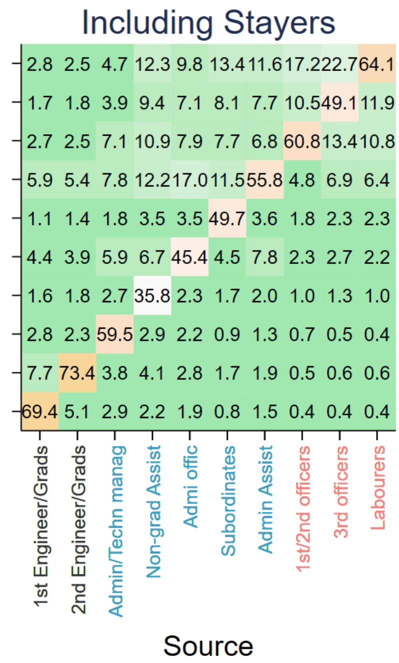
Figure 12: Share of job-to-job transitions over movers



Source: MCVL. Sample of workers aged 16 to 65. Recession-shading are the Spanish recession dates from the Spanish Business Cycle Dating Committee. Monthly data, seasonally adjusted.

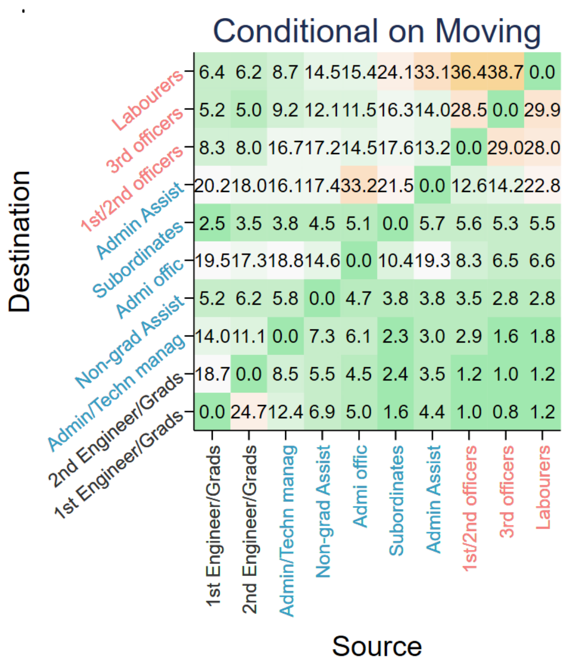
Figure 13: Occupational Mobility Matrix, Temporary Contracts

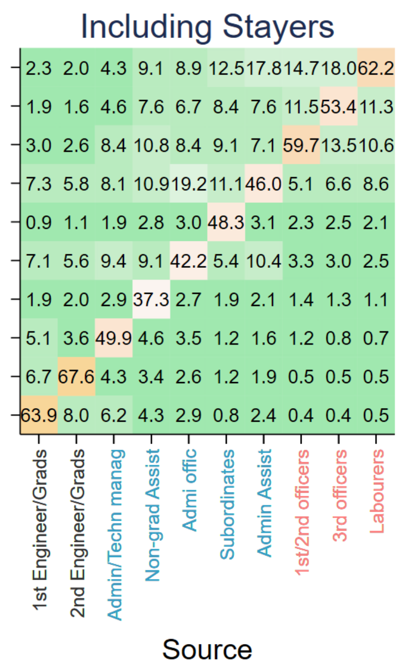




Source: MCVL. See notes of Figure 2

Figure 14: Occupational Mobility Matrix, Permanent Contracts





Source: MCVL. See notes of Figure 2

Table 11: Estimation results: wage log change

	(1)	(2)	(3)	(4)
Mover	-0.014***	-0.013***	-0.011***	-0.018***
	(0.003)	(0.002)	(0.002)	(0.002)
Time Trend	✓	✓	✓	✓
Worker Controls		✓	✓	✓
Sector/Contract/Prov FE			✓	✓
Sector/Contract/Prov/Occupation FE				✓
Observations	1304869	1304869	1137554	1137554

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$. Worker controls: sex, immigrant status, education and age. Sample of workers 16 to 65. The row with Sector, occupation, and province FE add as controls fixed-effects of the previous and the new job. We restrict to workers that are unemployed for less than 2 years. Source: Spanish MCVL, 2005M1-2019M12